they are used interchangeably as they are highly interrelated, however, there is a difference between them as well. Growth refers to clearly measurable or specific change which is quantitative in nature, such as growing tall, an old man growing a beard, etc. On the other hand, development includes qualitative changes or increase in capacity. It is not as obvious as growth. Examples of development include remarks such as, 'she has become a fine young woman', 'he has developed his talent in music very well', 'my father enjoys doing social work now because he has retired', etc. All these illustrate changes in personality, interest and abilities. Thus, development is a broader term and growth is one of ts aspects.

How development occurs

Development occurs through two main processes, viz., maturation, and learning. Maturation refers to the unfolding or gradual opening-up to traits or potentials present in an individual because of genetic inheritance. It is the net result of what one possesses genetically. Learning takes place as a result of a child's interaction with the environment which then brings about a change in his behaviour. For example, a baby matures as he starts to teeth ot starts walking. However, when a child performs a specific dance or sings a particular song, it is an act of learning.

Maturation and learning occur side by side and each one influences the other. In fact, maturation is often promoted by environmental learning; for example, a person's cognitive abilities' development depends on the opportunities and experiences arranged through maturation as well as by the environment.

It can be concluded that the raw material for learning is provided by maturation, i.e. no amount of effort on the part of the individual can bring desired results if the inherited trait has limited potentialities for development. Thus, everyone cannot become international athlete by putting in only effort, the genes in a person must contain the potential that will outstand physical abilities. Hence, the following could be concluded:

- Development occurs with the help of both the processes—learning and maturation.
- The genetic raw material that an individual has causes maturation.
- Behavioural changes occur due to learning or interacting with the environment by doing different activities.
- Learning and maturation are complementary processes.

2.3.1 Growth Curve

We have already learnt that 'growth' is measurable and can be represented quantitatively. Let us see what the pattern of growth is in the course of the human life span, that is, let us try to answer the following questions:

(i) Are there any stages of rapid growth?

(ii) When does maximum growth occur?

(iii) Does the pattern of growth changes from one stage to another stage?

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The growth curve helps us to answer all these questions. It basically shows the relationship between the percentage of growth and age in years.

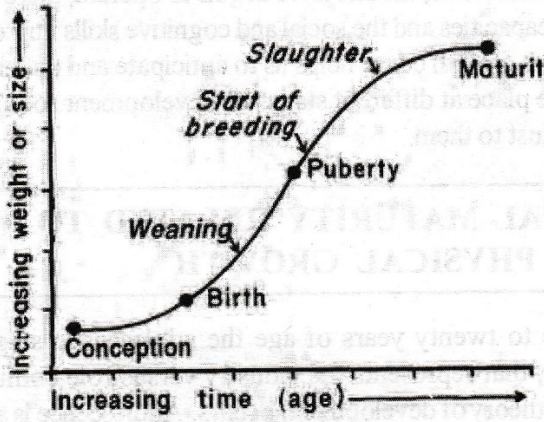

Fig. 2.1 Growth Curve

In Figure 2.1, X-axis represents the age in years and Y-axis represents percentage of growth. The slope of the curve shows the level and nature of growth. Figure 2.1 clearly shows quick growth in the first three years and that it is quicker in the first year. Then, the growth pace slows down from five years to approximately twelve years. This is called the plateau stage in which the child is probably assimilating and making sense of the growth experiences in the earlier years. The age between twelve years to eighteen years is again a stage of growth spurt in which rapid growth takes place. This is the stage of adolescence and takes place throughout, but the pace is slow. The growth curve is important as it indicates that growth is a continuous process with no breaks or discontinuities and that there are no sudden changes. Also, it shows that growth is an ongoing process throughout life. From the growth curve we can arrive Table 2.1 that identifies the descriptions of the different stages of development.

***Table 2.1** Stages of Development*

Stage	Age	Rate of growth
Infancy	Birth to 1 year	Very rapid
Early Childhood	1-3 year	Rapid
Middle Childhood	3-5 year	Somewhat rapid
Late Childhood	5-12 year	Plateau Stage
Adolescence	12-18 year	Very rapid
Adulthood	18 and above	Growth spurt stage (Gradual increase in growth)

The three stages of maximum growth are infancy, early childhood and adolescence. This is evident from the nature of skills acquired during these stages.

NOTES

There is improvement in cognitive skills, language acquisition and considerable psycho-motor development in infancy and early childhood. There are rapid body changes in adolescence, the sex drive begins to operate, there is gradual increase of all human capacities and the social and cognitive skills improve. In short, it can be said that the growth curve helps us to anticipate and understand the changes that may take place at different stages of development so that we could better adapt and adjust to them.

