BLOCK 2

PERCEPTION, LEARNING AND MEMORY

UNIT 2   SENSATION AND PERCEPTION*

Structure

2.0 LEARNING OBJECTIVES

After reading this unit, you will be able to:

● differentiate between sensation and perception;

● explain the nature of perception and its scope;

● explain the process of perception;

● identify the factors affecting perception;

● describe the laws of perceptual organization;

● summarize the most common types of perceptual constancies; and

● explain the basis of perceptual illusion.

2.1 INTRODUCTION

In Block 1, you learned that psychology is the scientific study of behavior and mental processes. Now in this unit, you will take a closer look of a very important mental process, that is sensation and perception. Understanding the process of sensation and perception is very important and psychologists are working closely with experts in applying the principles to diverse areas like defence, robotics, health, and sports. So, to understand the process, consider the following example:

You walk in a flower garden and see a beautiful rose, the word comes out from your mouth 'how beautiful', or you walk by the side of a river and see a crocodile, recognise it and escape. In our daily life we distinguish between two objects, although the world has dazzling array of objects like humans, animals, houses, plants, etc. But how do we really do it? How do we know the world around us? Have you ever thought on this issue? If not, it does not matter!

2.2 SENSATION

The Scottish philosopher Thomas Reid (1710-1796) first distinguished between sensation and perception. It was explained that sensations are the activities of sense organs as they are experienced in the consciousness. While as, perception is dependent on sensation and, different from sensation in that the perceiver is aware of objects or events in his or her environment. Thus, sensation is the awareness due to stimulation of a sense organ and perception is the organization and interpretation of sensations. There are six senses, seeing (eyes), hearing(ears), smelling(nose), touching(skin), taste (tongue), and sense the orientation of body's positions (proprioception and

kinesthesia). Our sensory receptors provide us with a variety of visual, tactile, auditory and olfactory information. Every sense accomplishes the process of *transduction*, that is the stimuli is detected by the receptor cells, which is then converted to electrical impulses and then carried to the brain.

Thus, the processes through which we come to experience the stimuli present in the environment are known as sensation and perception. Human senses translate physical energy into electrical signals by specialised receptor cells and transmit to our brain via specialised sensory nerves through which information about our environment is received. The study of sensation is related to the initial contact between organism and the physical environment focusing on different forms of sensory stimulation and the input registration by the sense organs (e.g. the eyes, ears, nose, tongue and skin). Perception is the process through which we interpret and organise the received information so as to produce our conscious experience of objects and their relationship. In this process, physical energy, such as light, sound waves, heat emanating from objects, is transformed by the concerned sense organs into a code and transferred to and interpreted by the brain. The line between the two terms sensation and perception, therefore, is somewhat arbitrary. Sensation typically refers to the direct reception and transmission of messages, whereas perception refers to the active process of integrating and organising these sensations.

The relationship between various forms of sensory stimulation (electro-magnetic, pressure, sound waves) and their registration by sense organs (eyes, tongue, skin, ears) is the process of sensation. This definition of sensation has the following components:

i)   involvement of sense organs of the organism.

ii)   presence of stimulus of stimuli in the physical environment

iii)   constructing knowledge out of raw material, and

iv)   initial contact, i.e. contact without meaning

Take an example: you encounter the pleasant fragrance of a rose. You get the fragrance through the sense organ 'nose'. Rose is the stimulus present in the physical environment. You feel something and it is constructing knowledge out of raw stimulus material. You just have the initial contact without clear cut knowledge of source, i.e. rose. Feeling up to this stage is sensation. Imagine some other example of similar nature and try to understand the meaning of sensation. Sensation is the starting point of knowledge of presence of any object around us.

2.2.1 Human Senses and Physical Energy

The beautiful sight of sun-rise, the intense "crack" of start of an old motor-cycle, the smooth touch of a skin of body, the summer heat, the intense cold, the foul odor, the sweet taste, all these are experienced by us. But how? These are all through different sense organs. Our sense organs-eyes, ears, skin, nose and tongue – provide sensations of vision, hearing, skin senses, smell and taste. Physical energy emanates from objects such as light, sound waves, heat and touch. These physical energies provide different types of sensations when presented as stimuli. You have known here two things, that is (i) our senses include vision, hearing, skin senses, smell and taste, (ii) physical energies emanates from objects such as light, sound waves, heat and touch. In the absence of physical energies as stimuli, sensation normally does not take place.

2.2.2 Process of Sensation

The process of sensation is very easy to understand. Physical energy, such as light,

sound waves, heat, emanating from objects becomes stimuli and is received by concerned sense organs like eyes, ears, and elsewhere through specialised receptor cells. The energy is next converted into electrical impulses and this process is known as transduction. **The translation of a physical energy into electrical impulses by specialised receptor cells is known as transduction**. The electrical impulses then travel from the sense organs along nerve fibers to the central nervous system and finally to appropriate area of the cerebral cortex. The process of sensation includes the direct reception and transmission of messages to cerebral cortex.

2.3 OUR SENSES

2.3.1 Vision

We see through our eyes and it acts like a colour television or a camera. The physical stimulus, i.e. light admits into it through a small hole and passes through lens that focuses on a photosensitive surface. The vision is managed through the cornea, pupil, iris and retina in the eyes and receptor cells transmit finally the information to the brain via optic nerve (see figure 2.1). Sensation of colour takes place by nerve cells called *cones*. Black and white sensation takes place by optic nerves called *rods*. Rods and cones are distributed on retina, the number being more than 100 million and 6 million respectively. These rods and cones help in *light or dark adaptation*. You may have the experience of going to theater when movie has started. The theater is dark and you stumble around not making out location of seat or people. After a few minutes you are able to locate seat and people around. Adaptation from bright to dim light is managed by rods and cones present in eyes. Chemicals in rods and cones are build-up faster in dim light with greater concentration than in by bright light stimulation, hence, adaptation to darkness becomes easy. The cones adapt quickly in the dark as compared to rods. But when adapted fully, the rods are much more sensitive to light than cones. Cones are located in the centre of the eye and rods on the edge of the retina. In pitch darkness, if you want to see a dim light look away from the object and not on it, you will see dim light more clearly. When you see away from the object in darkness, rods situated on the edge of retina become more active, providing better visibility. Try this process in a cinema hall. When movie is in progress and you want to move to the gate with dim light on the passage, you will have a better visibility of the way if you do not look at dim light point but away of it. It is said that a candle flame can be seen at a distance of 30 miles on the dark clear night as rods of retina become more active due to distinct image.
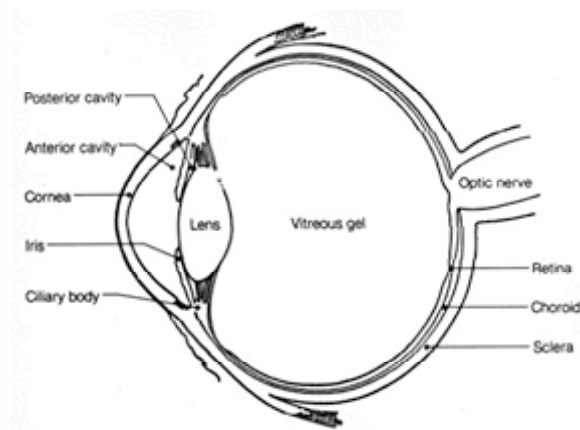

Fig.2.1: Diagram of the eye

2.3.1.1 Visual Acuity

You see many people using spectacle for reading or for seeing far objects or both. They

are not able to discriminate the details in the field of vision. This is greatly affected by the shape of a person's eyeball. When eyeball of a person is too big, the lens of eye focuses the image in front of the retina and not directly on it. In this case, vision to near object is clear, but far objects, appears blurred. This phenomenon is called *nearsightedness*. When eye ball is too short, the lens focuses the image behind the retina and the result is that far objects are in sharp focus but close objects become indistinct. This condition is known as *farsightedness*. Nearsightedness or farsightedness are the examples of non-discriminating objects in the field of vision properly. This ability to discriminate properly the details in the field of vision is known as *visual acuity*. There appears to be a relationship between advancement in age and visual acuity. Normally, as age advances visual activity becomes poorer in most cases.

2.3.1.2 Blind Spot

At one spot of the retina where the nerves of the eye converge to form the optic nerve is called *blind spot*. Blind spot has no visual acuity. These optic nerves connect the eyes to the brain from the back wall of the eyeball. People compensate the effects of blind spot by moving their head or making use of the other eye unknowingly. You must have now understood, how sensation of vision takes place with visual acuity in our daily life.

2.3.2 Hearing

Ears are through which sensation of hearing takes place. You have two ears on two sides which detect sound from the external world. Sound source produces changes in air pressure by vibrations or movements. It is noticed and registered through the ears. There are three main characteristics of sound – pitch, loudness and timbre. Pitch, the high or low quality of a sound, is determined by the frequency of vibration of waves. Faster the vibration, higher the pitch. Loudness is the amplitude of sound waves, the expansion and contraction. When you turn up the volume of television, you increase the amplitude of vibrations, hence, sound becomes louder. Timbre is the quality of sound that comes from a particular sound source. For instance, a note played on shehnai, will not sound the same as played on piano. This difference of richness is known as timbre. This way, pitch, loudness are the characteristics of hearing and frequency, amplitude are the characteristic of sound waves. There are three parts in an ear – the outer, the middle and the inner ones, which help in auditory functioining (see figure 2.2)
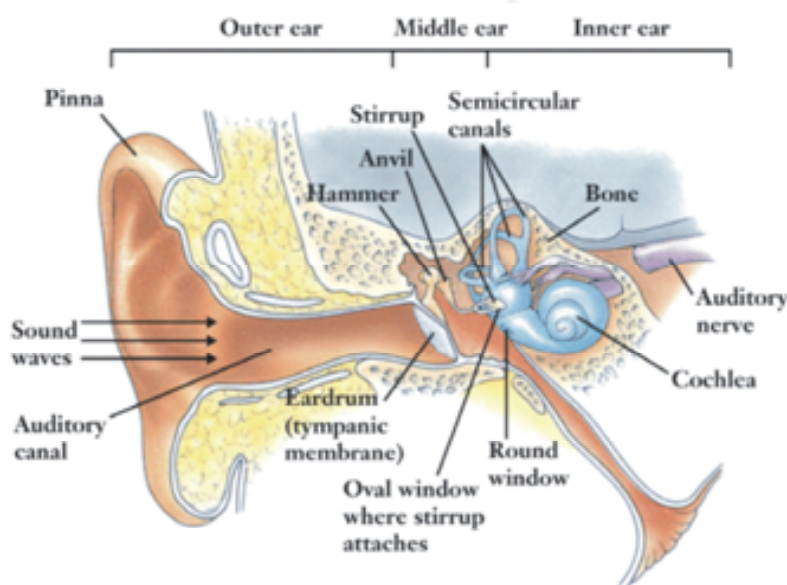

Fig. 2.2: Structure of Ear

2.3.3 Smell

The five senses vision, hearing, smell, taste and skin senses tell us about the objects and events close to our body. Vision, hearing and smell are receptive systems that enlarge our world by responding to a stimuli at a distance. Of these, smell in many ways is most primitive. The sense of smell, you get, from stimulation of receptor cells present in the nose. Smell provides information about chemicals suspended in air which excite receptors located at the top of our nasal cavity. Humans have only about 50 million olfactory receptors whereas, dogs possess more than 200 million such receptors. Dogs are more sensitive to smell therefore, they are put in dogsquad to detect crime and criminals in police department. Further, sensitivity of our olfactory receptors is limited in terms of stimuli range. Carlson (1998) stated that human olfactory receptors can detect only substances with molecular weights – the sum of the atomic weight of all atoms in an odorous molecule is between 15 and 300. This is the reason that you can smell alcohol contained in a mixed drink, with a molecular weight of 46, but cannot smell one table spoon sugar, with a molecular weight of 342. The sensation of smell in humans, in many ways, is the most primitive as compared to other senses. But in other species, olfaction is more effective. Certain animals secrete special chemical substances called *pheromones* which trigger particular reactions in other members of their own kind. In some cases, olfaction works as primitive form of communications. Individual differences are available in humans in smell sensation due to different reactions of olfactory receptors in them and the placement of stimuli.

2.3.4 Taste

Sensation of taste is related to smell as well. Tastes primarily depend upon the taste buds scattered across the upper surface and side of tongue. Each taste bud contains several receptor cells. Humans possess about 10,000 taste buds. In contrast, chickens have only 24 and the maximum number of taste buds is in catfish, the number being 175,000, distributed all over the body. You may be thinking, based on your experience, that you can distinguish a large number of flavours in food. It is not true. You have only four basic tastes – sweet, salty, sour and bitter. But why do you have such an opinion that you can distinguish many more tastes than these four? The reason is that while eating you are not aware of only taste of the food but of its smell, its texture, its temperature, the pressure it exerts on your tongue and mouth, and many more sensations. But the basic sensation of taste depends on taste buds. Normally, sensitivity to salt is highest on the tip and sides of the tongue. Sour is detected on the sides of the tongue and bitter on the back of the tongue. This view is based on widely held hypothesis that each of these primary taste qualities is associated with different kinds of taste receptors. Further, question about the stimuli that produce these four basic taste qualities, the answer is not definite. Sweet is produced by various sugars, but also by saccharin, a chemical compound that is structurally very different from sugar. Just what these substances have in common which activate the same taste receptors is still not known. The number of taste buds on the tongue decreases with age. As a result, older people are comparatively less sensitive to taste than children are.
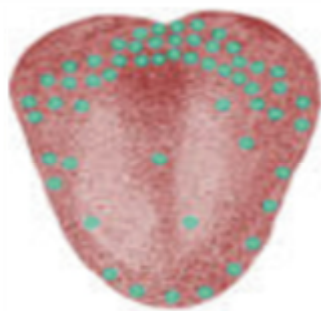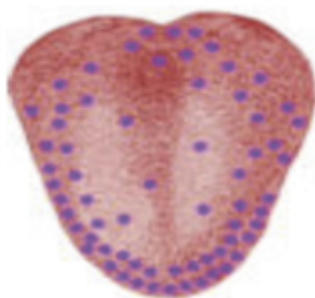
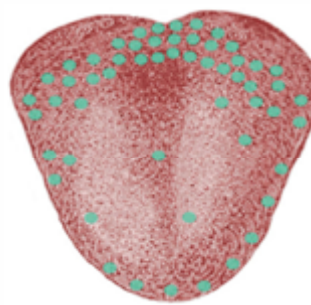**Fig. 2.3: Tongue Diagram**   **Fig. 2.4: Bitter Taste Buds**   **Fig. 2.5: Salty Taste Buds**
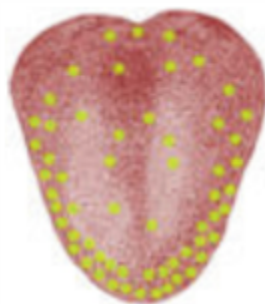
Fig. 2.6: Sour Taste Buds

2.3.5 Skin Senses

Consider the following example : Keep three buckets of water – one cold, another warm and third lukewarm. Now put one hand in cold water bucket and another hand in warm water bucket. You will feel that warmth or cold comes only on the portion where the hands meet both water and air. Take out your both hands and put in the third bucket filled with lukewarm water. You will feel cold in the hand that was in warm water and warm to the hand that was in cold water. The sensation in hand depends on the temperature to which the skin was previously adapted. Stimulation of the skin informs the organism of what is directly adjacent to its own body. Skin senses are, in fact, a combination of at least four different sensations: pressure, warmth, cold and pain. These sensory qualities are so very different that lead to the belief that they are produced by various underlying receptor systems. Skin sensitivity is acute in those parts of the body that are most relevant to exploring the world that surrounds us directly: the hands, the fingers, the lips, the tongue. Different spots on the skin are not uniformly sensitive to the stimuli which produce different sensations. Now have another experience of skin sensation on yourself. Get yourself blind folded. Now with the tip of a ball pen, probe an area of your skin lightly, you will feel pressure at certain points where the pen contacts your skin, but not at every point. You do the same process one by one with a cold wire, warm wire and a pin. With cold wire you will feel cold at various specific points, with warm wire, you will feel warmth at various points and the point of pin will produce spots of pain. Such a sensation takes place as different points on the skin are serviced by receptors that are sensitive to different kinds of stimuli. The experience you have when you are touched lightly with a pointed object is called pressure or touch. Some parts of the body are more sensitive to pressure or touch. The lips, the fingers, the hands and the tip of the tongue are most sensitive areas. The arms, legs, and body trunk are less sensitive. This way, different account of touch or pressure is required to produce such an experience which varies for different parts of the body. Less is known about the underlying receptor systems for temperature and pain. Skin also contains receptors for heat and cold. These temperature receptors are more concentrated on the trunk of the body with hands and feet with standing greater temperature extremes. Cold receptors

are about six times more than the heat receptors. Sensation of pain has been the subject of much controversy. Some investigators believe that these are specialised pain receptors which are activated by tissue injury and produce an unpleasant sensation. Others believe that pain is the outcome of the over estimation of any skin receptor. Pain seems to be received by a variety of nerve endings not only in skin but in other sense organs. Extreme stimulation of any sense organ may cause pain like very bright light, loud noise, high or low temperature.

