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Course Name: Master of Social Work

Paper Code: 102

Subject: Personality Development and Human Behavior

UNIT 2 SENSATION AND PERCEPTION*

Structure

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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.

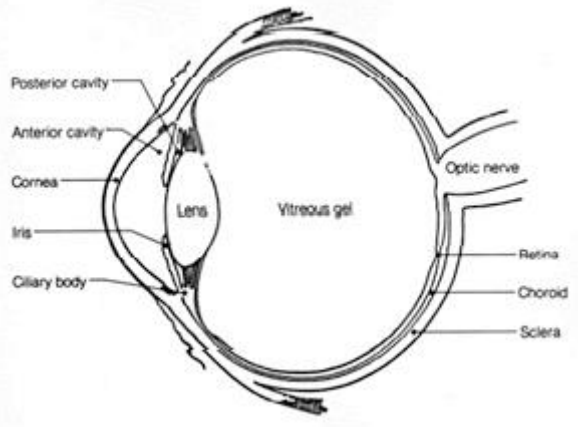

Fig.2.1: Diagram of the eye

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)

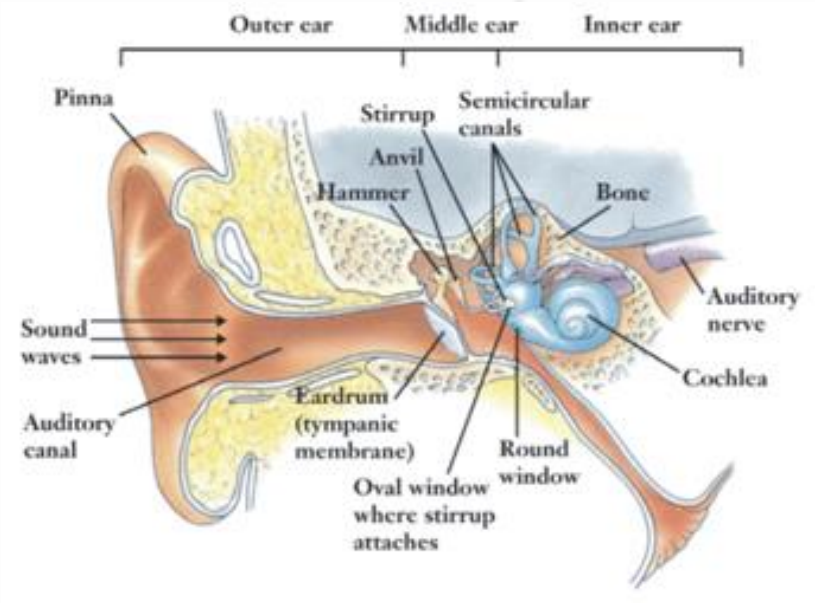

Fig. 2.2: Structure of Ear

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.

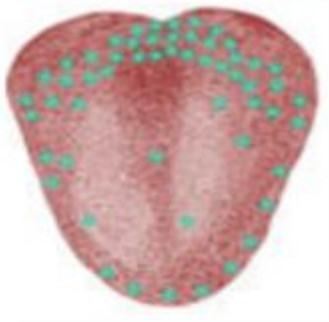

Fig. 2.3: Tongue Diagram

Fig. 2.4: Bitter Taste Buds

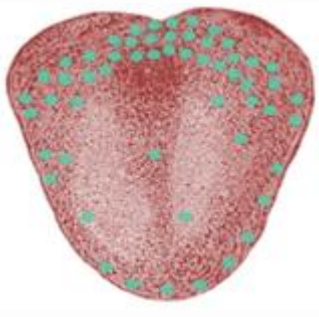

Fig. 2.5: Salty Taste Buds

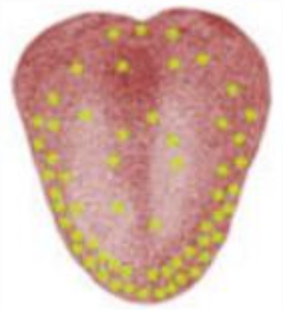

Fig. 2.6: Sour Taste Buds

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 injuryand 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.