2.4 SOCIAL MATURITY RELATED TO MENTAL AND PHYSICAL GROWTH

From twelve to twenty years of age the adolescence stage of growth and development, that represents the industry versus role confusion stage of the psychosocial theory of development, occurs. Adolescence is a transitional stage between childhood and adult life and is characterized by rapid physical growth and mental, social and psychological maturity. The stage officially starts at puberty and ends with the person achieving a level of maturity that makes him deal with and manage realities of life and when he is able to bear responsibility of him/her self and his/her actions. A child faces many developmental tasks, such as developing morals, attitudes and values needed for functioning in society, developing appropriate relationships with males and females of the same age, accepting changes in the body and appearance, becoming independent from parents and adults, and accepting the male and female role appropriate for one's age. Adolescence is thought to be a period of emotional turmoil and rebellion, shifting ideologies and clashes with authority and sudden mood changes. During adolescence, although emancipation from parents for achieving independence and learning to accept responsibility for oneself takes place, an adolescent still fluctuates between child-like dependency and stubborn independence. An adolescent is ambivalent, in this critical stage as he/she does not want to be controlled by adults but want to be guided. Also, sudden mood fluctuations are common and erratic behaviour could be related to it. In the process of socialization and social interaction, peer groups play a critical role. Self concept is gradually acquired as a result of reactions of an adolescent's peers towards him. As previously mentioned, an adolescent undergoes active mental maturity since he becomes capable of more than abstract mode of thinking and the capacity of receiving new information reaches its peak. This sort of development results in endless speculations about abstract issues. In spite of that, the adolescent still feels uncertain, i.e., lacks the ability to direct himself/herself and the confidence to translate his/her thoughts and ideas into a definite course of action. Persistent pretended wisdom and arguing are characteristics of adolescents. Moreover, an adolescent rethinks about matters of life. By the end of this stage, what an adolescent needs is to find out the type of person he/she is and what his/her abilities and limitations are. Therefore, this stage can also be called the period of readjustment.

Check Your Progress

1. What is the importance of the growth curve?
2. Define maturation.
3. What are amines?
4. What is nurture?
5. Define nature.
6. State whether True or False:
   (i) Maturation and learning are two separate process and have no connection with each other.
   (ii) Genes decide the upper limit of attaining development.
   (iii) All changes which occur as a result of development are of the same kind.
   (iv) According to growth curve, growth is an ongoing process.
   (v) The two period of maximum growth are early childhood and adolescence.
   (vi) Growth stops during the adult years.

2.5 PHYSIOLOGICAL BASIS OF BEHAVIOUR

2.5.1 The Brain and the Nervous System

- **Nervous system:** It is an extensive of billions network of specialized cells that are interconnected and carry information to and from all parts of the body. Four extraordinary characteristics allow the nervous system to direct our behaviour, which are as follows:
  - **Complexity:** The brain itself is composed of billion of nerves cells. The orchestration of all these cells allows people to sing, dance, write, talk and think.
  - **Integration:** The brain does a wonderful job of putting information together, such as sound, sight, touch, taste and environment. Each nerve cell communicates on average with 10,000 others, making up miles and miles of collection (F.E. Bloom, C.A. Nelson and A. Lazerson, 2001; M.H. Johnson, 2003). Interconnected nerves cells relay information through the nervous system in a very orderly fashion to the highest level of the brain (C. Blair, 2002).
  - **Adaptability:** Our brain and nervous systems together help in adapting to the world. Although nerve cells reside in certain brain regions, they are not fixed and immutable structures. They have a hereditary, biological foundation, but they are constantly adapting to changes in the body and the environment (Wilson, 2003).

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- **Electrochemical transmission:** Brain and nervous system function essentially as an information processing system, powered by electrical impulse and chemical messengers, when people speak to each other, they use word. Brain and the nervous system receive and transmit sensory input, integrate the information received from environment and direct the body's motor activities. Information flows into the brain through sensory input, becomes integrated within the brain and then moves out of the brain to be connected with motor output (S.M. Enger and R.K. Ross, 2003).

Figure 2.2 shows the division of nervous system into central and peripheral nervous system (PNS).