2.3.6 Kinesthetic Sense

The kinesthetic senses provide information about positions and movements of your muscles and joints. Close your eyes and touch your lips with finger. You know where both parts of the body are. The sense that gives us information about the location of our body parts with respect to one another and allows us to perform movement is known as kinesthesia. Kinesthetic receptors are available in muscles which send information to the brain about the load on the muscle and degree of contraction. Other receptors are in joints. There kinesthetic receptors provide information about body movement. Kinesthetic senses moreover provide sense of balance or equilibrium of the body. When this sensitivity is destroyed, one may not be in a position to maintain balance in the body parts, with sense you make distinction between objects of different weights by lifting. These senses keep track of body movement and body position in relation to gravity.

Check Your Progress 1

1) What is visual acuity? What are the factors related to acuity and how is it measured?

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2) Define the blind spot. Give an example.

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3) Describe the process of sensation of taste. What is the importance of taste buds?

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2.4   PERCEPTION: NATURE AND SCOPE

In the previous section, you learned about sensation. This section will explain the process of perception. The process of perception can be understood with an interesting example of South African English movie, *Gods Must be Crazy* (1980). The movie begins with an empty bottle of soft drink being dropped from the sky/heaven (but it is an airplane) and lands near a bushmen (Kalahari Bushmen Tribe) who was out for hunting.

The people in this part of the world, live a simple life and are not aware of technology. Thus, the bottle, a new object to the people, brings conflict to the once peaceful community. The following lines are narrator's description of the scene when the Bushmen are looking at the new object:

Narrator: "One day, something fell from the sky. Xi had never seen anything like this in his life. It looked like water, but it was harder than anything else in the world. He wondered why the Gods had sent this thing down to the earth. It was the strangest and most beautiful thing they had ever seen, and they wondered why the Gods had sent it."

What do you think, why these Bushmen were not able to recognize the bottle as we do? Is this because of their limited experience? If so, then does it mean our understanding of the world depends on our experiences? The answer is yes and our experience directs the process of perception. But what is perception? What factors affect it? We will seek answers to these questions. Further, we will also see various principles of perceptual organisation, types of perception and errors in perception.

Perception enables us to look, feel and experience the world, as it is. It is the way we interpret our experience. Since, we cannot attend to all of the incoming information, we focus on one and selectively attend to it. Attention helps to filter all the unnecessary sensory information or block it out (Broadbent, 1958).The focus of attention depends upon internal and external factors. Internal factors are like interest, motivation, needs or preparatory factors. External factors are intensity, size, repetition, contrast, novelty, and movement. So, for instance, any stimulus that is novel will catch one's attention more easily than an object that merges in the background.The louder the sound, the more likely is the person to attend to it. If there are two lights, the brighter light will attract more attention. The more often a stimulus is repeated, the more easily it is perceived.

Box 2.1

Perception includes all processes, that helps us in interpreting the sensory information and understanding the external world meaningfully.

Broadly speaking, the process of perception involves three steps when it encounters stimuli viz. (i) selection, (ii) organization and, (iii) interpretation. These stages of the process of perception have been discussed in detail in the following section.

2.5   STAGES OF PERCEPTION

This section will explain in details the stages involved in perception as well as the factors affecting these stages.

Stage I: Selection

The first stage of perception is "selection". Since our brain has limited capacity,

therefore, it cannot attend to all stimuli. We unconsciously or consciously select some stimuli and ignore others. The selected stimulus becomes the "attended stimulus". Now, look at the following two figures (see Figure 2.7 and 2.8). What do you see?

Figure 2.7: Rabbit or Duck   **Figure 2.8: Vase or Human Face**

Your interpretation of these two figures depends on your organisation of the information, and organisation of the information, in turn, depends on your attention. Take for example, the second figure. Some people give more attention to the white portion and thus see two human faces, while some focus their attention on black part and perceive it as a vase. These differences in answer suggest that individual differences also occur in the process of perception.

Stage II: Organization

In this stage, stimuli are arranged mentally in a meaningful pattern. This process occurs unconsciously. Many principles have been proposed to explain the process of organisation. Section 2.7 discusses the Gestalt principles of organisation. It will help you to understand how humans naturally organize stimuli to make a meaningful pattern and thus interpret the stimuli.

Stage III: Interpretation

In this last stage, meaning is assigned to the organized stimuli. Interpretation of the stimuli is based on one's experiences, expectations, needs, beliefs and other factors. Thus, this stage is subjective in nature and the same stimuli can be interpreted differently by different individuals.

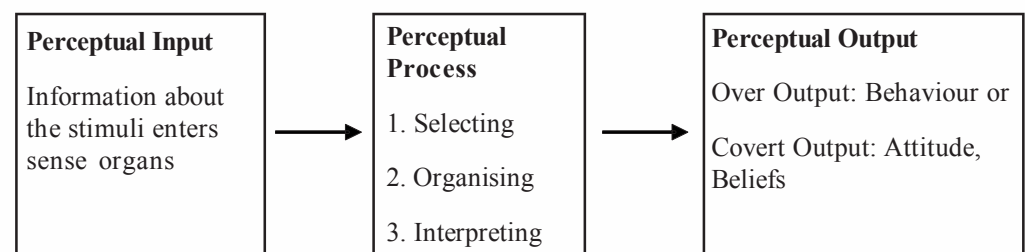| Perceptual Input	Perceptual Process	Perceptual Output
Information about the stimuli enters sense organs	1. Selecting 2. Organising 3. Interpreting	Over Output: Behaviour or Covert Output: Attitude, Beliefs

Figure 2.9: Process of Perception

2.6 THEORETICAL APPROACHES TO PERCEPTION

Two separate theoretical approaches have been proposed by psychologists to explain the process of perception in pattern recognition. One is known as "**top-down processing approach**" and, the other is "**bottom-up processing approach**". As

the name suggests, both the approaches are opposite in their perspective with regard to pattern recognition of visual stimuli.

Table 2.1: Theoretical Approaches to Perceptual Process: Pattern Recognition

Bottom-up processing	Top-down processing
Process of perception is direct	Process of perception is indirect
Perception is a data driven process i.e., stimuli carry sufficient information to be interpreted meaningfully and we do not need to rely on our experiences	Perception is an experience driven process i.e., stimuli does not have sufficient information to be interpreted meaningfully and therefore, we need to rely on our experiences
James J. Gibson (1966) was one of the strongest advocates of this view	Richard Gregory (1970) was the strongest advocate of this view

Thus, the top-down processing uses the existing knowledge to organize the features of the stimuli, while as bottom-up processing analyses smaller features and constructs the complete picture. Both the types of processing approaches are often used together in perceiving the visual stimuli.

Box 2.2 : Role of attention in perception

The dish antenna we use in our home, receives all available signals from the satellite but the tuner of the television-set selects signal according to our wishes. Similarly, our senses can register numerous stimuli at a given time but attentional processes help us in selecting relevant stimuli responsible for perception. Following are some important functions of attention in context of perception:

1) **Selective attention:** The most important function of attention is *selectivity*. It refers to a process by which attention is focused on stimulus of ongoing interest, while ignoring other irrelevant stimuli. Selective attention acts as a filter.

2) **Sustained attention:** It is the ability to attend to a stimulus for a longer period of time without being distracted. For instance, job of looking at a radar screen, requires sustained attention. Our attentional process helps us in doing this kind of monotonous jobs.

2.7 LAWS OF PERCEPTUAL ORGANIZATION: GESTALT PRINCIPLES

In the early 20th century, three German psychologists Max Wertheimer, and his associates Wolfgang Köhler and Kurt Koffka proposed new principles for explaining perception called as Gestalt principle. *Gestalt* psychology is *form* psychology. According to Gestaltists, the process of perception does not involve perceiving an array of stimuli as an object but it involves our tendency to seek a form or pattern in it. The literal meaning of the word *Gestalt* is form or configuration. The basic premise of Gestalt psychology is that 'whole is different from the sum of its part'. This implies that organization (or structured whole, known as Gestalten) gives a different meaning to the perception. It is because of organization that we are able to perceive complex patterns as unitary forms or objects. Organisation could be in the way things are grouped together. Based on this basic premise, Gestalt psychologists proposed a number of principles or laws to explain how we perceive smaller units of stimuli as a whole, having a particular pattern. These principles are known as *laws of perceptual organization*. In the following section, let us discuss some important Gestalt laws of perceptual organization but before doing so, can you find thirteen faces in the following picture (see Figure 2.10)?

Figure 2.10 : The Forest Has Eyes by Bev Doolittle (1984)
Image Source: http://www.greenwichworkshop.com

a)   **Law of Figure-ground Relationship**

This principle states that we have a tendency to segregate our world in the form of figure and ground. We always see a figure (image) against the background. Figure is that part of stimuli which has our focus of the visual field, whereas the ground is background. Figure has a definite shape and is better remembered whereas, background is shapeless and has no limits. Now look at the Figure 2.11. What do you see? Two people or two pieces of chess (two queens and one bishop)? When you focus on people, chess pieces disappear in the background and when you focus on the chess pieces, people become background. In either case, you will organize the figure (image) against the background.

Figure 2.11: An example of figure-ground relationship
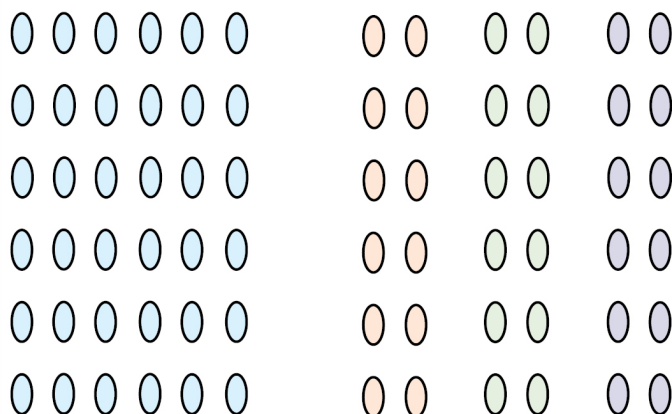
b)   **Law of Proximity**

Figure 2.12: The Gestalt principle of proximity

This refers to the grouping of elements or objects that occur close together. In order to perceive stimuli meaningfully, stimuli which are closer to each other are perceived by us belonging to one group. Due to this reason, people tend to see circles as cluster or group rather than individual circles; see Figure 2.12. Our brain tends to group large elements as one, so as to make interpretation more easily.

c) **Law of Good Figure/ Law of Pragnanz/Law of Symmetry:**

Figure 2.13: The Gestalt Principle of Pragnanz

The word Pragnanz is a German in origin, meaning "good figure". Therefore, this principle is also called as "law of good figure". According to this principle we have a tendency to organize stimuli to make the figure balanced or symmetrical.Thus, out of all possible ways of grouping stimuli, we tend to group stimuli in the simplest and stable shape. Thus, we can say that simpler forms are more perceived by us. For example, instead of perceiving Figure 2.13 as consisting of five separate circles, we tend to perceive it as a symbol of Olympics.

d) **Law of Continuation**

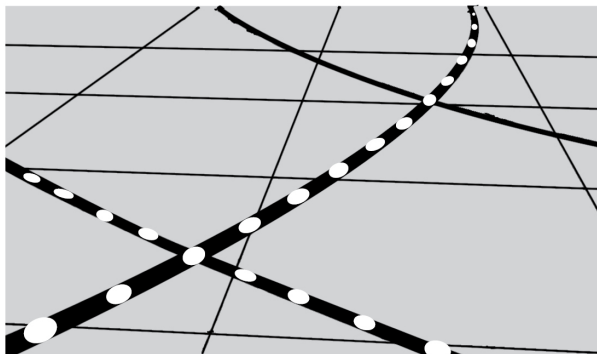**Figure 2.14: An example of law of continuation**

It refers to our tendency to perceive figures in continuation rather than in parts. This principle is exhibited more in the perception of line. Figure 2.14 is generally perceived by us as a line instead of separate circles and black patches.

e) **Law of Common fate**

Figure 2.15: The Gestalt Principle of Common Fate
Image Source: http://cdn.zmescience.com

This law involves movement. It states that things are organized according to their movement together in a group i.e., stimuli moving in similar directions are perceived as belonging to same group, as shown in Figure 2.15.

f)   **Law of Closure**
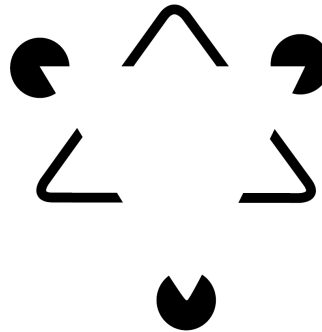
Figure 2.16: An example of law of closure

We sense so many things but it is the law of closure that completes our perception. The perceptual processes organize our perceptions of the stimulus by filling in the gaps in our sensations.Look at Figure 2.16 for an example of closure. This law should not be confused with the law of proximity.

g)   **Law of Similarity**
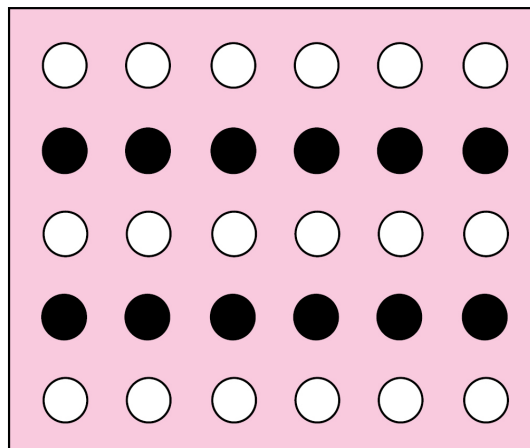
Figure 2.17: The Gestalt Principle of Similarity

This principle suggests that things are grouped together according to their similarity.For instance, in the Figure 2.17, we tend to group circles based on its colours. In real life also, we use this principle extensively. For example, during a cricket match, we tend to group players based on the colour of their jersey.

Check Your Progress 2

1) Differentiate between sensation and perception.

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2) List the different laws of perceptual organization.

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2.8   FACTORS AFECTING PERCEPTION

There are central determinants in perceptions. They are factors such as sets, attitudes, values, needs, and other similar intervening variables. Helmholtz and other Gestaltists have emphasized the significance of such determinants.

2.8.1   Effect of Motivation or Need and Set as Perceptual Determinants

Motivation always plays a vital role in various psychological processes including perception. You must have observed that when you feel hungry, the smell of the food catches your attention more easily than when you are full. Many experimental studies have also reported the same effect. In a classic experiment by Sanford (1936), it was shown that hungry participants perceived ambiguous stimuli more as food-related stimuli than non-hungry participants. Similarly, in a recent study, Changizi and Hall (2001) demonstrated that the need for thirst also affects perception. Participants showed a greater tendency to perceive transparency (common property of water) in ambiguous stimuli.

2.8.2   Effect of Expectation or Perceptual Expectancy

Perceptual expectancy is a person's readiness or a predisposition to perceive things in a particular way. In a classic experiment, Bruner & Minturn (1955) illustrated the role of expectation in our perception. In one condition they showed the participants an ambiguous figure of '13' in the context of numbers like this,

Figure 2.18: Stimulus used in first condition by Bruner & Minturn in their experiment
Image Source: https://www.simplypsychology.org

In the second condition they showed the same ambiguous figure of '13' in the context of alphabets like this;

Figure 2.19: Stimulus used in second condition by Bruner & Minturn in their experiment
Image Source: https://www.simplypsychology.org

In the first condition, participants perceived the ambiguous stimulus as 13 while in the second it was perceived as B. The ambiguous stimulus in both conditions was same but interpreted differently due to participants' expectation.

Box 2.3: The rat-man experiment

In a classical study, Bugelski and Alampay (1961) used an ambiguous picture of the 'rat-man', as shown in the Figure 2.20. This picture was presented in two conditions. In one condition, participants were first exposed to animal picture and then to the ambiguous 'rat-man' picture. Whereas, in another condition participants were first exposed to neutral pictures followed by the picture of 'rat-man'. Experimental condition in which participants were exposed to animal picture perceived this ambiguous picture more as a rat than in the later condition.
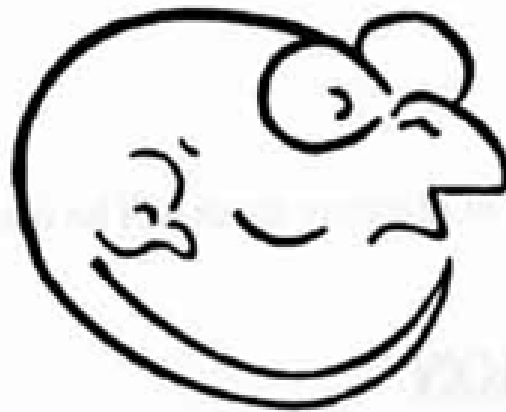

Figure 2.20: Rat-man stimulus used in a study by Bugelski and Alampay (1961)
Image Source: https://www.simplypsychology.org

2.8.3   Effect of Emotions

What do you think if emotions can affect your perceptual ability? McGinnies (1949) utilized list of words, eleven of which were neutral (*apple, child, river, music, sleep*) and seven were emotionally toned (*raped, whore, penis, bitch*). McGinnies found significant differences between the neutral and emotional (critical) words. The threshold was higher for emotional words, galvanic skin response was greater and there were more distortions for emotional words, which was interpreted as anxiety-avoidance response in the form of *perceptual defense* mechanism that protected the participants from unpleasant meanings of the critical words. Emotions do not hamper perception always. Studies have suggested that when the perceptual task is irrelevant to emotions, it hinders your performance. Whereas, when it is relevant to emotions it facilitates performance (Dodd, Vogt, Turkileri, &Notebaert, 2016; Compton et al., 2003).