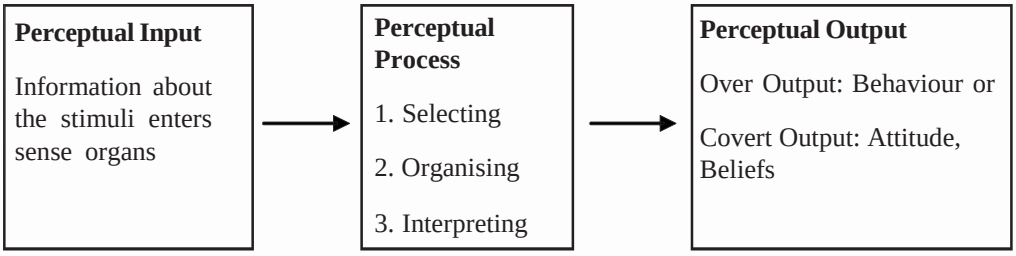

Figure 2.9: Process of Perception

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.

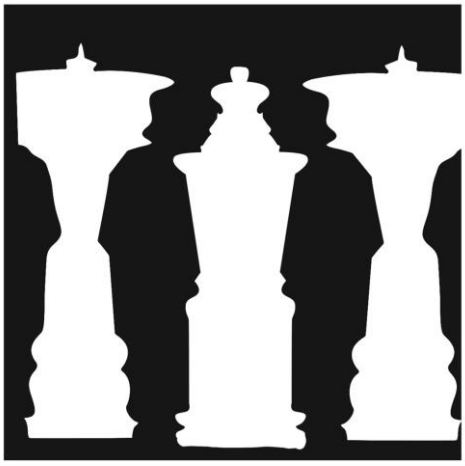

Figure 2.11: An example of figure-ground relationship

b) Law of Proximity

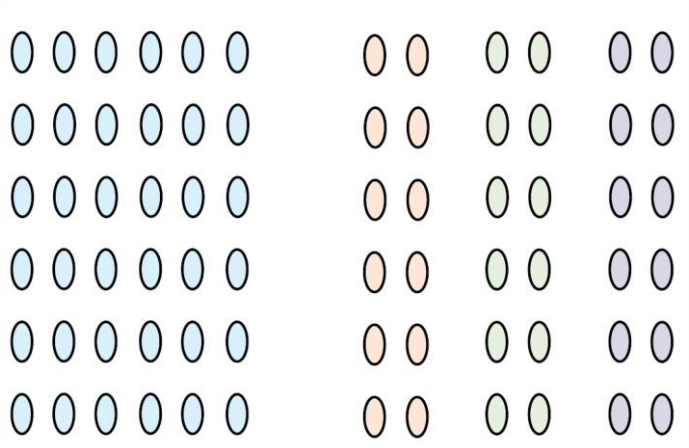

Figure 2.12: The Gestalt principle of proximity

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

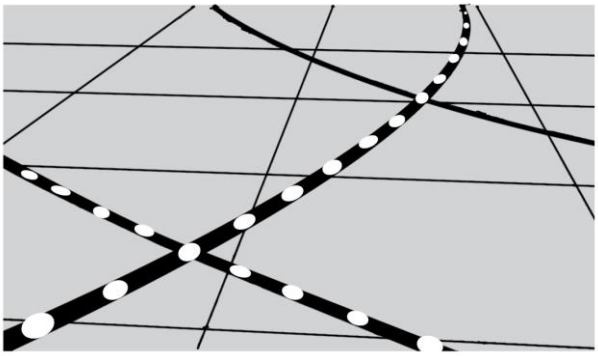

Figure 2.14: An example of law of continuation

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

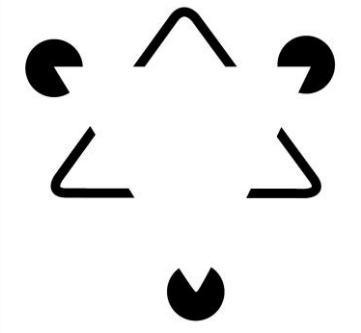

Figure 2.16: An example of law of closure

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

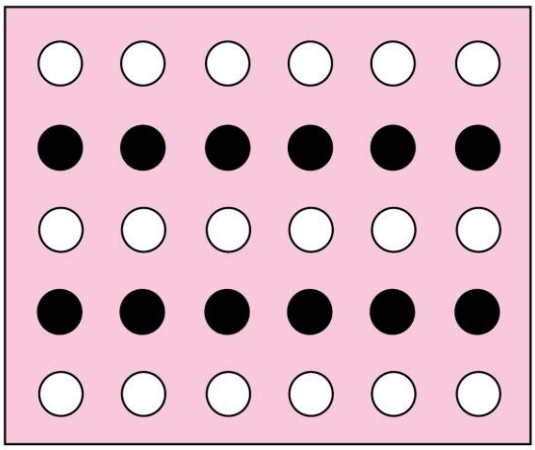

Figure 2.17: The Gestalt Principle of Similarity

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;

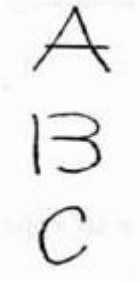


Figure 2.19: Stimulus used in second condition by Bruner & Minturn in their experiment
Image Source: https://www.simplypsychology.org

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?