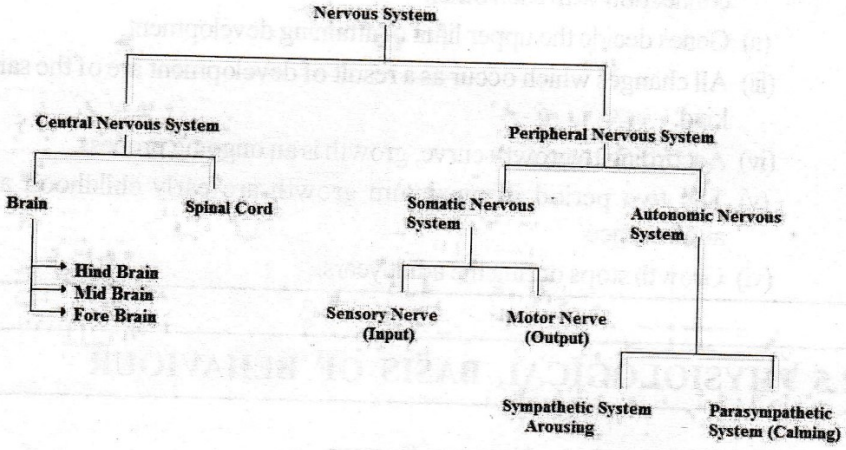

Fig. 2.2 The Nervous System

Decision-making in the nervous system occurs in specialized pathways and the network that carried different functions. Sensory nerves carry information to the brain. Then sensory pathways communicate information about external and bodily environment from sensory receptors into and throughout the brain.

There are two types of cells in the nervous system i.e. neurone and glial cells. Neurons are the nerve cells that actually process information. Glial cell provide support and nutritional benefits to neurons (Greg Lemke, 2001; T.D. Raabe and others, 2004).

- **Neurons:** Not all neurons are alike. They are specialized to handle different information processing functions that are as follows:
  - **Motor neuron:** Motor neurons carry the brain's output. Thus, motor pathways communicate information from the brain to the hands, feet, and other areas of the body.
  - **Neural network:** It is the central nervous system (CNS) and network of nerve cell that integrate sensory input and motor output (Kimoto and Okada, 2004; Mingolla, 2002).

Every neuron has the following three main parts:

- **The cell body:** It contains the nucleus which directs the manufacture of substance for the growth and maintenance of neuron.
- **Dendrites:** They receive and orient information towards the cell body. The dendrites are attached to the cell body or soma, which is the part of the cell that contains nucleus and keep the entire cell alive and functioning.
- **The axon:** It is a fibre attached to the soma, and its job is to carry messages out other cells.

Neurons are very thin cellular membranes that are much like the surface of a bubble. It has a semi-permeable membrane which contains tiny holes, channels that allow only certain substance to pass into and out of the neurone. Myelin Sheath, a layer of fat cell, encases and insulates most axon. By insulating axon, myelin sheath speeds up the transmission of nerve impulses (Mattson, 2002; Paus and others 2001).

- **The neural impulse:** A neuron sends information through its axon in the form of brief impulse, or waves of electricity. The term action potential is used to describe the wave of positive electrical change that sweeps down. It is abided by the all or none principle.
- **The synapses:** The nerve impulse reaches the synaptic knob, triggering the release of neurotransmitter from the synaptic vesicles, the molecules of neurotransmitter cross the synaptic gap to fit into the receptor sites that fit the shape of the molecule.
- **Axon:** Branches out into numerous fibres that store substances called neurotransmitters transmit, or carry, information across the synaptic gap to the next neuron.
- **Neurochemical messengers:** There are many neurotransmitters. Each play a specific role and function in specific pathway. Following are the most important and have major effect on our behaviour:
  - ***a. Acetylcholine (ACH):*** Found throughout the central and peripheral nervous systems.
  - ***b. GABA (Gamma Amino Butyric Acid):*** It is found throughout the CNS. It is important as it keeps neuron from firing.
  - ***c. Nor epinephrine:*** It inhibits the firing of neurons in the CNS, but it excites the heart muscle.
  - ***d. Dopamine:*** It helps to control voluntary movement. It also affects sleep, mood, attention and learning. (A. Razmy, A.E. Lang, C.M. Shapiro, 2004)
  - ***e. Serotonin:*** It primarily inhibits and regulates sleep, mood, attention and learning.
  - ***f. Endorphins:*** They are natural opiates that mainly stimulate the firing of neurons (Speten and others, 2002).

NOTES

g. Neural networks: They work together to integrate incoming information and coordinate outgoing information.

2.5.2 Central Nervous System

The central nervous system (CNS) is composed of the brain and the spinal cord both the brain and spinal cord are composed of neurons and glial cells that control the life sustaining functions of the body as well as thoughts, emotions and behaviour. More than 99 per cent of cells in the body are located in the CNS. Brain consists of three major regions of the brain—the hind brain, mid brain and forebrain. Another important part is the spinal cord.