2.8.4   Effect of Stimulus Characteristic

You may have noticed that the horns used by heavy trucks usually have high frequency, high pitch and high volume. Why? Just to seek your attention. Studies have shown that those stimuli which sound, taste, look or feel different, grab our attention more than other stimuli and thus affect our perception. According to the evolutionary psychologist, this property has a survival purpose. It has helped humans in identifying danger.

2.8.5 Effect of Experience

Figure 2.21: A Flamingo shaped pen
Image Source: https://www.amazon.in

Prior experience plays an important role in the way we interpret stimuli; it shapes your perception. For example, if you mistakenly perceive a rope as a snake in the dark, then your previous experience is guiding your perceptual process. What do you see in the above picture (see Figure 2.21)? A Flamingo shaped pen, right? Even though this is not a typical pen, but you perceive it as a pen because of your previous exposure.

2.8.6 Effect of Culture

Now look at the following hand gesture and interpret it. What does it mean?
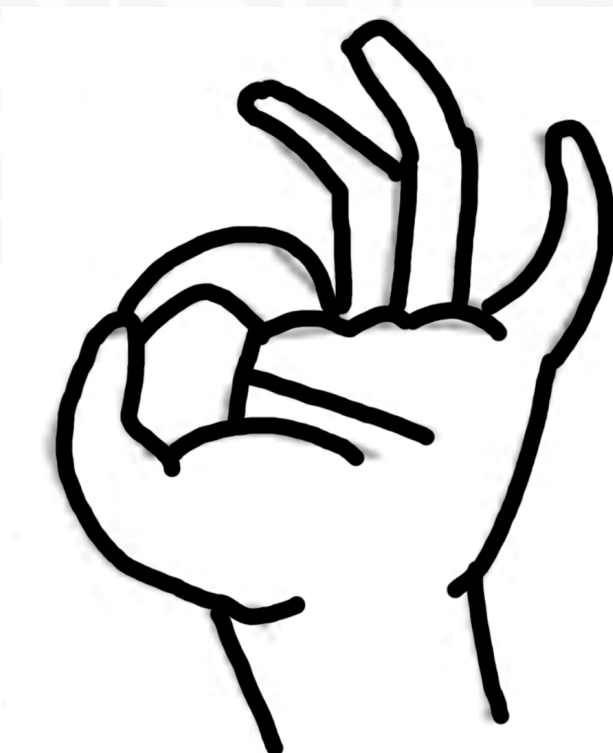
Figure 2.22: A hand gesture

In India, it refers to beautiful or being perfect but in Brazil, it is a rude gesture. This example suggests that interpretation of a stimulus changes with the change in the culture.

2.9   PERCEPTION OF DEPTH

Depth perception refers to one's visual ability to perceive the world in three dimensions and thus enabling us to judge the distance of an object. If there is no depth perception, then it would be very difficult to walk on the road, drive car, etc. The ability is not present at birth, but develops very early in age. So, partly it is innate and partly it is learned through experience. A very famous experiment conducted by Gibson and Walk (1960) tested the ability of depth perception in 6-14 months old infants by placing them on a *visual cliff* (an apparatus to study depth perception). The study concluded that the infants moved away from the cliff or cried and wanted to go to their mothers. The process by which we determine the distance of an object is known as distance perception. Our brain uses both monocular cues (one eye is used) and binocular cues (both eyes are used) to judge depth and distance.

2.9.1   Monocular Cues

These are those information or cues that our brain receives from one eye only. These cues are weaker than binocular cues in strength. Such cues are used by painters to give three-dimensional perspective from a flat painting. See Figure 2.23.

Figure 2.23: Use of monocular cues in flat painting for depth perception
Image Source: https://upload.wikimedia.org/wikipedia/commons/

Following are some of the common monocular cues:

2.9.1.1   Relative Size

Figure 2.24: Hot air balloons flying in the air
Image Source: http://www.freestockphotos.biz

This cue gives us information about the distance of an object based on its relative size with a similar object. This cue works on both two-dimensional and three-dimensional images. The basic premise is that if two objects are of the approximately similar size, then the object which is perceived as larger is closer (see figure 2.24).

2.9.1.2 Texture Gradient

Figure 2.25: Flower meadows
Image Source: https://commons.wikimedia.org

This cue is based on our perception of the change in the gradient or degree of texture. The texture of the objects which are nearer to our eyes are rough or distinct, but as you further move away from it, the texture of the object will become less distinct or smooth and thus suggesting the perception of more distance. For example, if you look at Figure 2.25, the flowers that are farther, seems smoother, but if you look at the flowers that are nearer, you can notice the details of the meadow. This change in the texture correlates with the distance.

2.9.1.3 Arial Perspective (atmospheric) or Haze
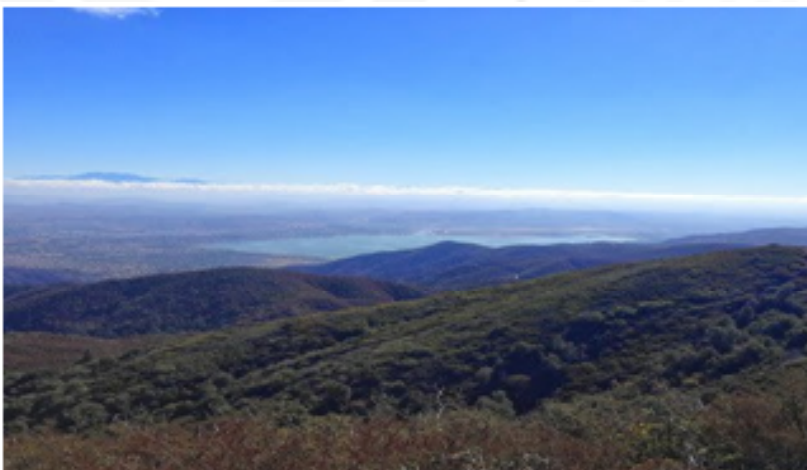
Figure 2.26: Los Pinos Peak- Southern California, USA
Image Source: https://www.gohikeit.com

Objects are perceived at a distance if there is a presence of haze in the environment. Haze is the result of atmospheric dust particles, fog or water vapour. Sometimes perception of distance based on haze can be deceptive. The same mountain can be perceived as nearer or at distance depending on the presence of haze (see Figure 2.26).

2.9.1.4 Linear Perspective

Figure 2.27: Linear perspective
Image Source: http://acddpsych.blogspot.in

This cue is based on the convergence of straight lines at a point on the horizon. An appropriate example of this cue could be the perception of convergence of rail tracks or road at a distance (see Figure 2.27). This cue suggests that closure the lines are, the greater will be the distance.

2.9.1.5 Interposition/Occlusion

When two objects are overlapped, then the object which has been overlapped or obscured will be perceived as farther away than the overlapping object (see Figure 2.28).
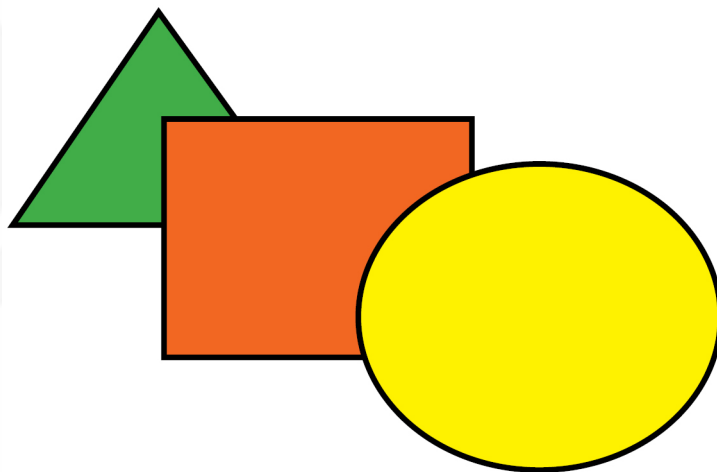
Figure 2.28: An example of occlusion

2.9.1.6 Accommodation

Even though this cue occurs with both eyes, it is still considered as a monocular cue. It is known as accommodation because the size of our lenses accommodates themselves based on the distance. Our lenses become thicker when an object lies closer to eyes while it becomes thinner when an object lies at a distance.

2.9.1.7 Motion Parallax

Motion perspective is the term used by J.J. Gibson for the flow of visual information surrounding a moving observer. The term is used with the focus on the critical point that as one moves about in the environment, objects at a different distance move at different speeds according to their distance from, and position relative to, the observer. This results in complex movements knows as motion parallax (see Figure 2.29).
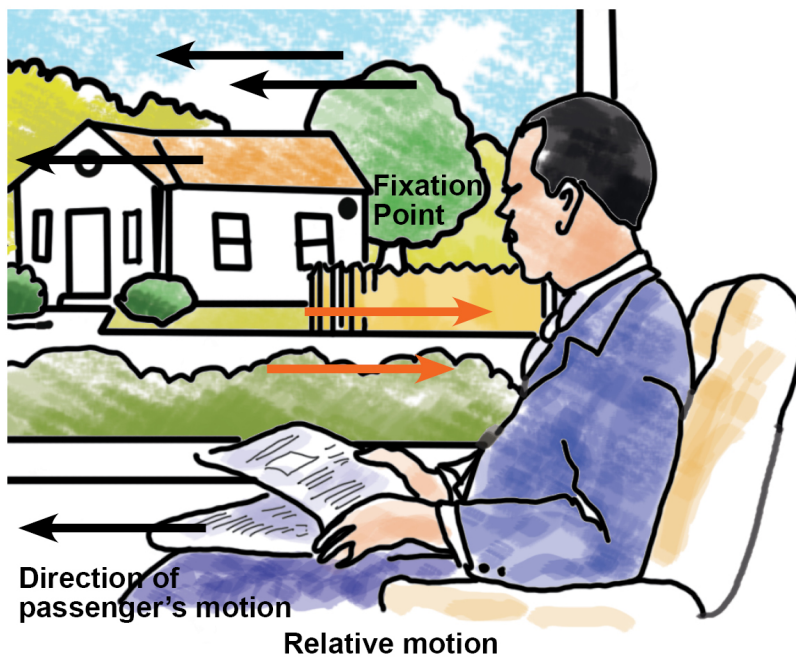
Figure 2.29: Train travel and Motion Parallax

2.9.2 Binocular Cues

The cues that we receive from both eyes are known as binocular cues. These cues are more powerful than monocular cues. The process of gaining binocular cues to assess depth is known as *stereopsis*. Following are two types of binocular cues:

2.9.2.1 Retinal Disparity (binocular parallax)
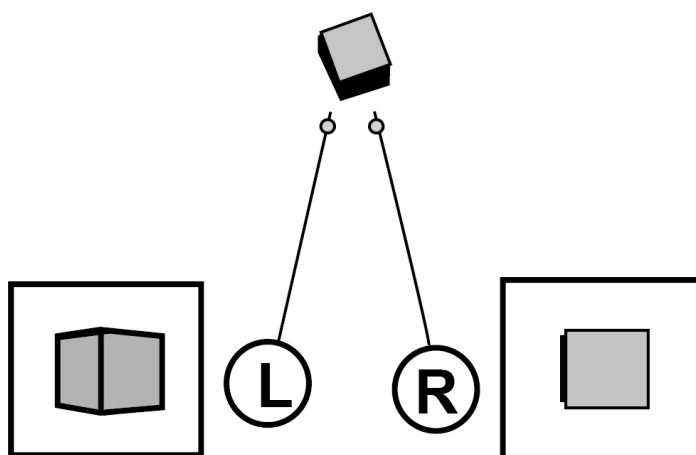
L= Left eye

R=Right eye

Figure 2.30: Formation of different retinal image by left and right eyes

Humans have two eyes, separated by the distance of average 6.3 cm. Therefore, the retinal image of the same object differs slightly from each other or *disparate* view. The closer an object is to eyes, greater will be the difference in its retinal image. Our brain analyses the degree of disparity between these two separate retinal images and produces a single image of the object to judge information on depth, height and width.

2.9.2.2 Convergence
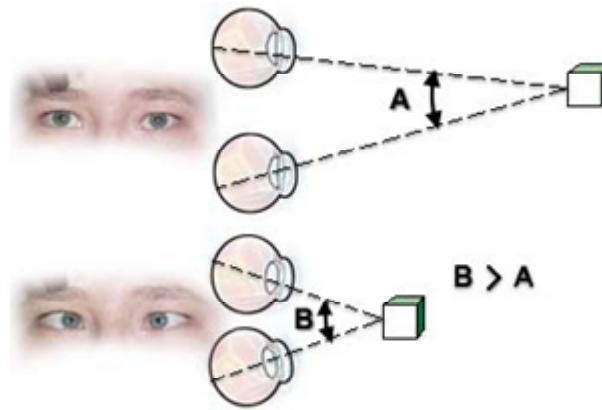
Figure 2.31: Two convergence angles formed by our eyes
Image Source: https://psychlopedia.wikispaces.com

Our eyes make an angle while focusing on an object, known as convergence angle. Convergence angle for distant and nearby objects are different. When an object is at a distance, our eyes make smaller convergence angle, but when an object is closer to our eyes, our eyeballs rotate inwards and form large convergence angle. This change in convergence gives a clue about distance and depth to the perceiver.

2.10 MOVEMENT PERCEPTION

How do we know that if a car is coming towards us or moving away from us? Movement perception is our ability to judge the direction and speed of a moving object. Psychologists have tried to answer the questions on movement perception by applying following four factors:

1) **Retinal motion:** When an object moves its image on retina also moves. This motion of the retinal image is detected by special visual neurons which are sensitive to change in motion and direction. In this way, we perceive movement.

2) **Motion after-effect (MAE):** If you fixate your gaze on a moving object for some time (few seconds to minutes) and then move your gaze to a stationary object. Then the stationary object will be perceived as moving in opposite direction to the original moving object. This phenomenon is known as MAE and occurs due to motion adaption.

3) **Induced movement:** When a smaller stationary body is surrounded by larger moving body then smaller body is perceived to move in the direction opposite to the larger body. Due to this phenomenon, we perceive moon as moving when it is surrounded by slowly moving clouds.

Figure 2.32: Moon behind clouds

Image Source: http://courses.washington.edu

4) **Apparent movement:** Also called as phenomenal motion, it was first proposed by Gestalt theorist Wertheimer (1912). In this phenomenon, when stationary stimuli are presented in succession, it is perceived in a motion. Perceived motion occurs without any energy movement across the receptor surface. That is, when the eyes, head and body are static, and there is no movement of the object, motion is still perceived.

Phi-phenomenon: This effect can be seen in a string of decorative lights, when the lights are turned in sequence, they appear to move, that is the light appears to move across the distance. The series of light goes on and off in a sequence, and movement is perceived.

Stroboscopic Effect: This effect is seen in movies. The example is a movie projector which places successive pictures of a moving scene onto a screen. When the frames are examined separately, there is still a picture that is different from the preceding one. When the frames are presented at the right speed, continuous and smooth motion is perceived.

Autokinetic Effect: If a person stares or fixates on a stationery spot of light in a completely dark room, the spot will eventually appear to move or drift. The movement may cover as much as $20°$ of the visual field and is apparently not due to eye movements. It is also called as autokinetic illusion or phenomenon.

2.11 SIZE PERCEPTION

In this section, we will discuss those mechanisms that are involved in judging the size of the stimuli. Our ability to judge the size of the stimuli correctly even with the change in the distance has been explained using three hypotheses: the size-distance invariance hypothesis, familiar size hypothesis and the direct perception hypothesis.

1) **Size-distance invariance hypothesis (SDIH):** The basic premise of this hypothesis is that the perceived size of a stimulus is proportional to perceived distance (Kilpatrick and Ittelson, 1953). It further states that if information about the distance is available then size of the stimuli is interpreted based on retinal image. However, if the information about the distance is not available then size of the stimuli is judged based on the visual angle alone. The mathematical expression of this relationship is as follows:

$$S`/D` = f\left(\theta\right)$$

Where, S` = perceived size

D` = perceived distance

θ = visual angle

Here, before proceeding further, it is important to explain the term "visual angle". It is the angle made by our eyes after looking at the object.

2) **Familiar Size Theory/Cue:** This cue is used to judge not only size but also the distance and depth of the stimuli. We know the visual angle for a stimulus decreases with the decrease in the distance. Our brain uses this information (visual angle) along with our previous information of the size of the targeted stimulus and determines its actual size, distance and depth. Thus, according to this theory familiar size influences our size perception, which in turn influences our distance perception (Ittelson, 1960). However, later psychologists Gogel

& Da Silva (1987) proposed that the theory of familiar size is valid in all conditions. When the condition of viewing is improvised then we use egocentric reference distance to determine the size of the familiar object.

3) **Theory of Direct Perception:** Gibson in 1979 proposed the theory of direct perception. His ideas regarding size perception were summarised by Epstein (1982) (pg.78) as: "(i) there is no perceptual representation of size correlated with the retinal size of the object, (ii) perceived size and perceived distance are independent functions of information in stimulation, and (iii) perceived size and perceived distance are not causally linked, nor is the perception of size mediated by operations combining information about retinal size and perceived distance. The correlation between perceived size and perceived distance is attributed to the correlation between the specific variables of stimulation which governs these precepts in the particular situations".