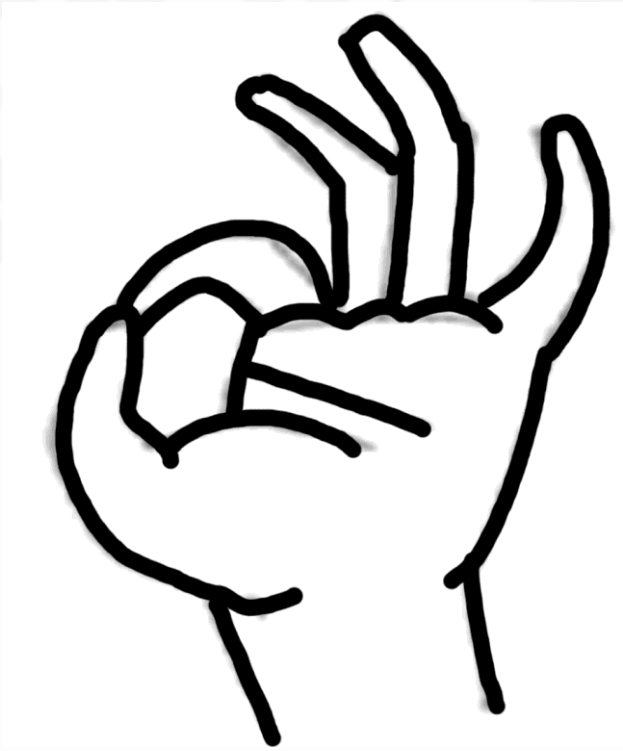


Figure 2.22: A hand gesture

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).

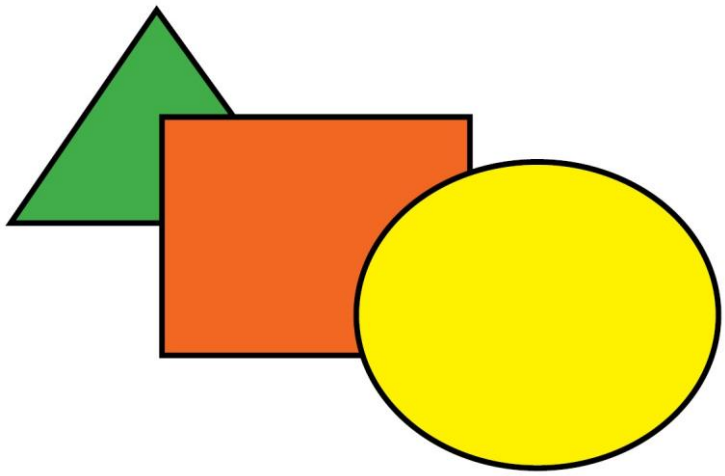


Figure 2.28: An example of occlusion

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).