- **Hind brain:** It is located at the lowest portion of the brain. Three main parts of the hind brain are the medulla, cerebellum and pons.
  - o **Medulla:** It is located at the top of the spinal column. It helps in controlling our breathing and regulates reflexes that allow us to maintain an upright posture.
  - o **Cerebellum:** The cerebellum extends from the rear of the hind brain, just above the medulla. It plays an important role in motor coordinations.
  - o **Pons:** It is a bridge in the hind brain that consists of several cluster of fibre involved in sleep and arousal.
- **Midbrain:** It is located between the hindbrain and forebrain in which many nerve fibre systems ascend and descend to connect the higher and lower portion of the brain. Midbrains relay information between the brain, eyes and ears. Parkinson disease, a deterioration of movement that produces rigidity and tremors, is due to the damage of the bottom of the midbrain.

  The important system in the midbrain are reticular formation, a diffuse collection of neuron involved in walking or turning to attend to a sudden noise (Sasaki, Yoshimura and Naito, 2004; Soja and others, 2001). The system consists of small group of neurons that use the neurotransmitters serotonin, dopamine, and norepinephrine. Although these groups contain relatively few cells, they send their axon to a remarkable variety of brain regions, perhaps explaining their involvement in high level, integrative functions (David Shier, Jackie Butler and Ricki Lewis, 1999).
  - o **Brain stem:** A region including much of the hind brain (it does not include the cerebellum) and the mid brain and is so called because it looks like a stem (N.R. Carlson, 2001).

    The brain stem evolved more than 500 million years ago (Rita Carter, 1998). Clumps of cells in the brain stem determine alertness and regulate basic survival function, such as breathing, heartbeat and blood pressure.
- **Forebrain:** The human hindbrain and midbrain are similar to other animals, it is the forebrain structure that mainly differentiate the human brain. It consists of the following

- **Limbic system:** It is a loosely connected network of structures under the cerebral cortex which is important in both memory and emotion. It has two principal structures, viz., the amygdala and hippocampus.

  The amygdala is individual in the discrimination of objects that is necessary for the organism's survival. It has special role in the storage of memory (D. Bannerman and other, 2002; P. Ryan and C. Cohen, 2004)
- **Thalamus:** The thalamus is in the forebrain at the top of the brain stem in the central case of the brain. It functions as a relay station to sort input and direct it to different areas of the cerebral cortex. It also has ties with the reticular formation.
- **Basal ganglia:** It is a large cluster of neurons under the cerebral cortex that control and coordinate voluntary movements.
- **Hypothalamus:** It is the forebrain structure involved in regulating, drinking, eating and sex. It directs the endocrine system through the pituitary gland, and monitors stress, emotion and reward. The left and right hemispheres resemble the halves of walnut. Each hemisphere processes information about the opposite side of the body.

  Certain areas of the hypothalamus are electrically stimulated, for example, a feeling of pleasure. Researches agree that the hypothalamus is involved in pleasurable feeling, but limbic system and bundle of fibres in the forebrain are also important in the link between brain and pleasure.

  The cerebral cortex, divided into two halves, is the highest region of the fore brain. Highest mental functions, such as thinking and planning take place in cerebral cortex. The cortex consists of a thick layer of dimly packed neurones. It has a large area that is to be fitted into the skull cavity and therefore it has a large number of turns and twists. The twists and turns make the structure look like hills and valleys, called gyri (Singular gyrus) and suki (singular sulcus)

The lobe of cerebral cortex

The cerebral cortex is divided into four lobes—frontal, occipital, parietal and temporal. The four lobes are defined as follows:

a. Occipital lobe: It is present at the back of the head and responds to visual stimuli. Different areas of the two occipital lobes are connected to process, like information as colour, shape and motion. A stroke in occipital lobe can cause blindness.

b. ***Temporal lobe:*** The portion of the cerebral cortex just above the ears. It is involved in hearing, language processing and memory.

c. ***Frontal lobe:*** The portion of the cerebral cortex behind the forehead is involved in the cortex of voluntary muscles, intelligence and personality.

d. ***Parietal lobe:*** It is located at the top and towards the rear of each hemisphere. It is involved in registering spatial location, attention and motor control.

NOTES

- **Spinal cord:** The CNS is made up of the brain and the spinal cord. Spinal cord is a long bundle of neurons that serves two vital functions for the nervous system. The outer section is composed mainly of axon and nerves that appear white, whereas the inner section is mainly composed of cell bodies of neurons that appear gray. The purpose of the outer section is to carry message from the brain down to the body. It has the shape of a pipe.