Check Your Progress 3

Fill in the blanks

1) In a classic experiment, ... illustrated the role of expectation in our perception.

2) Monocular cues are .... than binocular cues in strength.

3) The texture of the objects which are nearer to our eyes are rough or distinct, but as you further move away from it, the texture of the object will become less distinct or smooth and thus suggesting the perception of more ....

4) Objects are perceived at a distance if there is a presence of .... in the environment.

5) .... cue is based on the convergence of straight lines at a point on the horizon.

6) We humans have two eyes, separated by the distance of average ....

7) When an object is at a distance, our eyes make .... convergence angle, but when an object is closer to our eyes, our eyeballs rotate inwards and form .... convergence angle.

Answer:

1) Bruner & Minturn (1955), (2) weaker, (3) distance, (4) haze, (5) linear perspective, (6) 6.3 cm, (7) small, large

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2.12 ERRORS IN PERCEPTION: ILLUSION

Is perception a reality? Not always. The process of perception is capable of going wrong or misused. Knowingly or unknowingly, we tend to make mistakes and misinterpret the stimuli. When we 'misinterpret' the sensory information, then it is known as an illusion. Illusion also been defined as "a discrepancy between one's awareness and some stimulus" (Reynolds, 2008). Some typical examples of illusions include perceiving tree branches as ghosts or perceive rope as a snake at night. In this section, we will talk about some common forms of illusion.

1) **Muller-Lyre Illusion**

Which of the following lines appear longest (see Figure 2.32)?
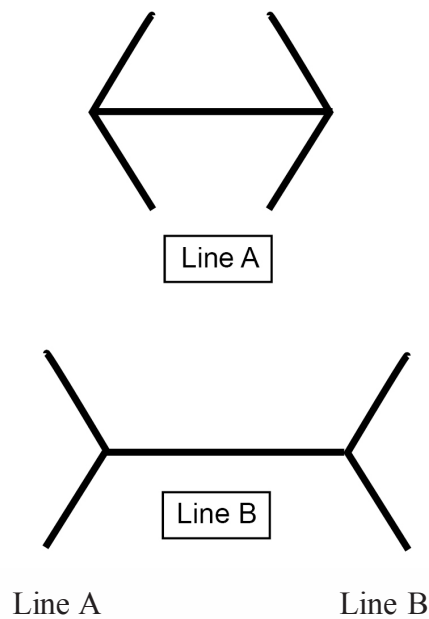
Figure 2.32: Muller-Lyre Illusion

If your answer is line A, then you are wrong. And if your answer is line B, then again you have given an incorrect answer because both lines are of equal length. The illusion you have just seen is a geometrical-optical illusion known as Muller-Lyer illusion. In this illusion, two straight lines of the same length appear to be of different length. Lines with inward pointing arrow seem shorter than the outward-pointing line. Also known as arrow-head illusion, in which perceived length of a line depends upon the shape and position of other lines that enclose it.

2)   **Ponzo Illusion**
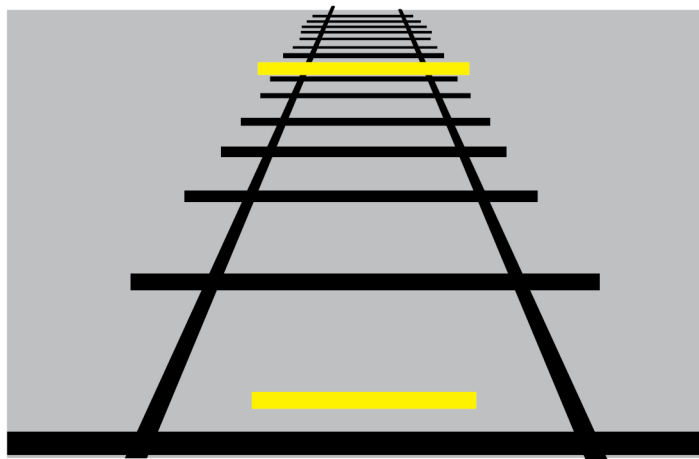
Figure 2.33: The Ponzo Illusion

It is also an optical illusion, in which two converging straight lines distort our perception of the size of two identical lines drawn across it. The upper yellow line appears to be longer than the lower yellow line, when in fact both are of the same length (see Figure 2.33). The incorrect judgment of the size of yellow lines happens because we use liner perspective cue to judge its size. It is also known as *railway illusion*.

3)   **Ebbinghaus Illusion**

It is an optical illusion of relative size perception. Discovered by Hermann Ebbinghaus but popularised by Edward B. Titchener, this illusion is also known as Titchener circles. Now, answer this. Which of the following *magenta* circle is smaller (See Figure 2.34)?
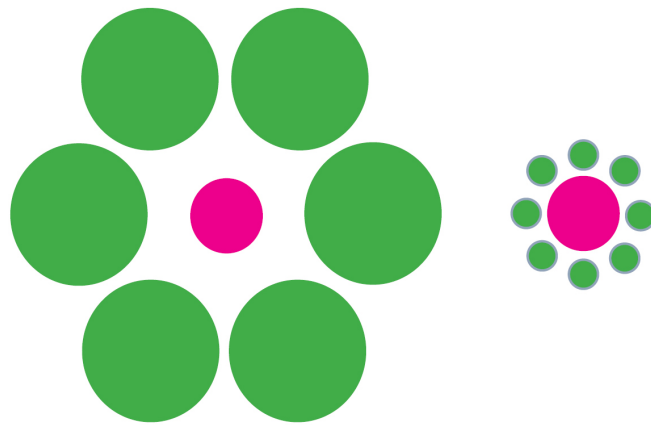
Figure 2.34: The Ebbinghaus Illusion

Irrespective of your answer, both magenta circles are of the same size. This is known as Ebbinghaus illusion. The perception of the size of magenta circle depends on the relative sizes of green circles.

4) The Ames Room Illusion

Named after its creator, American ophthalmologist and perceptual psychologist Adelbert Ames, Jr., this optical illusion leads to the distortion of perception of relative size. To an observer, a person standing in one corner of the room is perceived as significantly larger than the person standing in another corner (see Figure 2.35). The illusion provides a striking demonstration of the cues for depth perception.
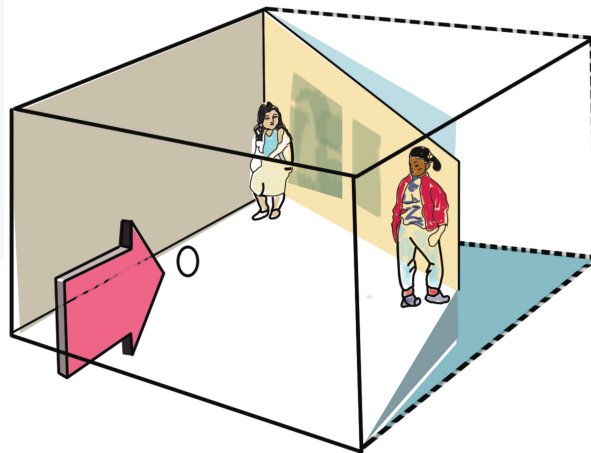
Figure 2.35: The Ames Room Illusion

5) The Moon Illusion
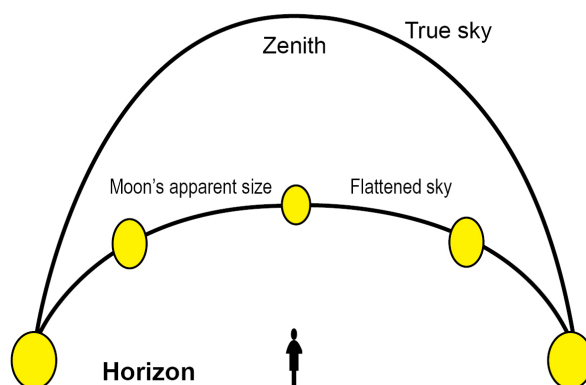
Figure 2.36: The moon Illusion

Have you ever noticed that the size of the moon when it is coming over the horizon? If yes, then you must have noticed that it looks bigger on the horizon than when it comes overhead. However, in reality, there are no differences in the size of the moon. Our perception of the moon having different sizes at horizon and zenith is known as moon illusion (see Figure 2.36). This illusion occurs because of our perception of the sky as a flattened dome and thus forcing our brain to reduce the size of the moon at zenith. Thus, the type of illusion is that of a shape or area.

5) **Poggendorff Illusion**
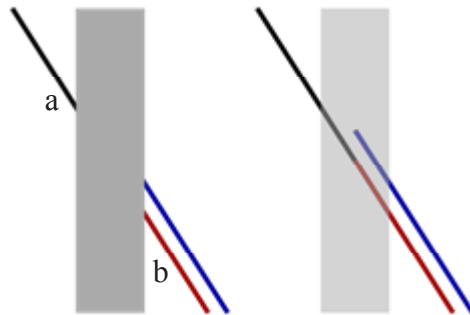
Figure 2.37: Poggendorff Illusion
Image Source: https://commons.wikimedia.org/wiki/

The Poggendorff illusion was influenced by Zollner illusion. When on ablique line is intercepted by a blank area defined by two vertical parallel lines, the two resulting segments of the oblique line do not appear to be in a straight line. In Figure 2.37, it seems that segment 'a' does not fall in straight line with segment 'b'. Line a appears to be too high or line b seems to be too low. This is known as Poggendorff illusion.

Check Your Progress 4

Fill in the blanks

1) When we .... the sensory information then it is known as an illusion.

2) In ...., two straight lines of the same length appear to be of different length.

3) Ames room illusion was created by American ophthalmologist ....

4) Our perception of the moon having different sizes at .... and .... is known as moon illusion.

5) In Muller-Lyer illusion, lines with inward pointing arrow seem .... than the outward-pointing line.

Answer:

(1) Misinterpret, (2) Muller-Lyer illusion, (3) Adelbert Ames, Jr., (4) horizon and zenith, (5) shorter

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2.13 SUMMARY

Now that we have come to the end of this unit, let us summarize all the major points that we have covered.

● Sensation is the awareness due to stimulation of a sense organ. There are six senses, seeing (eyes), hearing (ears), smelling (nose), touching (skin), taste (tongue) and sense of orientation of body's position (proprioception and kinesthesia).

- Perception is a set of process, which helps us in understanding the world around us. The process of perception involves three steps when it encounters stimuli viz. (i) selection, (ii) organization and, (iii) interpretation.

- Two separate theoretical approaches have been proposed by psychologists to explain the process of perception. One is known as "Top-down processing approach" and, other is known as "Bottom-up processing approach".

- According to bottom-up processing approach process of perception is direct. Stimuli carry sufficient information to be interpreted meaningfully and we do not need to rely on our experiences.

- Whereas, according to top-down processing, perception is an experience driven process i.e., stimuli do not have sufficient information to be interpreted meaningfully.

- Gestalt principles of organization states that the process of perception does not involve perceiving an array of stimuli as an object but it involves our tendency to seek a form or pattern in it.

- The basic premise of Gestalt psychology is that 'whole is different from the sum of its part'. This implies that organization gives a different meaning to the perception. It is because of organization that we are able to perceive complex patterns as unitary forms or objects.

- Numerous factors have been found to affect our process of perception such as our expectation, emotions, stimulus characteristics,previous experiences and cultural background.

- There are different types of perception. Such as depth perception, distance perception, movement perception and size perception.

- Illusion can be defined as a process of perceptual distortion, leading to misinterpretation of the stimulus. People think they see something when the reality is quite different. There are many types of illusions, like, Muller-Lyre illusion, Ponzo illusion, Poggendorff illusion, Ames Room illusion and moon illusion.

2.14 KEY WORDS

Perception	:	It is a process of selecting, organising and interpreting the sensory information based on previous experiences, other's experiences, need or expectation.
Depth perception	:	It refers to one's visual ability to perceive the world in three dimensions thus, enabling us to judge the distance of an object.
Movement perception	:	It is our ability to judge the direction and speed of a moving object. Four factors involved are retinal motion, motion after-effect (MAE), induced movement, stroboscopic motion.
Size perception	:	Our ability to judge the size of the stimuli correctly even with the change in the distance is known as size perception.

Law of figure-ground relationship	:	This principle states that we have a tendency to segregate our world in the form of figure and ground. Figure is that part of stimuli which has our focus of the visual field, whereas the ground is background.
Principle of Pragnanz	:	According to this principle, out of all possible ways of grouping stimuli, we tend to group stimuli in the simplest and stable shape.
Perceptual expectancy	:	It is a person's readiness or a predisposition to perceive things in a particular way.
Monocular cues	:	These are those information or cues that our brain receives from one eye only. These cues are weaker than binocular cues in strength.
Binocular cues	:	Cues that our brain receives from both eyes.
Convergence angle	:	The angle made by our eyes while focusing on an object is known as convergence angle. Convergence angle for distant and near-by objects are different.
Stroboscopic motion	:	According to this phenomenon, when stationary stimuli are presented in succession, it is perceived in a motion. This phenomenon is used to explain the movement perception in videos.

2.15 REVIEW QUESTIONS

1) The first stage of perception process is

    a) Attention

    b) Interpretation

    c) Exposure to stimuli

    d) Response

2) The tendency for people to 'fill-in' the missing element of an incomplete picture is the definition of:

    a) Similarity

    b) The principle of proximity

    c) Figure and ground

    d) Closure

3) .... depth cues require the use of both eyes.

    a) Monocular

    b) Binocular

    c) Monaural

    d) Binaural

4) According to the principle of ...., objects that occur close to one another tend to be grouped together.

   a) Similarity

   b) Good continuation

   c) Proximity

   d) Closure

5) What do you understand by perception? Describe the stages of perceptual process.

6) What is Gestalt principle of organization? Explain the following principles:

   a) Figure-ground relationship

   b) Law of closure

   c) Law of similarity

   d) Law of continuity

7) Explain perceptual expectancy and describe how it can affect one's perception.

8) Differentiate between monocular and binocular cues of perception.

9) Explain the factors responsible for movement perception.

10) Explain the process of size perception with reference to size-distance invariance hypothesis.

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2.18   ONLINE RESOURCES

● For more understanding on perception as a phenomenon, visit:

- https://www.cognifit.com/perception

● For more on principle of perceptual organization, visit:

- https://pdfs.semanticscholar.org/9bcf/2a9b3ed3defe86059a3ac 180a188fad53aff.pdf

- http://courseweb.stthomas.edu/mjodonnell/cojo232/pdf/gestalt.pdf

- https://courses.lumenlearning.com/wsu-sandbox/chapter/gestalt-principles-of-perception/

● For more on the factors affecting perception, visit:

  - https://pdfs.semanticscholar.org/c4bd/148e1a26ee1fd23449a6ffe8131e62213e17.pdf

  - https://pdfs.semanticscholar.org/e546/d1dd0c015059b4464fd8c178d89c9036bb9e.pdf

  - http://faculty.virginia.edu/perlab/pdf/ZadraCloreEmotPercept.pdf

● For more understanding on theoretical approaches of perception, visit:

  - http://cognitivepsychology.wikidot.com/cognition:topdown

  - http://www.socialscientist.us/nphs/psychIB/psychpdfs/Theories_of_Perception.pdf

Answers of Multiple Choice Questions

1) (c)   2) (d)   3) (b)   4) (c)

UNIT 3   LEARNING*

Structure

3.0   LEARNING OBJECTIVES

After reading this unit, you will be able to,

- explain the nature and scope of learning;

- identify different types of learning;

- differentiate and describe the theories of learning; and

- summarize the strategies used in the process of learning.

3.1   INTRODUCTION

You have acquired many good things in your life-time, such as, you know how to read, write and perform other functions in socially desirable manner. You have acquired these through experience in your life time. Such an experience has remained interactive. These skills help you in adjusting in life in an appropriate manner. How have you acquired such behaviour patterns? This is through the process of learning. Learning process is crucial to all organisms which eventually results in proper adaptation in different situations. In this unit, you will be introduced to learning, one of the key aspect of life. You will also know the learning processes and their characteristics. The theories and other related facts will also be presented in a simple manner.

3.2 NATURE OF LEARNING

Learning is the key factor involved in behavioural change of an organism. Through learning, we make changes in our behaviour. There are many processes from which we get experience in life. Psychologists have found out such processes and are constantly engaged in conducting research in such areas.

The term learning has been defined by psychologists in many ways. According to the most acceptable definition, it is a "relatively permanent change in behaviour (or behaviour potential) resulting from experience" (Baron, 2001). Three apects in this definition that need attention are, first, 'relatively permanent change'. It is important to mention here that any temporary change in behaviour can not be termed as learning. Such as, feeling sleepy after taking drugs or heavy meals or feeling tired due to illness. Second, permanent change due to ageing or maturation (as a person grows and develops), will not be considered as learning. For example, change in height takes place because of maturation. Third, here 'experience' does not mean our own experience only. Learning can also occur through direct experiences as well as vicarious, i.e., observing events and participating in them (Bandura, 1986).

From the above explanation, it is obvious that all modifications of behaviours are not learned. Some modifications do take place due to physical maturity. In most of the cases the distinction between learning and maturation is very clear but in some places this distinction is less obvious. You take an example of infant's walking. Normally, infant does not walk before the age about 12-15 months. They walk when they are physically fit and ready, perhaps, without learning. So, walking here does not have the role of learning. But in children, recognition of colour is the outcome of learning. This way, the impact of learning and maturation on modification of behaviour are different.