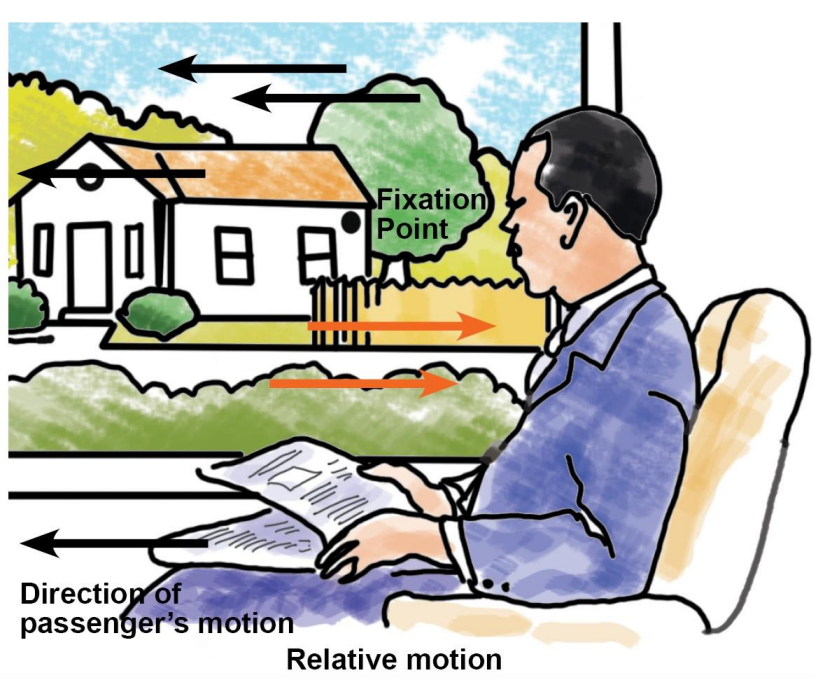
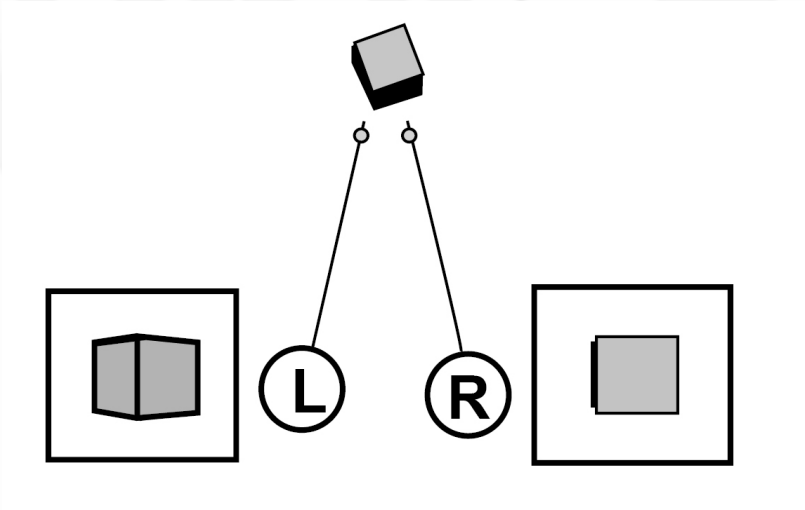


Figure 2.29: Train travel and Motion Parallax

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

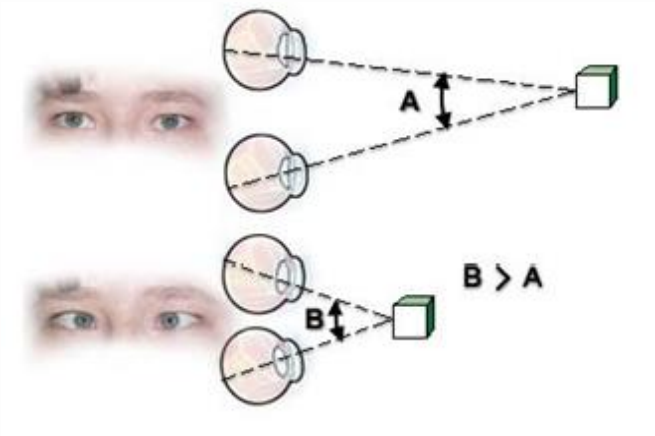


Figure 2.31: Two convergence angles formed by our eyes
Image Source: https://psychlopedia.wikispaces.com

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^o 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:

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

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

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)?