2.5.3 Peripheral Nervous System

This system consists of the group of neurones which transmit information between the CNS and rest of the body. The system senses and acts upon the external world. It consists of both sensory and motor neurons. Sensory neuron transmits incoming signals to the CNS. These signals originate in the receptor cells and are located in the sense organs like eyes and ears. Motor neurons that are found inside the spinal cord transmit outgoing signals from the spinal cord. The peripheral nervous system has two major divisions that are as follows:

(i) **Somatic nervous system:** It consists of sensory nerves, which convey information from the skin and muscles to the CNS about pain and temperature, and motor nerves directs muscles for different functions.

(ii) **Autonomous nervous system:** It takes messages to and from the body's internal organs, monitoring such processes as breathing, heart rate and digestion. The autonomies nervous system is divided into two parts tahtare as follows:

a. **Sympathetic division:** The sympathetic division of the autonomic nervous system is located on the middle of the spinal column—running from near the top of the ribcage to the waist area. It allows people to deal with all kind of stressful events.

b. **Parasympathetic division:** The neurons of this division are located at the top and bottom of the spinal column on either side of the sympathetic division neurons. It is responsible for most of the day-to-day bodily functions. It is responsible for involuntary functions like, beating of the heart, breathing and normal functioning of the digestive system.

CHECK YOUR PROGRESS

7. The nervous system is divided into two parts, what are they?
8. What are the two types of cells in the nervous system?
9. What are the three main parts of a neuron?
10. What are the three main parts of the hind brain?
11. What are the two divisions of PNS?

2.6 THE SENSORY PROCESS

NOTES

Our senses are our input system and constitute the means by which we determine the nature of the environment within which we exists and behave. At the biological level, sensory processes involved the sense organs and connected neural pathways which are concerned with the initial stages of acquiring stimulus information. The senses include vision, audition (hearing) olfactory (smell), gustation (taste), the skin senses, which include pressure, temperature and pain and the body senses.

External stimulus like light is received by a specific sense organ, that is, eye. There are specialized receptors within a sense organ that transform the physical energy into neural signal; this process is known as transduction. These receptions are then transmitted to the specific area in the brain. The pattern of neural activity is recognized by the specific sense organs. The sense organs pre-processes (encode) the information and transmits it to the specific area in the brain where encoded messages is decoded and further processed, which leads to perception following, which is the sequences of processing of stimulus information (refer Figure 2.3).

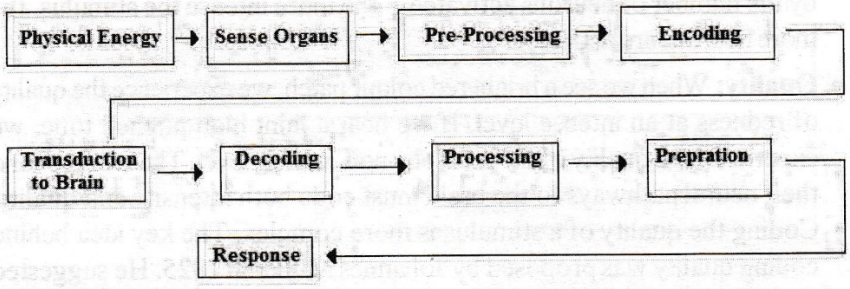

Fig. 2.3 Processing Sequence of Stimulus Information

2.6.1 General Characteristics of Sense (Sensory Modalities)

There are some characteristics that are common to all sensory modalities. Sensitivity describes sensory modalities at a psychological level, sensory coding described them at a biological level; other characteristics are also discussed as follows:

- **Sensitivity:** More intense a stimulus, the more strongly it affects the relevant sense organs. A bright light affects the visual system more than dim light. A basic way of assessing the sensitivity of sensory modalities is to determine the absolute threshold, the minimum magnitude of a stimulus that can be reliably discriminated from no stimulus at all. Our sensory modalities are extremely sensitive to the presences of or change in an object or event. The values were determined by using psychophysical procedure, a technique measuring relation between the physical stimulus and psychological response.
- **Sensory coding:** It determines how stimuli are transmitted from the sensory receptor to the brain. Each sense respond to a certain kind of stimuli—light energy for vision, mechanical energy for hearing and touch and chemical

energy for smell and taste. However, the brain understands only the language of electrical signals associated with neural discharge. Each sensory modality must perform physical transduction first. It must translate physical energy into electrical signals that can make their way to the brain. This is accomplished by specialized cells in the sense organ called receptor. A receptor is a specialized nerve cell or neuron. Numerous aspects of our conscious perceptions are caused by specific neural events in the receptor.