Now, the question is why we 'learn'? What is the importance of the process called 'learning'. Learning is an important process in human behavior. The reason being, it helps us in adaptation and in survival. Learning may be good as well as bad, and learning can be of many types. Some of the most important types of learning have been discussed in the following section.

3.3 TYPES OF LEARNING

a) Motor learning

Motor learning involves acquiring of a new motor skill or functions as a result of practice or experience. This learning helps us in executing motor functions, for example walking, running, skating, driving, climbing, etc.

b) Verbal learning

It involves acquiring skills to communicate with others by using words, sounds, pictures, etc. The earlier studies were conducted with *nonsense syllables* which differed according to meaningfulness. A list of syllables of high association value, such as LUV, LOS, RUF, were compared to syllables which are comparatively meaningless, like XUY, ZER, XUT. McGeoch (1930) concluded that when the learning of three-letter words was compared to the learning of nonsense syllables with different association values, three-letter words were significantly easier to learn than nonsense syllables with 100 percent association value; when the association value decreased, the non-sense syllables were harder to learn.

c) Concept learning

The type of learning in which we learn to classify stimuli based on its characteristics

and features. For example, our ability to identify a barking, four legged animal with a tail as a 'dog', is the part of concept learning. We have learned that the word dog refers to this particular type of described animal. A classic study by Bruner, Goodnow, and Austin (1956) emphasized cognitive interpretations of the process of concept formation. Eighty-one cards were used in the experiment that were different on the basis of four attributes, namely number of borders, color of figures, shape of figures, and number of figures. The task was to learn the concept that the experimenter has in mind. For instance, 'all cards with one figure and two borders'. The cards are presented and the participant says that the card is an example of the concept or not. The experimenter tells whether the response is right or wrong for each card. Thus, the process helps in forming a hypothesis that makes the participant learn the concept.

d)   Discrimination learning

Our ability to discriminate between stimuli and giving response accordingly is known as discrimination learning. In one of the classic study of concept formation conducted by Hull (1920), analysed the findings on the bases of discrimination learning. The participants learned to discriminate the *common element* in the characters and on the basis of one's experiences, can recognize and use similar elements when they appear in new settings. Hull interpreted concept formation, on the principles of conditioned learning- reinforcement, generalization, and selective discrimination.

3.4   THEORIES OF LEARNING

Learning is a very integral part of our lives. It influences the way we perceive information, understand and use language, our thoughts, beliefs, attitudes, and so forth. Learning is a change in behavior that is relatively permanent in nature as it is influenced by practice and experience. The change in behavior could be good or bad and it may last for some time at least. There are different ways in which learning occurs and this will be explained as follows:

3.4.1   Pavlov's Classical Conditioning

Ivan Petrovich Pavlov (1849-1936), a famous Russian physiologist, was the pioneer in the study of learning. He was awarded Nobel Prize in 1904 in the field of medicine, for his work on physiology of digestion. He used classical experiments in learning and established many basic principles of learning. Classical conditioning is a kind of learning that is based on the classical experiments by Pavlov. This kind of conditioning is also known as **respondent conditioning** or **Pavlovian conditioning**. This kind of conditioning involves pairing of two stimuli. One is called as the *conditioned stimulus (CS)* and the other is *unconditioned stimulus (UCS)*. The CS is also known as the neutral stimulus. This is so because when it is presented initially for a first few times, it merely serves to alert the organism and not evoke any response. The UCS is a stimulus that produces a reflex response consistently known as *unconditioned response (UCR)*. The CS and UCS are paired repeatedly a number of times so that conditioning can be done. The CS is presented a little before the UCS. The time gap between the CS and UCS is known as the *inter-stimulus interval* and it ranges from about half a second to a few seconds. When the neutral stimulus is repeatedly paired with the UCS, it acquires the properties of the UCS and hence produces the unconditioned response, UCR. If the CS and the UCS are paired a number of times with appropriate inter-stimulus interval, then the stimulus that was originally neutral will begin to produce a response that is produced by the UCS before the CS and UCS were paired together.

In his classic experiment, Pavlov designed a special apparatus to assess how much saliva the dog elicits on seeing the food. He attached a tube to his salivary glands that could collect the saliva that was secreted and collect it in a cup attached to the dog's neck. Pavlov trained the dog to salivate at the sound of the bell. He rang the bell after presenting the food that was the UCS. This was done a number of times till the dog acquired the conditioning, which is the relationship between the food and the bell. This was plotted on a learning curve and was known as the ac*quisition curve*. When the CS was repeatedly paired with the UCS, the salivation increased. Pavlov repeatedly tested this with new CS and UCS and found that any stimulus that reliably produces a reflex response can serve as a UCS. Once the response has been acquired, if the bell (CS) is rung without presenting the food (UCS), then the dog's salivation decreased. That is to say, that if the CS is presented without being followed by the UCS, the CR reduces gradually, known as *extinction curve*. After a period of rest, when the bell (CS) was rung again, it led to salivation in the dog. This is known as *spontaneous recovery*, as the learning had not completely ended and after a break, the dog responded thinking about the past association between the CS and UCS. Hence, this association had not diminished. That is to say that some learning still remained after extinction (Pavlov's experiment). The level of saliva was much more at the time of spontaneous recovery than it was at the time of extinction. When the pairing of the CS and the UCS was repeated again, it produced a stronger response (salivation). This is known as *reconditioning*.
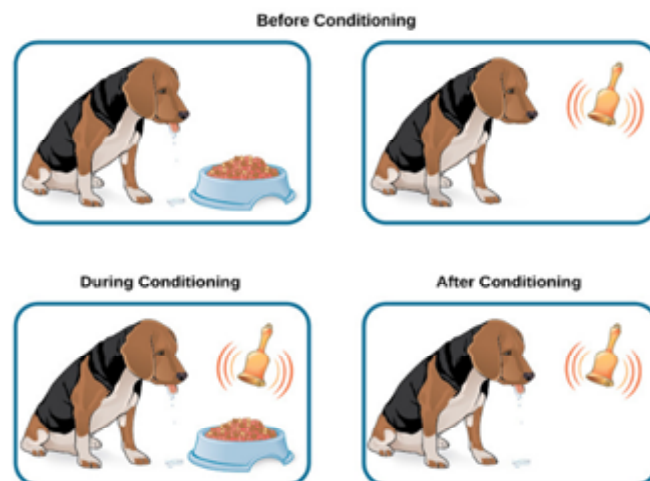
Figure 3.1: Steps involved classical conditioning of a dog
Image Source: https://courses.lumenlearning.com

Box 3.1

A review of important terms:

Unconditioned Stimulus (UCS): A stimulus that can produce response unconditionally and naturally, whenever it is presented. For example, cutting an onion can make you cry or pollen from flower can make you sneeze. Here, onion and pollen are two examples of UCS.

Conditioned Stimulus (CS): A stimulus that was initially neutral in nature i.e., was not capable of producing any response. Later, with repeated paring with UCS, it is able to predict a UCS and thus can elicit the response originally meant for UCS only.

Unconditioned Response (UCR): Response for which we do not need any previous learning i.e., which occurs automatically without any condition. As discussed already, 'crying' while cutting onion and 'sneezing' due to pollen, are two examples of UCR.

Conditioned Response (CR): The response we give to a conditioned stimulus because of some experience is known as CR.

Principles of Classical Conditioning

Pavlov's experimental findings concluded five basic principles of classical conditioning. They are summarized as follows:

Acquisition: A CR is acquired by a series of contiguous pairings of CS and UCS. In *simultaneous conditioning*, CS and UCS are presented at the same time and continue together until CR occurs. In *trace conditioning*, CS is presented first, and after a brief delay UCS follows. In *backward conditioning*, UCS is presented before CS. In *delayed conditioned response*, CS is presented somewhere between few seconds up to a minute before UCS and may continue with it for a few seconds. According to Pavlov, simultaneous, trace and delayed conditioning were effective procedures to acquire learning.

Extinction: Once Conditioned, Always Conditioned?

Pavlov after coming up with the principle of learning tried to understand the conditions under which one can unlearn the acquired conditioning. So, how can we get rid of conditioning? Stop giving UCS. When the conditioned stimulus is presented for a number of times in the absence of UCS, it will eventually lead to the disappearance of the conditioned response; this phenomenon has been termed by Pavlov as **extinction**. In the context of Pavlov's dog, if the bell was not followed by any food for many presentations, then after some time, the dog will stop salivating in response to the bell. But, when US (bell) is again followed by UCS (food) after extinction has taken place, conditioned response (salivation) will return very quickly-a process known as **reconditioning**. The reappearance of the conditioned response after a time interval due to UCS-CS pairing is known as **spontaneous recovery**.

Generalization and Discrimination: Responding to similarities and differences

Pavlov also found that if the animal could be trained to respond to a bell, he could also be trained to respond to a buzzer with a similar response. This is known as **generalization** of the CS to other stimuli that were somewhere similar to the original CS where the learning took place. The level of generalization depends upon the extent to which the new stimulus is similar to the CS. Sometimes phobia can be treated by using this procedure by pairing the feared stimulus with a pleasant one. On the contrary, if Pavlov's dog responded to the bell used in the experiment only and ignored other similar sounding bell, then this phenomenon will be called as **stimulus discrimination**-tendency to make a response to a certain stimulus and ignore others.

Higher-Order Conditioning

A CS after acquiring the ability to elicit CR may acquire reinforcing properties. For example, buzzer (CS) has been used to elicit salivation (CR) with food (UCS). After salivation is established to the buzzer (CS or CS_1), CS_1 will now be paired with a flashing light (CS_2). After repeated trials CS_2 will elicit CR_2. This is when higher-order conditioned response is established. Such responses are difficult to establish and maintain.

Principles of classical conditioning can help in behavior modification or behavior therapy by extinction or reconditioning of the unpleasant emotional responses.

3.4.1.1 The Little Albert Experiment: Applying Classical Conditioning on Human Learning

Can we apply the principle of classical conditioning on human learning also? **John**

B.Watson was highly influenced by Pavlov's work on dogs. Thus, Watson wanted to demonstrate that the principles applied to humans also. Watson and his co-researcher **Rosalie Rayner**, conducted an experiment 'Little Albert' on a nine-month old child named "Albert". Watson hypothesized that children's fearful response to loud noise is an unconditioned response. He further proposed that using the principles of classical conditioning a child can be made fearful to any neutral stimulus. In the baseline condition of experiment, Watson and his assistants exposed little Albert to a number of stimuli (harmless objects and animals) such as a white rat, a rabbit, mask etc. As expected, the little Albert did not show any fearful response to these objects. In control condition, when Albert was exposed to the rat, Watson made a frightening noise by striking a piece of metal with a hammer. This made Albert fearful and he started crying. After repeated presentation of white rat with a loud noise, he began to cry just after seeing the rat and tried to escape. Later, it was observed that Albert started to generalize his fear and became afraid to similar looking white and furry objects, like a rabbit, fur coat, and a fake beard.

So, in the above experiment,

Neutral Stimulus: White rat

Unconditioned Stimulus: Loud noise

Unconditioned Response: Crying and fearful emotional response

Conditioned Stimulus: White rat

Conditioned Response: Crying and fearful emotional response

Figure 3.2: Rat or rabbit, I don't like it.
ImageSource: https://www.newscientist.com

Watson claimed that human behavior could entirely be determined by careful manipulation of stimulus and response.

Box 3.2: Learned Helplessness

The phenomenon of learned helplessness was given by Martin Seligman in the late 1960s while working on classical conditioning with dogs. He noticed that those dogs who received an unavoidable electric shock for a number of times did not act to rescue themselves when they had an opportunity for it in the subsequent situations. Whereas, those dogs who received no inescapable shock, took action to save themselves from the electric shock. He termed the behaviour of the first group as *learned helplessness*- one's learned response to not to take any appropriate action to avoid aversive stimuli. In other words, one's tendency to avoid taking any action for a successful escape from an aversive or painful situation due to the history of failed attempts. The theory of learned helplessness has also been successfully applied to understand the problem of depression in human beings.
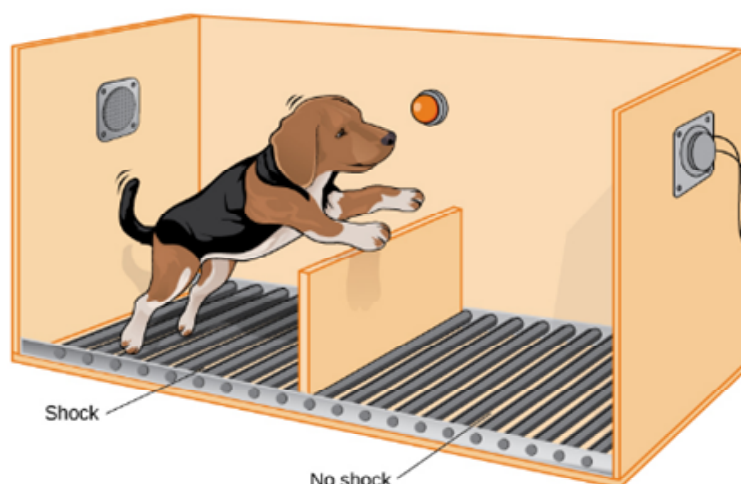
Figure 3.3: Seligman's learned helplessness experiments with dogs used an apparatus that measured when the animals would move from a floor delivering shocks to one without.

Image Source: https://virtualuniversity.in

3.4.2 Skinner's Instrumental Conditioning

Instrumental conditioning is also known as operant conditioning. This kind of learning involves some kind of behavior or action that is instrumental in producing reinforcement (or reward) when it operates upon the environment. Operant conditioning is based on the research findings of **Edward L. Thorndike** and **B.F.Skinner**. In this learning, the most important thing to understand is reinforcement. Reinforcement is any stimulus or event which increases the likelihood that the response will occur again. It could be a reward or a punishment.For example, when the rabbit is given a carrot after running a distance, he will run faster to eat more carrots. Here, carrot is reinforcement in the form of reward. Thus, we can say that the nature or occurrence of a particular response depends on the extent to which the reinforcement is given. Hence, the term operant is used.That is the way the response operates on the environment, its desirability or non- desirability will strengthen or weaken the occurrence of the response.

Skinner used a simple experiment to explain this concept. He placed a rat in a box.There was a lever which if pressed would activate the food or water delivery mechanism.This was called as the Skinner box.The rat is placed in a box and the experimenter delivers the food pellets by pressing the lever from outside.The rat eats the pellet one at a time.After some training, the rat is left alone in the box and the experimenter does not release the food pellets for him. After some time, when the rat is hungry again, he moves about exploring the box and by chance tends to press the lever that releases the food pellet. Thus, food pellet is the reinforcement that depends upon the pressing of the lever. Then the rat moves about in the box and again tends to press the lever by chance.This enables him to eat another food pellet. Thus, after that he does not explore much but tends to press the lever again and again quickly to eat the food pellets that are released. Hence, the operant behavior is very evident now.The number of times the rat presses the bar in a particular time are counted and recorded as rate of responding per unit.A cumulative recorder is used to record the rate of responding, that is the number of responses recorded per unit time. The examples of reinforcement could be smiles or approval of others that can make the response more likely to occur.
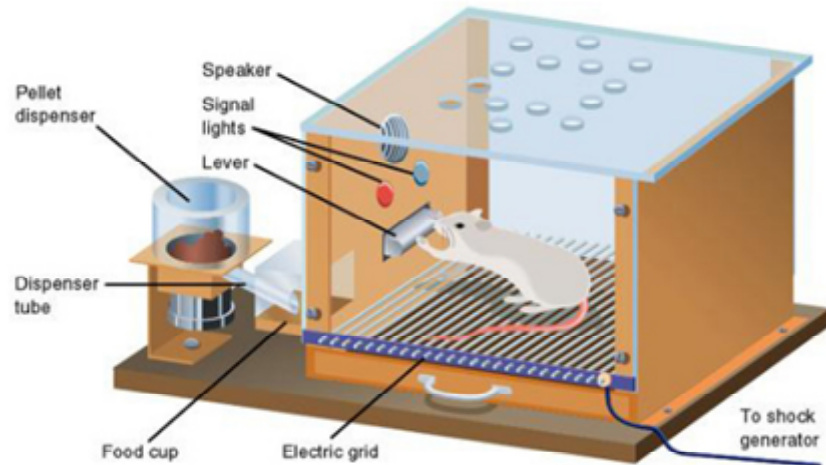
Figure 3.4: A Skinner box
Image Source: https://www.simplypsychology.org/

Operant conditioning helps in shaping a response. The reinforcement can be used to shape the behavior in a relatively shorter period of time. The learner learns the desired behavior when the chain of simple behaviors leading to the desired behavior is reinforced step by step. As each step is learned and the desired response is given, reinforcement is given. This makes the occurrence of the response more likely to occur again. This method of shaping is known as the method of *successive approximations*. This method of shaping is often used to shape the behavior of children, attitude, language, beliefs, etc. For example, when a child learns to walk, each step she/he takes, is reinforced to encourage her/him to walk.

Thus, the learning of the response is contingent on the reinforcement that follows it. Hence, if the response is not followed by reinforcement, then the tendency to produce that response will also reduce. This process when the tendency to produce a response again and again reduces due to non-reinforcement of the response is known as **extinction**. This means that once the response is not followed by reinforcement, then it is less likely to occur in future.