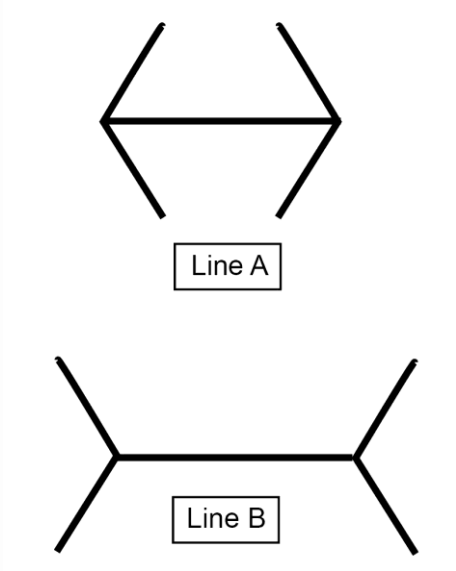


Figure 2.32: Muller-Lyre Illusion

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

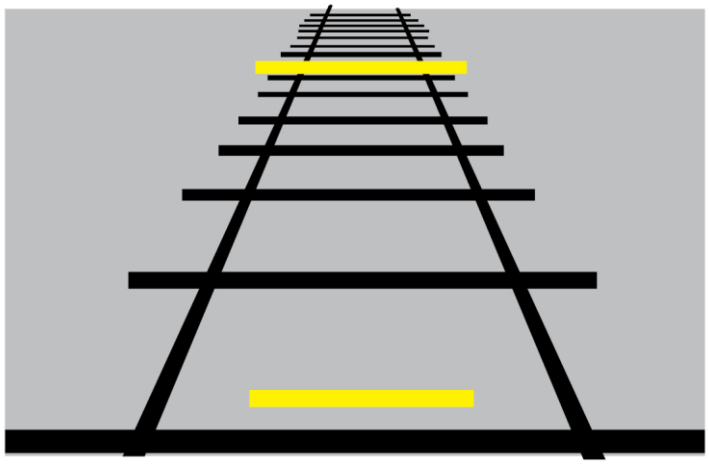


Figure 2.33: The Ponzo Illusion

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)?

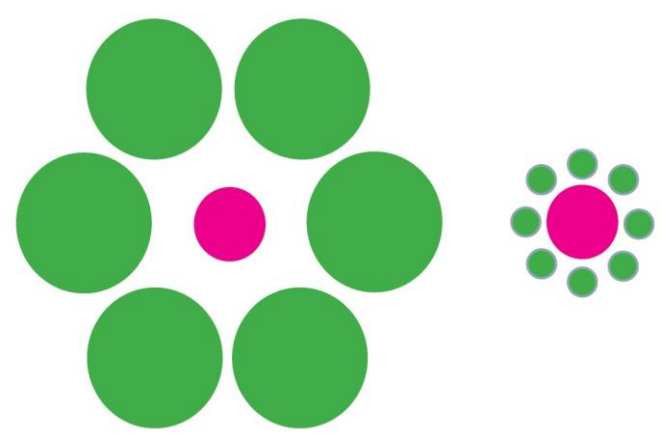


Figure 2.34: The Ebbinghaus Illusion

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.

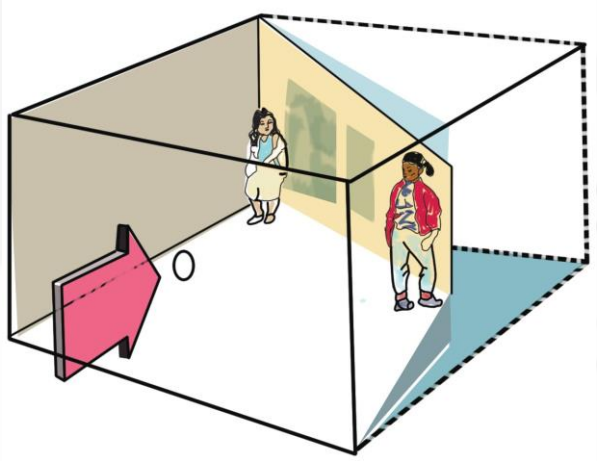


Figure 2.35: The Ames Room Illusion

5) The Moon Illusion

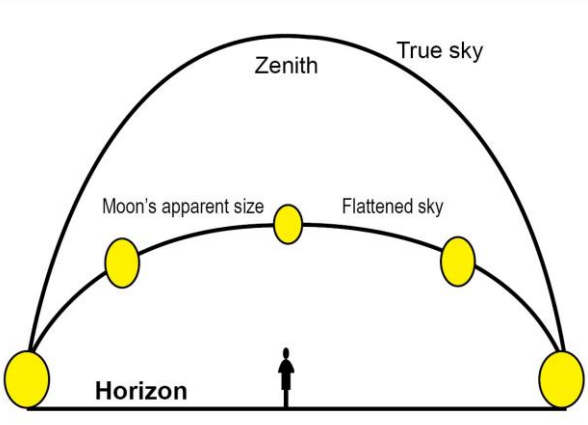


Figure 2.36: The moon Illusion

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**

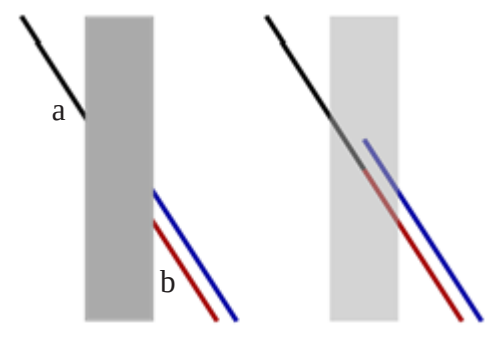


Figure 2.37: Poggendorff Illusion
Image Source: https://commons.wikimedia.org/wiki/

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

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/2a9b3ed3defe86059a3ac180a188fad53aff.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)