- **Intensity:** Intensity is an important property of stimulus that indicates how strong the stimulus is. The primary means of coding the intensity of the stimulus is via the number of neural impulses in each unit of time, i.e., the rate of neural impulse is generated in nerve fibre. The greater the intensity of the stimulus, the higher the neural firing rate and grater the firing rate, the greater the perceived magnitude of the stimulus. Our alternative for coding the intensity of a stimulus is by the temporal pattern or spacing sequence of the electrical impulse. At low intensities, nerve impulses are further apart in time and the length of the time between impulses is variable. At high intensities, the time between impulses may be quite instant. Another alternative is coding by the number of neurons activated—the more intense the stimulus, the more neurons are activated.
- **Quality:** When we see a bright red colour patch, we experience the quality of redness at an intense level. If we hear a faint high pitched tone, we experience the quality of the pitch at a non-intense level. The receptor and their neural pathways to the brain must code both intensity and quality. Coding the quality of a stimulus is more complex. The key idea behind coding quality was proposed by Johannes Muller in 1825. He suggested that the brain can distinguish between information from different sensory modalities, such as lights and sounds because they involved different sensory nerve (some nerves lead to visual experience, other to auditory experience and so on)

2.6.2 The Five Senses

These sense organs (eyes, ear, tongue, nose and skin) are our windows to collect information from the external world. Each of these sense organs is sensitive to different types of stimuli. They are discussed in detail as follows:

(i) **Vision:** Vision is the most developed and frequently used sense organ in human being. It dominates over the information received from other senses. Light is a complicated phenomenon and has a property of both waves and particles. There are three psychological aspects to the experience of light—brightness, colour and saturation.

(i) **Hearing:** The physical properties of sounds are different from theory of light; sound waves are simply the vibrations of the light molecules of air that surrounded us. Sound waves have property like wavelength, amplitude and purity. Wavelengths are interpreted by the brain as the frequency or pitch

(high, medium or low). Amplitude is interpreted as volume—how soft or loud a sound is.

Frequency is measured in cycles (wave) per second, or hertz (Hz). Human limits are between 20 and 20,000 Hz, with the most accurate hearing occurring at around 1,000 Hz.

(iii) **Chemical senses:** Gestation, the sense of taste and the sense of smell are very closely related. Taste buds are the common name for the taste receptors cell, special gustation. Most taste buds are located on the tongue, but there are very few on the roof of the mouth, the cheeks and under the tongue as well. Some people have only around 500, whereas others have twenty times that number. The latter are called 'superstars' and need less seasoning in their food than those with fewer taste buds (Bartoshuk, 1993).

Each taste bud has about twenty receptor and they are very similar to the receptor sites on receiving neurons at the synapse. In fact, the receptor on taste work exactly like receptor sites on neurons—they receive molecules of various substances that fit into the receptor like a key into lock.

The five basic tastes

Han Henning a German psychologist (1916) proposed four primary tastes—sweet, sour, salty and bitter. In 1966, Lindonann proposed that there is a fifth kind of taste receptor that detests a pleasant brothy taste associated with food like chicken soup, tuna, kelp, cheese and Soya product. The five taste sensations work together along with the senses of smell and the texture, temperature and heat of food to produce thousands of taste sensation.

(iv) **The sense of smell/olfaction:** The sense of smell is a chemical sense. The ability to smell odours is called olfaction or the olfactory sense. The part of the olfactory system runs odours signal that the brain can understand. The olfactory receptor cell is located at the top of the nasal passages. The area of olfactory receptor cell is only about an inch square in each cavity, yet contains about 10 million olfactory receptors.

(v) **Somatic sense:** The sense of touch has several sensations originating in several different places in the body. It refers as the body sense, or somatic sense. The first part of the word 'soma' means body. The second part aesthetic means feeling. There are three somatic sense system, the skin sense (touch, pressure, temperature and pain), the kinaesthetic sense (having to do with body location of the body parts in relation to the ground and to each other), and the vestibular sense (movement and body position).

NOTES

CHECK YOUR PROGRESS

12. What is transduction?
13. What are the three psychological aspects to the experience of light?
14. State whether True or False:
    (i) The central nervous system consists of the brain and spinal cord.
    (ii) The spinal cord has three components.
    (iii) The brain has three major divisions.
    (iv) The peripheral nervous system consists of three major divisions.

2.7 PERCEPTION

Most psychologists describe perception as interpretation of sensation. Perception is the process of organizing and interpreting sensory information to give it meaning. The brain automatically perceives the information it receives from the sense organs. For this reason most psychologists refer to sensation and perception as a unified information processing system (Goldstein, 2002). According to the expert A. David (1982) the purpose of perception is to represent information from the outside world internally.