Stimulus **generalization** also takes place in operant conditioning. The more similar is the new stimulus to the previous one, the more likely is the response to be reinforced. In stimulus **discrimination**, the ability to discriminate is learnt when the response elicited by one stimulus is reinforced and in the presence of another stimulus is not reinforced. Thus, reinforcers are items or events that will strengthen the response. There are two types of reinforcers, namely, **primary reinforcer** and **secondary reinforcer**. Food is an example of primary reinforcer. It fulfills the basic need of hunger motive. Money is an example of secondary reinforcer. It acquires reinforcing properties by being associated with the primary reinforcer. Thus, a child learns to use money when she/he observes that it can be exchanged (traded) for a toffee.

Skinner postulated that the timing of reinforcement is very crucial for learning. It determines the speed of the learning as well as strength of learned response. All responses should not be reinforced, for the response to be continued for a long period of time. Thus, the **schedules of reinforcement** are used in operant conditioning. In **continuous reinforcement**(CRF) every response being learnt is reinforced so that it becomes more likely to occur again. **Partial reinforcement** or intermittent

reinforcement takes place when reinforcement is not given on every desired behavior. The main types of partial reinforcement schedules (schedules of reinforcement) depend upon the time at which the reinforcement is given or the rate/number of times the reinforcement is given to the response.

i) **Fixed-ratio schedule (FR):** This depends upon a particular number of responses that must be made before the reinforcement is given. For example, reinforcement is given after every fourth response or every third response. This schedule leads to a high rate of response that occurs at a relatively steady rate.

ii) **Fixed-interval schedule (FI):** The reinforcement is given after a fixed interval of time, irrespective of the number of responses delivered. The performance is relatively varied in this kind of a schedule. The responses become fewer after the reinforcement has been given and then it slowly increases before it is the time for the next reinforcement. This tends to produce a variable rate of response during the time interval.

iii) **Variable-ratio schedule (VR):** In this schedule the reinforcement is given after a varied number of responses. That is it may be given after the first response, then after three responses, then after five responses and so on. So, there is no fixed number of responses preceding the reinforcement. This kind of reinforcement schedule leads to a high and steady rate of responding.

iv) **Variable-interval schedule (VI):** The reinforcement is given after a varied interval of time. That is to say that it may be given after one-time interval and then after another interval and so on. This causes behaviors that resist extinction as in case of VR schedules and provide steady rates of responding.

Table 3.1: An Overview of reinforcement and punishment used in instrumental conditioning

Procedure	Stimulus Event	Effects	Behavioural Outcomes
Positive reinforcement	Some desirable stimulus (e.g., food, sexual pleasure, praise)	Strengthens responses	Organism learns the response
Negative reinforcement	Some undesirable (aversive) stimulus (e.g., heat, cold, harsh criticism)	Strengthens responses that permit escape from or avoidance of stimulus	Organism learns to perform responses that permits him/her to avoid or escape from negative reinforces
Positive punishment	Something undesirable (aversive) stimulus	Weakens the responses that precede occurrence of stimulus	Organism learns to suppress responses that lead to unpleasant consequences
Negative punishment	Something desirable	Weakens responses that lead to a loss or postponement of stimulus	Organism learns to suppress responses that lead to loss or postponement of desired stimulus

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Box 3.3: The principle of *Shaping* and *Chaining*

Have you seen a circus or have you watched an animal performing some tricks or stunts in a movie? How can they perform such a complicated behaviour?

The answer to this question lies in two principles of operant conditioning called as **shaping** and **chaining**. Shaping is a process of learning a new behaviour in which successively closer approximation of the desired behaviour is reinforced, that is the organism will be rewarded for each small step towards targeted behaviour.

Any complex behaviour or skill is the chain of many steps. The process of **chaining** involves breaking a task into small steps and then teaching these steps in sequence or chain. In chaining, only the targeted behaviour is rewarded, i.e., once the trainee accomplishes the last step, the person will be rewarded. For example, if you want to teach a child to use the spoon to feed himself/herself, then chaining principle can be used.

Box 3.4: Premack Principle

Given by David Premack, it is a principle of reinforcement. According to this principle, a more preferred behaviour can be used as reinforcement for a less preferred behaviour. For instance, in order to make her child develop the habit of reading, a mother tells the child that if she reads a book for 20 minutes then she could play outside for 20 minutes, The mother is using Premack principle.This is also known as 'Grandma's Rule' because the grandmother or any care giver often use this principle. Likewise, the child is asked to clean her/his room before leaving the house to play.

3.4.3 Bandura's Social Learning Theory

According to Bandura's (1977) social learning theory, learning occurs in a social setting by observing others behaviour and its outcome. This observational learning can occur in two ways: (i) direct observation, and (ii) indirect observation. In direct observation, you learn behaviour by observing others (called as model) directly, while in indirect observation you learn by observing or hearing others experiences. This kind of indirect learning is known as vicarious learning. Suppose you wanted to go on a trip to North-eastern states of India. One of your friends who recently came back from a trip of north-east suggests you to carry umbrella or raincoat, as it can rain anytime. What will you do? There are very high chances that you will listen to the other person's experience and carry an umbrella. This kind of learning is an example of vicarious learning.

Bandura's (1961) famous experiment with the bobo doll showed how behaviors can be learnt by observing others' behaviors. People whose behaviors are observed are known as models. These models provide information about how to interact with others, how to express one self, how to play, etc. Our parents, teachers, peers, TV actors, film actors, singers, sportspersons, or any significant person could serve as a model for learning behaviors that could be pro-social, as altruistic or anti-social, as criminal acts.

Box 3.5: Bobo Doll Experiment

Bandura and his colleagues conducted an experiment on children to investigate the role of observational and imitation in learning social behaviour, such as aggression. They selected 72 children between the age group of three to six years. Children were randomly assigned to three groups: one control and two experimental conditions. In one group of experimental condition, children were shown a movie with an aggressive model, beating, hitting and abusing a bobo doll. In another experimental condition, a non-aggressive model was shown playing peacefully and friendly with a bobo doll. Whereas, in control condition children were not shown any movie. Later, all groups of children were placed in a room full of varieties of toys. It was observed that children

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who were exposed to aggressive model imitated the model's behaviour. They also punched, hit, and used abusive words for bobo dolls. In contrast, the children of second experimental group, who were exposed to non-aggressive model, did not demonstrate any aggression with bobo doll. This was one of the landmark studies in psychology. It suggested that observation and imitation play crucial role in learning.

Figure 3.5: Children imitating aggressive behaviour of the actor of the film
Image Source: https://thedirtpsychology.org/

Bandura further suggested that whatever information the person grasps, this information is then actively processed and various cognitions are involved before the observations are displayed as expressed behaviors. These cognitive processes are as: (1) the extent to which we **attend** to the information and (2) how well we remember or **retain** the observed behavior. This is followed by how well we are able to **reproduce** the observed behavior and what **motivates** us to perform the observed behaviors.

Check Your Progress1

1) Differentiate between classical and operant conditioning?

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2) Explain learned helplessness with the help of the theory of classical conditioning.

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3) List the main principles involved in observational learning.

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4) Differentiate between partial and continuous schedule of reinforcement.

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3.5 COGNITIVE LEARNING

Many psychologists proposed that to explain learning of behaviour based on simple stimulus-response association, is not appropriate. Since, both humans and animals possess the brain, therefore learning without higher mental processes is not possible. Learning based on cognitive processes is known as cognitive learning. In this section, we will discuss two prominent forms of cognitive learning, latent learning and insight learning.

3.5.1 Latent Learning

Gestalt psychologist, Edward Tolman was the main proponent of latent learning. Tolman and his colleagues (Tolman &Honzik, 1930; Tolman, Ritchie, & Kalish, 1946) in a series of experiments on rats demonstrated that learning can take place without immediate reinforcement.

In a study by Tolman and Honzik (1930), hungry rats were trained to run in a maze (see Figure 3.6).They took three groups of rats; reward group, no-reward group and, no-reward/reward group. For the first group, they placed hungry rats in a complicated maze with food at the end, while the second group never received any food after coming out of the maze successfully. Rats of the third group received no food for the first ten sessions but for their eleventh session, they received food as reinforcement. Results suggest that rats of the first group took lesser time for every next trial to reach their goal while the rats of the second group showed very slight improvement in their time and errors. Interestingly, rats of the third group initially also showed very slight improvement in their error but once they became aware of the presence of food by its smell, their performance improved dramatically and in fact, it was on par with the performance of rats of the first group. This change in behaviour was attributed to **latent learning** or the learning that takes place but does not express until the situation for it is conducive.

Figure 3.6: Tolman's maze
Image Source: https://courses.lumenlearning.com

3.5.2 Insight Learning

Given by one of the founders of Gestalt psychology, Wolfgang Kohler, insight learning refers to the sudden realization of a problem's solution. Kohler proposed that not all kind of learning depends on trial-error or conditioning. We also use our cognitive processes to learn. Using cognitive processes, we visualize the problem and solution for it internally. Even though this learning takes place implicitly but the change in the behaviour is long lasting.

To prove his point, Kohler conducted a series of experiment on chimpanzees, with whom the human share 99 percent DNA. In one such experiment, Kohler placed a chimpanzee in a cage and placed a banana above its reach. Initially, after a few failed attempts to get that banana, chimpanzee started spending its time unproductively by playing and sitting. Suddenly, after some time chimpanzee started piling up the kept wooden boxes on top of each other and climbed, and grabbed the banana. Kohler argued that the internal process that led the chimpanzee to use boxes in this way is an example of insight learning.

Figure 3.7: Chimpanzee trying to reach banana placed above his reach
Image Source: http://slideplayer.com

The famous story behind Archimedes "Eureka" moment and sudden realization of gravitational force after seeing a falling apple by Isaac Newton, are some of the most famous examples of insight learning.

3.6 STRATEGIES IN LEARNING: IMAGERY, REHEARSAL AND ORGANISATION

What could be the best way or strategy of learning information? Cognitive and educational psychologists have done extensive studies in finding out the most appropriate strategies of learning. Findings suggest that learning can be improved by using the method of imagery, rehearsal and organisation. In this section, we will discuss these strategies briefly.

1) *Mental Imagery:* Answer the following questions:

   - How many windows are in your house?

   - How many vowels are in the spelling of 100?

For answering the first questions, people will imagine themselves as taking a mental tour of their house and counting the number of windows. And for answering the second question, people mentally form the image of the spelling of digit 100 and count the number of vowels present in its spelling.

So, here mental imagery has helped you in answering these questions. Without the ability to produce mental images, you would have not answered it correctly. Studies have suggested that if you are capable of producing mental images of the information to be remembered, then, you can learn things more efficiently. It can be defined as one's ability to visualize the situation or information mentally. Developmental studies have suggested that older students get more benefits using this method. Learning information using imagery, involves two steps:

1) Reading the information to be remembered.

2) Mentally forming a picture of that information.

If the mental image contains all the relevant information, then it will be more accurately learned. Further, reading from a book or source having lot of details also helps in forming images and thus, improves learning.

2) *Rehearsal:* Rehearsing refers to repeating of information over and over again to order to learn it. Rehearsal can be two types: maintenance rehearsal and elaborative rehearsal. In *maintenance rehearsal,* information is simply repeated a number of times, without understanding the underlying meaning, to keep it in memory. On the other hand, *elaborative rehearsal* is a method of learning information by making an attempt to elaborate it either by understanding its underlying meaning or by making meaningful connections with other information. Studies have suggested that learning a concept or information using elaborative rehearsal method is more effective, as it helps in retaining information for longer period. One way of doing elaborative rehearsal is *elaborative interrogation*. It involves asking 'why' question for the information to be remembered and then generating an answer. Studies have suggested that this specific technique is useful in remembering facts.

3) *Organisation:* This strategy of learning requires reorganisation of information to be remembered in such a way that would facilitate learning process. For example, you were asked to remember the following list:

Delhi

Ostrich

London

Ludhiana

Yak

Greenwich

Owl

You can either learn these items by making separate groups for city and animal names or you can create a new word by taking first alphabet from each word, such as, DOLLY-GO. This method helps of organization of information improves learning for two reasons; (i) it reduces the large number of information into manageable amount, and (ii) it helps in retrieving information more accurately.

Check Your Progress 2

Fill in the blanks

1) .... was the main proponent of latent learning.

2) Learning that takes place but does not express until the situation for it is conducive is known as ....

3) .... was the main proponent of insight learning.

4) .... refers to the sudden realization of a problem's solution.

5) Findings suggest that learning can be improved using the method of imagery, ... and organisation.

6) Rehearsal can be of two types: .... and ....

Answers

(1) Tolman, (2) latent learning, (3) Wolfgang Kohler, (4) insight learning, (5) rehearsal, (6) maintenance rehearsal and elaborative rehearsal.

3.7 SUMMARY

Now that we have come to the end of this unit, let us recapitulate all the major points that we have covered.

- Learning can be defined as a "relatively permanent change in behaviour (or behaviour potential) resulting from experience".

- Ivan Petrovich Pavlov gave principles of classical conditioning, which is also known as **respondent conditioning** or **Pavlovian conditioning**. This kind of conditioning involves pairing of two stimuli. One is called as the *Conditioned Stimulus (CS)* and the other is *Unconditioned Stimulus (UCS)*.

- Instrumental conditioning also known as operant conditioning was given by B. F. Skinner. This kind of learning involves some kind of behavior or action that is instrumental in producing reinforcement (or reward) when it operates upon the environment.

- The phenomenon of learned helplessness was given by Martin Seligman in the late 1960s while working on a classical conditioning with dogs. It can be defined

as one's tendency to avoid taking any action for a successful escape from an aversive or painful situation due to the history of failed attempts.

● According to Bandura's social learning theory, learning occurs in a social setting by observing others behaviour and its outcome. This observational learning can occur in two ways: (i) direct observation, and (ii) indirect observation.

● Learning based on cognitive processes is known as cognitive learning. Types of cognitive learning are latent learning and insight learning.

● Findings suggest that learning can be improved using the method of imagery, rehearsal and organisation.

3.8 REVIEW QUESTIONS

1) Blinking in response to a puff of air directed to your eye is a(n):

   a) UCR

   b) UCS

   c) CR

   d) CS

2) A year after surviving a classroom shooting incident, a child still responds with terror at the sight of toy guns and to the sound of balloons popping. This reaction best illustrates:

   a) an unconditioned response.

   b) operant conditioning.

   c) latent learning.

   d) generalization.

3) Airline frequent flyer programs that reward customers with a free flight after every 25,000 miles of travel, illustrate the use of a .... schedule of reinforcement.

   a) fixed-interval

   b) variable-interval

   c) fixed-ratio

   d) variable-ratio

4) Which pioneering learning researcher highlighted the antisocial effects of aggressive models on children's behavior?

   a) Watson

   b) Bandura

   c) Pavlov

   d) Skinner

5) Explain different types of learning.

6) Differentiate between theory of classical conditioning and operant conditioning.

7) Explain the principles of extinction, spontaneous recovery and reconditioning.

8) Describe the different types of reinforcement schedules.

9) Explain the phenomenon of learned helplessness and discuss how it is a form of classical conditioning.

10) What do you understand by the principle of shaping and chaining?

11) Differentiate between latent learning and insight learning.

3.9 KEY WORDS

Classical Conditioning	:	A basic form of learning in which one stimulus comes to serve as a signal for the occurrence of a second stimulus. Organisms acquire information about the relations between various stimuli, not simple associations between them.
Operant Conditioning	:	A form of learning in which behaviour is maintained or changed through its positive or negative consequences. Positive consequences lead to the repetition of behaviour, whereas, negative consequences will lead to avoidance of behaviour.
Reinforcement	:	It is any stimulus or event which increases the likelihood that the response will occur again. It could be a reward or a punishment.
Premack Prinicple	:	This principle states that, a more preferred behaviour can be used as reinforcement for a less preferred behaviour.
Chaining	:	The process of breaking a task into small steps and then teaching these steps in sequence or chain by rewarding only targeted behaviour is rewarded.
Schedule of reinforcement	:	Rules determining when and how reinforcement will be delivered, is known as schedule of reinforcement.

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- Chimpanzee trying to reach banana placed above his reach. Retrieved June 1, 2018, fromhttp://slideplayer.com/slide/7222286/

3.12 ONLINE RESOURCES

- For more on Latent learning, visit
  - https://courses.lumenlearning.com/wmopen-psychology/chapter/psychology-in-real-life-latent-learning/
  - https://www.psychestudy.com/behavioral/learning-memory/latent-learning
  - http://fac.hsu.edu/ahmada/3%20courses/2%20learning/learning%20notes/9%20tolman.pdf

- For more information on Social Learning Theory, visit
  - http://www.asecib.ase.ro/mps/Bandura_SocialLearningTheory.pdf
  - https://www.lsrhs.net/sites/kleina/files/2012/11/SocialLearningTheory.pdf

- For more information on Pavlov's classical conditioning, visit

    - https://courses.lumenlearning.com/boundless-psychology/chapter/classical-conditioning/

    - https://web.mst.edu/~psyworld/general/cc/cc.pdf

    - https://courses.edx.org/c4x/SMES/PSYCH101x/asset/Chapter_7.pdf

- For more on Learned Helplessness, visit

    - https://ppc.sas.upenn.edu/sites/default/files/learnedhelplessness.pdf

    - https://positivepsychologyprogram.com/learned-helplessness-seligman-theory-depression-cure/

Answers for *Multiple Choice Questions*:

1) (a),   2) (d),   3) (c),   4) (b)

UNIT 4   MEMORY*

Structure

4.0   LEARNING OBJECTIVES

After having read this unit, you will be able to:

- explain the concept of memory and its nature;

- describe the various models of memory;

- identify different types of memory;

- explain the process of forgetting;

- describe different theories of forgetting it; and

- know various strategies of enhancing memory.

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* Dr. Arti Singh, Academic Associate of Psychology, IGNOU, New Delhi and Dr. Meetu Khosla, Associate Professor of Psychology, Daulat Ram College, University of Delhi.

4.1 INTRODUCTION

Consider the following examples:

Do you know how to ride a bike? If you know, then how much do you think about rotating the pedals or balancing while riding the bike?

How much time do you take while processing the information of a repeated television advertisement that you are watching?

Do you remember the last time you met your school teacher?

Instances mentioned above and other such instances, highlight the importance of *memory* in everyday life. The term memory refers to conscious retrieval of previously experienced information. So, for the above instances, the process of conscious retrieval of the experienced information is the part of the process. However, all instances involve different types of memory!

A glance over the two preceding units on Perception and Learning, reflect that the two processes are important for human behavior along with Memory. Perception, learning and memory are closely linked. An object or event is perceived, learned, memorized and recalled, thereby helping the individual to adapt. In this unit, we shall turn our attention to the process of memory. In the first part of the unit, nature, scope and models of memory will be explained followed by types of memory. In the latter part of the unit, we shall summarize about the process of forgetting and the strategies to improve memory.

4.2 NATURE AND SCOPE OF MEMORY

What did you eat in dinner yesterday? What is the name of your best friend? Do you know how to drive a car or ride a cycle? How did you feel when you got highest marks in your class? The mental process you used to answer all of these questions is known as **memory**. In 1885, Hermann Ebbinghaus (1850-1909), a German psychologist was the first person to study memory in a scientific way. Ebbinghaus conducted memory experiments on himself and the findings were found to be valid. Ebbinghaus taught himself **nonsense syllables** (consonant-vowel-consonant trigrams, like TOB, etc.). They can be pronounced but are meaningless. Ebbinghaus created 20,000 such trigrams in his experimental study. He assumed that meaningful stimuli would be more memorable than non-meaningful stimuli. Based on the experimental findings, Ebbinghaus also concluded that *distributed practice* (the efforts to learn the material is spread overtime) is often better than *massed practice* (the attempt to memorize the material at once).

Memory refers to the ability of retaining information and reproducing it over a period of time when required to perform a cognitive task. It has been conceptualised as a process comprising of three stages; (i) encoding, (ii) storage, and (iii) retrieval. All information received by our senses goes through these stages.

i) **Encoding:** It is the process of converting sensory information into a form that can be processed further by the memory systems.

ii) **Storage:** In this second stage, received information by memory systems are stored so that it can be used at later time also.

iii) **Retrieval:** It refers to locating and bringing the stored material to one's awareness when required to complete a task.

However, any obstacle or hindrance in the completion of any of these stages can lead to memory failure.

4.3 THEORIES OR MODELS OF MEMORY

Whatever we have learnt needs to be stored properly so that we are able to retrieve it when we want to. This process involves memory. There are different theories or models of memory.

4.3.1 Information-processing Model

1960s onwards, cognitive approaches were based on the model of computer as an information-processing mechanism. In 1968, American psychologists Richard Atkinson and Richard Shiffrin (1968) proposed Atkinson-Shiffrin Model of memory which is very similar to the way computer handles the input and storage of data. This model involves various steps to store information.

a) **The sensory register or memory:** This receives information from the various sensory receptors from the environment. Here, the information is held for a very brief period of time, perhaps a few seconds. The information passes from the sensory register to the short-term memory, only if attention is paid to it.

b) **Short-term store or memory:** This is also known as *working memory*. William James referred it as **primary memory.** Here, the information is kept for 20 to 30 seconds. The information that is attended to, is processed here in a rehearsal buffer and repeated again and again. It has a very limited capacity to store information. G. A. Miller (1956) suggested that the capacity of working memory was about seven items (plus or minus two), By items, Miller argued that a lot of information could be packed in a single item. This strategy was called *chunking* and the basic unit of information in working memory is known as *chunk*. Chunking can help to store more information in short-term store. Several pieces of information can be combined into chunks and stored in short-term store and later retrieved. It stores sound of the speech, visual images, words, meaningful sentences. Since the storage is very small, most of the new incoming information, displaces the previously stored information. Information that is rehearsed well, then moves to the long-term memory. Rehearsal here means to actively maintain the item in working memory. Rehearsal can be made in two ways. In *maintenance rehearsal*, the information is repeated again and again. This information may not be passed on to the long-term memory. In *elaborative rehearsal,* strategies are used to organize and give meaning to the material to some other concept that is encoded. Elaborative rehearsal associates the item in working memory to existing long-term memory structures.

c) **Long-term store or memory:** Information that is rehearsed well, then moves to the long-term memory and the information that is not rehearsed is lost. The information is organized in different ways in long term store for days, months, years, and maybe forever. The long-term memory has unlimited capacity to store information. Information is generally not forgotten from long term store, and if any forgetting occurs, it is because the information has not been retrieved or organized properly. The information that is stored in long-term store consists of meaningful words, sentences, ideas, and various experiences of our life.
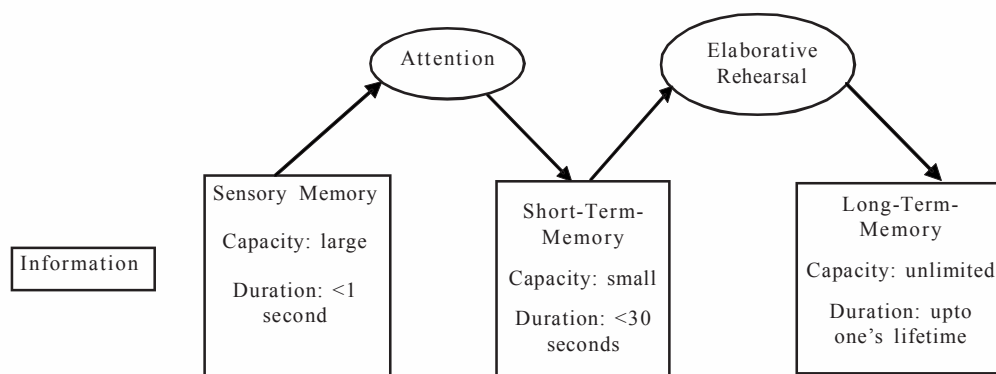
Figure 4.1: Information-Processing Model

4.3.2 Levels of Processing Theory

This model refutes the claim of Atkinson and Shiffrin model that memory consists of different subsystems. According to level of processing (LOP), whether information will be retrieved successfully or not depends on its level of processing. LOP refers to the fact that more meaning-based handling of information leads to better encoding of information. According to this model, the information that is encoded is processed at different levels. The manner in which information is first encountered and rehearsed leads to a different depth of processing. Fergus Craik and Robert Lockhart (1972) have proposed that elaborative rehearsal leads to deeper processing and maintenance rehearsal leads to shallow processing. Craik and Tulving (1975) proposed three LOP;

a) *Physical/Structural Processing:* Encoding of information based on its physical attributes-shallow processing.

b) *Phonological Processing:* Encoding based on how it sounds. Such as, 'Hat' rhymes with 'Cat'-shallow processing.

c) *Semantic Processing:* Encoding done based on its meaning and/or concept-deep processing.

Studies on this model have suggested that deeper the level of processing, the higher will be its probability to be retrieved successfully (better retention of the information than shallow processing).
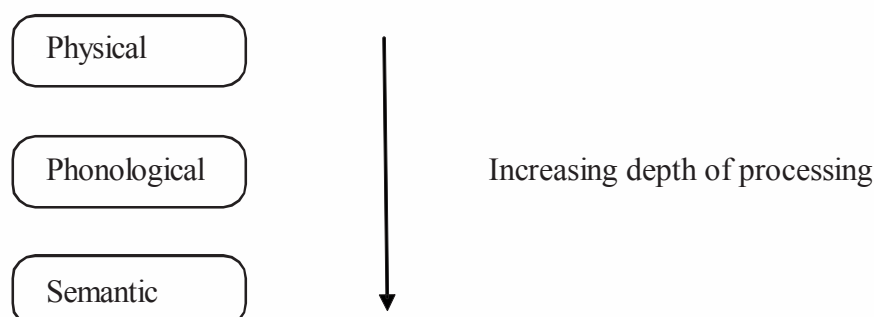
Figure 4.2: Level of Processing (Craik & Tulving, 1975)

4.3.3 An Integrative Model: Working Memory

The concept of STM propounded by Atkinson and Shiffrin was very narrow. They considered STM only as a short-term memory storehouse but later studies disapproved it. Later studies suggested that STM is dynamic in nature i.e., it works not just as

a storehouse of information but also responsible for manipulation of incoming information for the completion of a cognitive task. Baddeley & Hitch (1974), after incorporating the idea of level of processing (LOP) proposed a new model for STM and termed it as working memory. Thus, working memory can be defined as "a limited-capacity system for temporary storage and manipulation of information for complex tasks such as comprehension, learning, and reasoning" (Goldstein, 2011, p. 131). Baddeley's model of Working Memory (WM) consists of four components: the *central executive,* the *phonological loop,* the *visuospatial sketch pad,* and the *episodic buffer* (see Figure 4.3).

- The **central executive**, as the name suggests, works as an executive in our working memory. It coordinates and regulates cognitive operation between sub-ordinate systems namely, phonological loop, visuospatial sketch pad and episodic buffer. It decides which of the memory will become part of long-term memory and which will fade away.

- The **phonological loop** is responsible for storing verbal and auditory information. The information stored in phonological loop will decay within 2 seconds, unless it is not rehearsed. It consists of two components, **phonological store**, which stores information for few seconds; and the **articulatory rehearsal process**, responsible for rehearsing the information in order to keep the information stored in phonological store from decaying. For instance, trying to remember a phone number, you have just been told by your friend, involves phonological loop.

- The **visuospatial sketch pad** keeps visual and spatial information stored. For instance, the mental picture that comes up in your mind while listening to a story or solving a puzzle, involves using your visuospatial sketch pad.

- The **episodic buffer** is responsible for combining information from phonological loop, visuospatial sketch pad and long-term memory to generating a unitary episodic representation of information. Thus, this component helps us in making a sense of the received information.
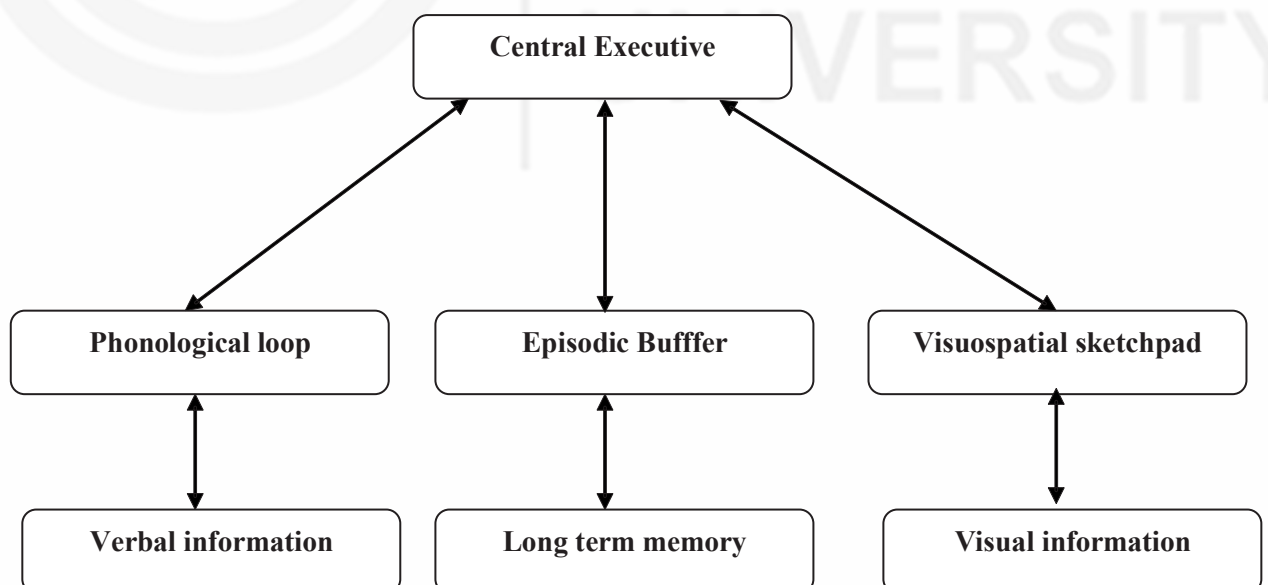
Figure 4.3: Baddeley's Model of Working Memory

Box 4.1: Declarative vs. Non-declarative Memory

Declarative Memory or Explicit Memory: It refers to that memory system which can be controlled consciously and for which we are aware of in some form. It involves effort and intention, and it generally declines with the age. Recalling the name of a friend, remembering a contact number or ATM pin involves declarative memory. There are basically three types of declarative memory namely; *working memory, episodic memory and semantic memory.*

Non-declarative Memory or Implicit Memory: That system of memory for which we have no awareness. It works unconsciously and without any efforts and intentions. It is unaffected by aging. Following are its three forms:

1. Priming

It is the process that works unconsciously and helps in speeding up the process of retrieving. This process suggests that memory can be activated unconsciously also.

2. Conditioning

As already discussed in the previous unit, this form of memory is responsible for learning an association between two stimuli.

3. Motor/Procedural memory

The process of learning a motor skill is slow but once it is well learned, it becomes automatic in nature. That is, it does not need any further attention or conscious effort. Such as the motor process involved in walking does not need any conscious effort.

Check Your Progress 1

1) What are the three stages of memory?

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2) List important characteristics of Short-Term Memory and Long-Term Memory.

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3) Name the three levels of processing proposed by Craik and Tulving model of memory.

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4) What is the importance of central executive component in working memory?

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4.4   TYPES OF MEMORY

The last two sections focused on nature of memory and the various models of memory. In this section, we will continue with the different types of memory.

4.4.1   Semantic Memory

Semantic memory is like the knowledge of the world. So, it may include knowledge about culture, history, sports, music, etc. This kind of memory tends to encode, store or organize, retrieve information (knowledge of the world) in the memory according to its meaning. This also talks about how the information is related to other kinds of information that already exists in the memory. There is very little forgetting when information is stored according to the meaning, or logical hierarchies, or semantically (Quillian, 1966). Closely related, but different type of memory is **lexical memory.** It is the representational system for the words of our language. Psycholinguists are interested in the structure of lexical memory.

4.4.2   Sensory Memory

Sensory memory, which is also known as 'fleeting memory' sometimes, is closely related to the process of perception. It is responsible for keeping a record of our percept for very brief period of time. It is important to note here that our sensory register works as a memory system. The information from environment first reaches sensory memory and if required attention is given to the information, it moves to other memory systems. It can store information only for a fraction a second to allow cognitive processing. Psychologists have argued that there is visual sensory memory, an auditory sensory memory, an olfactory (smell) sensory memory, a gustatory (taste) sensory memory, and a tactile (touch) sensory memory. However, a bulk of literature is available on *iconic* sensory memory; that is memory for visual inputs and *echoic* sensory memory, memory for auditory inputs. Some people also have *eidetic imagery* or *photographic memory* which is a rare ability to access a visual memory over long period of time. George Sperling (1960) was credited for conducting classic experiments on sensory memory.

Box 4.2: Sperling's Sensory Memory Experiments

Cognitive psychologist George Sperling (1960), in his classic experiment demonstrated the hypothetical existence of iconic memory (visual sensory memory). Participants were shown a matrix of 12 letters (4x3 grid) for a brief time (50 msec). Participants were asked to report in either whole-report technique or partial-report technique. In the former, the participants were asked to report all the letters of the matrix. But the participants could report only five letters. In the partial-report technique, the participants had to report the words, as per the tone that occurred just after the stimulus grid disappeared. The tone's volume was different for each line (high tone for top row, medium tone for middle row, and low tone for lowest row). Participants could report three words from each

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line, thus suggesting that nine letters were visible as compared to five in the whole-report condition. Thus, Sperling concluded that sensory memory is a low-level system separate from working memory.

4.4.3 Episodic Memory

The memories that are stored with respect to the time when they happened are known as episodic memory. The various episodes of our life experiences that are encoded, stored, retrieved memories in the LTM that are related to our personal individual experiences. They may have a reference to our past events or things that happened to us at particular times.

4.4.4 Autobiographical Memory

Figure 4.4: Our memories
Image Source: https://www.newscientist.com

As the name suggests, it is the memory of your own past events or personal experiences. Our autobiographical memory (AM) is generally accurate but sometimes it is also influenced by constructive nature of memory. But, do we remember life events from all periods of life equally? Studies have suggested that people from middle age remember life events from their youth period and early-adult period more vividly than their recent past (Read & Connolly, 2007). Marigold Linton (1975, 1982) did a classic study on AM using Ebbinghaus' method of introspection. She kept a diary for six periods, recording at least two events per day. She studied these recorded memories to understand the nature of AM.