Sensory information travels rapidly through the brain because of parallel processing, the simultaneous distribution of information across different neural path ways (Beauchamp and other, 2002). Sensory system designed to process information about sensory qualities one at a time (such as the shapes of image, their colours, their movements their location and soon) would be too slow to keep us current with a rapidly changing world.

Perceiving visual stimuli means organizing and interpreting the fragments of information that the eye send to the visual cortex. Information about the dimension of what we see are critical to this process. Shape and form are critical to perception. The term shape and form are often used interchangeably. There are many questions before us related to the perception of shape such as how do we perceive shape and form innate, or how do we segregate figure from ground.

The shape or form is defined as one of visual field that is set off from the rest of the field by visible cortex. The figure-ground relationship is the principle by which we organize the stand out (figure) and those that are left over (background) (refer Figure 2.5).

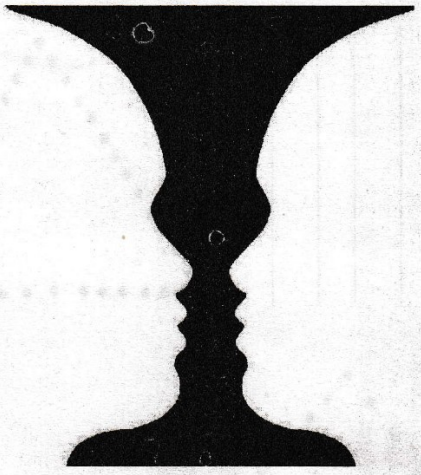

Fig. 2.5 The Figure and the Backgrund

Reversible figure ground pattern

Some figure-ground relationships are highly ambiguous, and it may be hard to tell Between the figure and the ground. In our visual field (whatever we lookout in the environment around us) some area is segregated to form figure and the rest is relegated to the background. Figure ground segregation is essential for the perception of shape. It is not only the characteristics of visual perception but comes under sense modalities. Following are the difference between figure and backgrounds.

- The ground seems to extend behind the figure.
- The figure has a shape, while the ground is relatively shapeless.
- The figure is more impressive, meaningful and better remembered.
- The figure usually tends to appear in front, the ground behind.
- The figure has some of the characteristics of a thing, whereas the background appears like unformed material.

2.7.1 Perceptual Organization

The gestalt psychologists, Kohler, Koffka and Wertheimer (1886–1941) proposed that the brain has the innate capacity for organizing perception. According to them, people naturally organize their perceptions according to certain patterns. The main principles of gestalt psychologist is that the whole is different from the sum of its part, e.g., thousands of tiny dots (parts) make up an image (whole) in print or on computer screen. Similarly, when we watch a film, the frame moves a light source at a high rate, and we perceive the whole that is very different from the separate frames that are the film's part. Following are the factors that influence perception:

- **Proximity:** Tendency to perceive objects that are close to one another as a part of the same grouping (refer Figure 2.6).

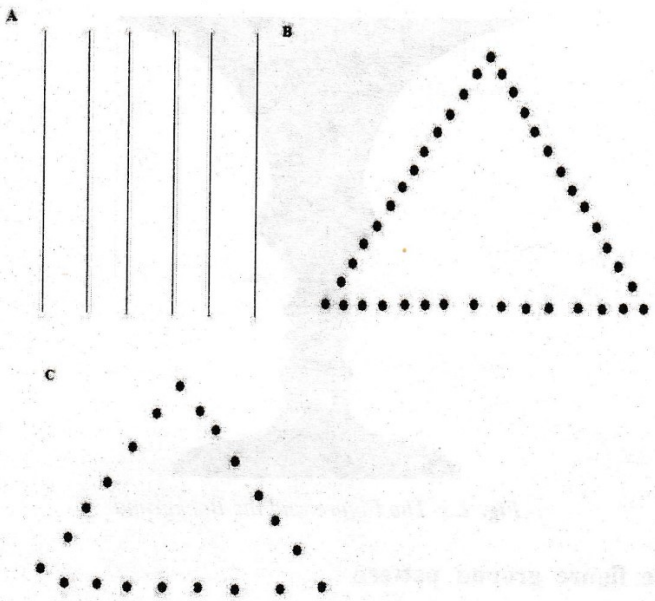

***Fig. 2.6** Proximity of Figures*

In Figure 2.6, A is perceived as three pair of vertical lines not six vertical lines. The set of dots in B may be perceived as a triangle.