4.4.5 False memory

As the name suggests, it is the memory of an event that never happened. It can be defined as "a mental experience that is mistakenly taken to be a veridical representation of an event from one's personal past" (International Encyclopedia of the Social & Behavioural Sciences, 2001). Also known as recovered memory or pseudo memory, these memories are very vivid and emotionally charged. In majority of the false memory cases, people were found to have memory associated with the act of childhood sexual abuse or violence. Various studies have suggested that our memory in not fixed and it can be easily manipulated through effective suggestion, such as during a session of psychotherapy. False memory syndrome is very relevant in the context of psychotherapy and forensic witness. In one such study, it was found that around 20 percent memory of the witnesses were false (Mazzoni, Scoboria, and Harvey, 2010).

4.4.6 Flashbulb Memory

Figure 4.5: 9/11 terrorist attack on twin towers of World Trade Centre, USA

Image Source: https://www.onthisday.com

What were you doing, when you first heard about 9/11 attack? What was your first reaction? Many people still have very clear memories of 9/11 attack. They could recall what they were doing when they first heard about it, from where they heard it, how they felt and other details vividly. So, what is so special about this memory? According to Roger Brown and James Kulik (1977), these memories are so vivid that it seems to be preserved and found to be quite accurate. In context of India, people old enough to recall assassination of Prime Minister Indira Gandhi or Rajeev Gandhi may have flashbulb memories of these events.

What are the reasons for such vivid memories of an event? Studies have pointed out a number of factors like, emotional intensity of the event (Bohannon, 1988). Another view suggests that because of the significance, we retell our experiences leading to frequent rehearsal and thus making those memories more accurate and vivid even after many years (Bohannon, 1988).

Box 4.3: Retrieval Processes: Recall and Recognition

Recall and recognition are two processes with the help of which we may retrieve information. In recall, the information is retrieved without the help of external cues. For instance, from where did you do your schooling. Similarly, essay-type questions, short-answer, fill in the blanks, are examples of recall. An important feature of recall is *serial-position effect* (Murdock, 1962). The information in the beginning and at the end is remembered more accurately than the information present in the middle. *Primacy* and *recency effect* are also interesting features of recall. The former is the tendency to remember words that occur in the beginning and the latter is the tendency to remember information that is presented at the last (the information is still there in short-term memory to be retrieved) (Craik,1970, Murdock, 1962).

Recognition is a process where the information is matched to what is there in the memory. For instance, multiple-choice questions, matching, true-false. It is easier than recall, since the cues are present. An interesting feature in recognition is *false positives*, when a person thinks that she/he has recognized or recalled some information but infact , it is not there in memory.

4.5 FORGETTING

Why do we tend to forget the names of the people we just met? Or why do we forget the phone number we just dialed few minutes ago? We all have experienced forgetting in one's day to day life, but what are the causes behind it? Psychologists have defined **forgetting** as our inability to recall already encoded and stored information from our memory system.

To understand the nature of forgetting, Hermann Ebbinghaus, a German psychologist (discussed in the first section), conducted the first systematic experiment in 1879. He created many CVC (constant vowel constant) nonsense syllabuses such as NAK or PUD and administered on himself (The method of conducting experiment on one self only and using your own experience is known as *introspective method)*. To investigate the nature of memory and forgetting, first he memorised lists of nonsense syllabus until he had reached a pre-defined criterion and then measured the number of syllables retained by him after variable time interval. Further, he also noted the number of trials taken by him to relearn the same list of syllables again at variable time interval. Based on his observations, he came up with the following curve (see Figure 4.6) for explaining the nature of forgetting;
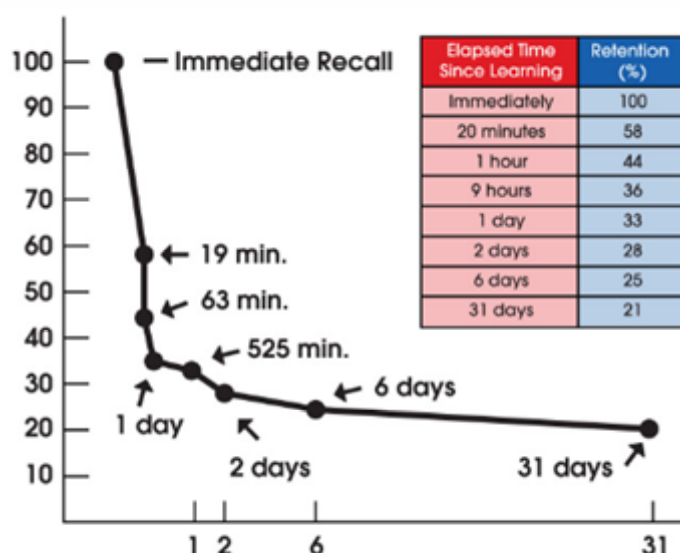
Figure 4.6: Ebbinghaus forgetting curve
Image Source: http://www.keyandparent.com

This curve is famously known as *Ebbinghaus forgetting curve*. You can see from the graph that the rate of forgetting is the maximum in the starting but after a few hours it becomes slow. Recent studies have reported similar results.

Main theories available in the literature, explaining the causes of forgetting are as follows:

a) *Theory of Interference*

According to this theory, forgetting occurs due to interference with other memories. This interference can be of two types:

Proactive Interference (Pro=forward) - Forgetting of newly acquired information due to interference from previously learned information.

Retroactive Interference (Retro=backward) - Forgetting of previously stored information due to learning of new information.

The experiments of the both types may be conducted in the following manner:

Retro-active inhibition

Groups	Original Learning	Interpolated Activity	Recall
Control	Learning of list A of 10 Nonsense syllables	Rest for 5 minutes	List A
Experimental	Learning of List B of 10 Nonsense syllables	Learning of list C of 10 Nonsense syllables for 5 minutes	List B

Pro-active inhibition

Groups	Original Learning	Interpolated Activity	Recall
Control	Learning of list A of 10 Nonsense syllables	Rest for 5 minutes	List A
Experimental	Learning of List B of 10 Nonsense syllables	Learning of list C of 10 Nonsense syllables	List C

b) *Trace Decay Theory*

It is an older theory, also known as disuse theory. Trace decay theory proposes that learning causes change in the central nervous system leading to the formation of *memory traces* or physical changes in the brain due to learning (Brown, 1958). When these memory traces are not used for long time, they fade away leading to forgetting. Thus, the underlying mechanism of this theory is "use it or lose it", i.e., if you do not use your stored information at regular interval of time, then you may be at the risk of losing it.

c) *Cue Dependent Forgetting Theory*

According to this theory, forgetting can also occur due to the absence of an appropriate cue or presence of poor cue. Suppose you were given a list of objects to buy from the market. By mistake, you lost the list. Now, you are trying your best to recall all the items from the list, but there are good chances that you will forget many. Studies have suggested that if participants were given hint or cue about the category of those items, then it improved their recall. Studies have even suggested that the physical attributes of the environment also play a positive role in retrieval.

d) *Encoding failure*

As discussed in the earlier section, encoding is an important process in memory. There are many events or objects that are not encoded properly and do not go beyond sensory memory. Thus, it results in failure to process information to memory. Encoding failure is also one of the reasons why people forget things.

Check Your Progress 2

1) Define sensory memory.

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2) What is autobiographical memory?

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3) What is Ebbinghaus forgetting curve?

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4.6 TECHNIQUES TO IMPROVE MEMORY

There are various techniques to improve memory. Different techniques are used for different circumstances. There are four broad principles that govern the memory techniques. They are as follows:

1) Process for meaning: As you learn new material, focus should be on the meaning of the stimuli. To achieve this, one should avoid distraction. In the presence of distraction, we loose our attention towards meaning in what we want to learn and remember.

2) Retrieval process: This is related to retrieval practice. Generate and practice the items that you need to remember from memory rather than read or restudy. Self-testing is the best retrieval practice.

3) Metamemory: It is the awareness and knowledge of our own memories. It helps in reflecting and monitoring memory. This way, it may help in strategic planning, allocation of study hours/resources, evaluation of performance, etc.

4) Distributed learning or practice: This is a superior method than massed practice (also discussed in the first section). So, one should avoid cramming because it is an inefficient way of learning. Distributed practice helps in improved memory efficiency.

Now, let us examine some techniques that aid in retrieving the information and also reduce the amount of forgetting. These are known as **mnemonic** (pronounced as ni-mo-nicks) **aids.**In this section, we will discuss about mnemonic methods or techniques of enhancing memory. There are basically two broad categories of mnemonics; one category of mnemonics uses images, while other uses principles of organization to memorise information.

4.6.1 Mnemonics Using Images

There are many strategies which uses images to improve efficiency in retaining and retrieval of information. Following two types of mnemonics use images:

1) *Method of Loci: Placing images at location*

Loci (pronounced as low-sye), is the plural form of "Locus", which refers to position or place. This method uses the location of a familiar place as a cue to retrieve information. Now suppose, you want to learn a list of objects that you want to buy from a nearby grocery store. The lists contain items like, egg, tomato, pen, washing powder and salt. Now to remember these items, first, visualise each of them to be located in some separate spatial location, such as, in different rooms of your house. Then, mentally go through your house visualising each item in a separate place. After reaching the market, all you need to do is to take another mental tour of your house and recall the items you have placed in different location in a sequence.

2) *Keyword method*

The keyword method is considered appropriate for learning vocabulary and foreign language. In this method, any two pieces of information is linked using images. Now suppose, you want to extend your vocabulary for English language. You come across a word "scowl" which stands for "an angry or bad-tempered expression". In order to learn its meaning, first you need to find a *keyword*, a familiar word that sounds similar to the *target word*, scowl. Now, using an image try to relate your target word with keyword. Since, the word 'scowl' sounds similar to owl, you can imagine a picture of owl with angry expression. Studies have suggested that this method of learning definition or vocabulary is far more superior than rote learning.

Figure 4.7: An owl with angry expression
Image Source: https://pixabay.com

4.6.2 Mnemonics Using Organisation

It improves the ability to learn and retrieve information accurately by applying the principle of reorganization of the material to be learned. In this section, we will discuss two types of mnemonics:

1) *Chunking*

It is a method of combining smaller units into meaningful larger units, such as, if you were asked to remember following series of number

1-9-3-9-1-9-4-5

If you are well versed with world history, then, you can also group these numbers in the following ways;

1939-1945

Second World War started in 1939 and ended in 1945. In this way, you can memorise as well as recall these numbers more accurately. You can also chunk information by using it in a sentences, songs or phrases.Therefore, it can be suggested that it is another way to remember large information. The items are grouped together according to some similarity or common theme at the time of encoding. So, it is easier to recall a chunk of information than individual bits.

2) *First Letter Technique*

In this technique, first letter of each word, you want to memorise, is taken to make a meaningful word or sentence. For example, colour of the rainbow can be remembered using this technique.

Violet

Indigo

Blue

Green

Yellow

Orange

Red

The word VIBGYOR stands for all the seven colours of rainbow.This method is also known as "acronyms", when the word is formed by taking the first letter or groups of letters from a name or phrase to be remembered. It helps in remembering the names of the events or the music notes with ease.

3) *Rhymes*

This involves using a similar sounding word at the end of each line of a verse. This enables to encode the information acoustically.

4.7   SUMMARY

Now that we have come to the end of this unit, let us recapitulate all the major points that we have covered.

●   Memory refers to the ability of retaining information and reproducing it over a period of time when required to perform a cognitive task. It has been conceptualised as a process comprised of three stages; (i) encoding, (ii) storage, and (iii) retrieval.

●   Information processing model was given by Atkinson and Shiffrin in 1968. According to this model memory consist of three stores or subsystem namely, the sensory memory, short-term memory, and long-term memory.

- Levels of Processing (LOP) model of memory was proposed by Craik and Tulving in 1975. According to this model, whether information will be retrieved successfully or not depends on its level of processing. LOP refers to the level at which information have been encoded. Craik and Tulving (1975) proposed three LOP; physical/structural processing, phonological processing, and semantic processing.

- Baddeley proposed a model for Working Memory (WM). According to his model, WM consists of four components namely, the *central executive,* the *phonological loop,* the *visuospatial sketch pad,* and the *episodic buffer*.

- There are various types of memory namely, semantic memory, sensory memory, episodic memory, false memory, and flashbulb memory.

- Forgetting can be defined as our inability to recall already encoded and stored information from our memory system.

- To understand the nature of forgetting, Hermann Ebbinghaus, a German psychologist, conducted first systematic experiment in 1879.

- The main causes of forgetting are explained in terms of theories, namely, *theory of interference, trace decay theory, cue dependent forgetting theory* and *encoding failure.*

- There are various techniques to improve our memory. These techniques are primarily based on the principles of *process for meaning, retrieval practice, metamemory* and *distributed learning or practice.* The main technique to enhance memory is known as mnemonics. There are two broad categories of mnemonics, one category of mnemonics uses images (*Method of Loci and Keyword method).* Whereas, the other method uses principles of organization to memorise information (*chunking, first letter technique, and rhymes).*

4.8   REVIEW QUESTIONS

1) The tendency for prior learning to inhibit recall of later learning is called _____ .

   a) Encoding failure

   b) Repression

   c) Retroactive interference

   d) Proactive interference

2) A distinction is made in memory research between .... memory and .... memory. The former refers to ...., whereas the latter refers to ....

   a) Semantic; short-term; memory for personally meaningful events; memory held in temporary storage

   b) Episodic; autobiographical; memory for personally meaningful events; memory for general knowledge

   c) Semantic; procedural; memory for general knowledge; memory for personally meaningful events

   d) Semantic; episodic; memory for general knowledge; memory for personally meaningful events

3) The storage capacity of long-term memory is best described as

   a) A single item

   b) About seven items

   c) About seven volume

   d) limitless

4) The first step in placing information into memory storage is

   a) Mnemonics

   b) Short-term memory

   c) Sensory memory

   d) Rehearsal

5) .... determines what information moves from sensory memory to short-term memory.

   a) Encoding failure

   b) Selective attention

   c) Repression

   d) Eidetic encoding

6) Describe the nature and types of memory.

7) Explain Baddeley's theory of working memory.

8) Differentiate between autobiographical memory and false memory.

9) What do you mean by forgetting? Explain any two causes of forgetting.

10) Explain information processing model of memory.

11) Elucidate different techniques to improve memory.

12) Differentiate between episodic memory and semantic memory.

4.9 KEY WORDS

Memory	:	It refers to the ability of retaining information and reproducing it over a period of time when required to perform a cognitive task.
Forgetting	:	It is our inability to recall already encoded and stored information from our memory system.
Method of Loci	:	It is a method of enhancing memory. It uses the location of a familiar place as a cue to retrieve information.
Chunking	:	It is another memory of remembering and recalling information correctly. In this method, smaller units of information are combined into meaningful larger units.

Autobiographical memory	:	It is the memory of your own past events or personal experiences.
Working memory	:	It can be defined as a limited-capacity system for temporary storage and manipulation of information for complex tasks such as comprehension, learning, and reasoning.
Encoding	:	It is the process of converting sensory information into a form that can be processed further by the memory systems.
Retrieval	:	It refers to locating and bringing the stored material to one's awareness when required to complete a task.

4.10 REFERENCES AND SUGGESTED READINGS

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4.12   ONLINE RESOURCES

- For more understanding on the theory of level of processing, visit

  - http://shodhganga.inflibnet.ac.in/bitstream/10603/41677/9/09_chapter%202.pdf

  - https://www.instructionaldesign.org/theories/levels-processing/

  - http://wixtedlab.ucsd.edu/publications/Psych%20218/Craik_Lockhart_1972.pdf

- For more understanding on Baddeley's working memory, visit

  - http://www.csuchico.edu/~nschwartz/1.%20Working%20Memory%20-%20Theories%20and%20Models%20and%20Controversies.pdf

  - https://app.nova.edu/toolbox/instructionalproducts/edd8124/fall11/1974-Baddeley-and-Hitch.pdf

  - https://www.cs.indiana.edu/~port/HDphonol/Baddely.wkg.mem.Science.pdf

  - https://www.unige.ch/fapse/logopedie/files/1914/1285/1086/article1-barrouillet.pdf

- For a glimpse on how false memory can influence one's life and judiciary system, visit

- https://www.wired.co.uk/article/false-memory-syndrome-false-confessions-memories

- https://www.theguardian.com/science/2017/sep/23/inside-case-of-repressed-memory-nicole-kluemper

- https://www.theguardian.com/science/2010/nov/24/false-memories-abuse-convict-innocent

- https://www.independent.co.uk/news/false-memory-ends-sex-assault-case-1354848.html

● For more understanding on forgetting, visit

- https://courses.lumenlearning.com/boundless-psychology/chapter/the-process-of-forgetting/

- http://thepeakperformancecenter.com/educational-learning/learning/memory/forgetting/

- http://psychologyrats.edublogs.org/files/2012/02/Unit_3_2012_INSJ_Theories-of-Forgetting-1612h26.pdf

- http://socialscientist.us/nphs/psychIB/psychpdfs/TheoriesofForgetting.pdf

● For more understanding on mnemonics memory strategies, visit

- https://www.memory-key.com/sites/default/files/books/mnemonics.pdf

- http://www.ucdenver.edu/life/services/LRCOLD/Documents/Self-paced%20trainings/memory%20Techniques-%20student%20version.pdf

- http://thepeakperformancecenter.com/educational-learning/learning/memory/memory-techniques/

- https://www.mobap.edu/wp-content/uploads/2013/01/memorystrategies.pdf

Answers of Multiple Choice Questions

(1) d, (2) d, (3) d, (4) c, (5) b