- **Similarity:** Similarity stimuli are more likely to be perceived as one whole than dissimilar stimuli (refer Figure 2.7).

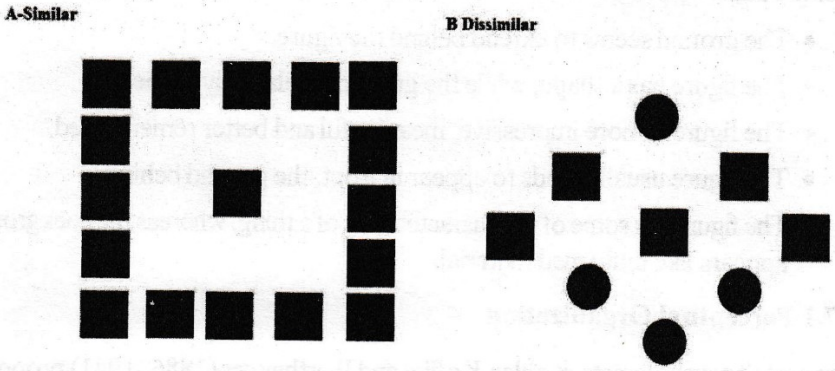

***Fig. 2.7** Similar and Dissimilar Stimuli*

In Figure 2.7, A and B have the same number and arrangements of parts. A is perceived as one whole. B contains dissimilar parts and it is perceived as dots and squares.

- **Good figure (Law of Pragnauz):** This law states that a perceptual organization will always be as good as the prevailing conditions allow. The simplest organization requiring the least cognitive effort will always emerge. Pragnauz means that we perceive the simplest organization that fits the stimulus pattern (refer Figure 2.8).

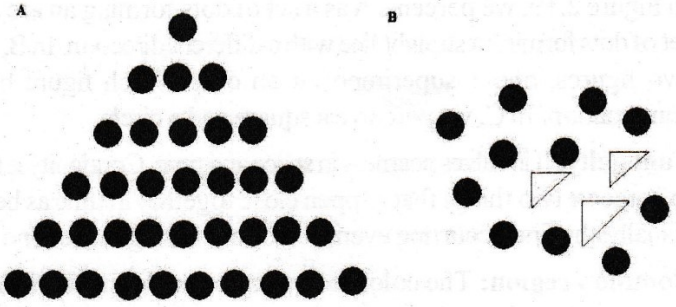

Fig. 2.8 Understanding the Law of Pragnauzx

In Figure 2.8, A is perceived as a triangle of dots with another triangle. However, it fails to operate in B as the system parts have no symmetry. They do not form a good figure in B.

- **Closure:** It is the tendency to complete figure that are incomplete as it yields subjective contours (refer Figure 2.9)

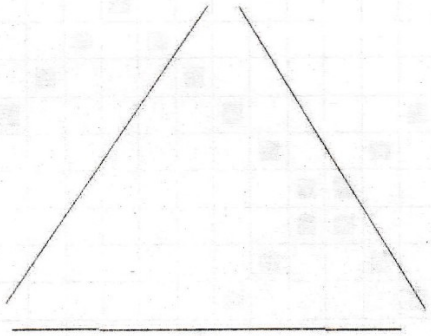

Fig. 2.9 A Closure

In Figure 2.9, the triangle does not exist, still it is compelling to perceive a triangle.

- **Continuation common direction:** Stimuli that have a common direction are organized in perception as a separate object from those stimuli that have different direction (refer Figure 2.10).

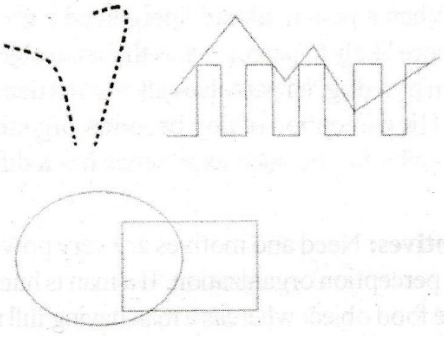

Fig. 2.10 Continuation Common Direction

In Figure 2.10, we perceive A as a set of dots forming an arc and another set of dots forming a straight line with a different direction. In B, we perceive two figures; one is superimposed on other. Each figure has different continuation. In C, we perceive a square and a circle.

- **Contiguity:** It involves nearness in space and time. Contiguity is the tendency to perceive two things that happen close together in time as being related. Usually, the first occurring event is seen as causing the second event.
- **Common region:** The coloured background defines a visible common region and tendency is to perceive objects that are in common area or region (refer Figure 2.11).

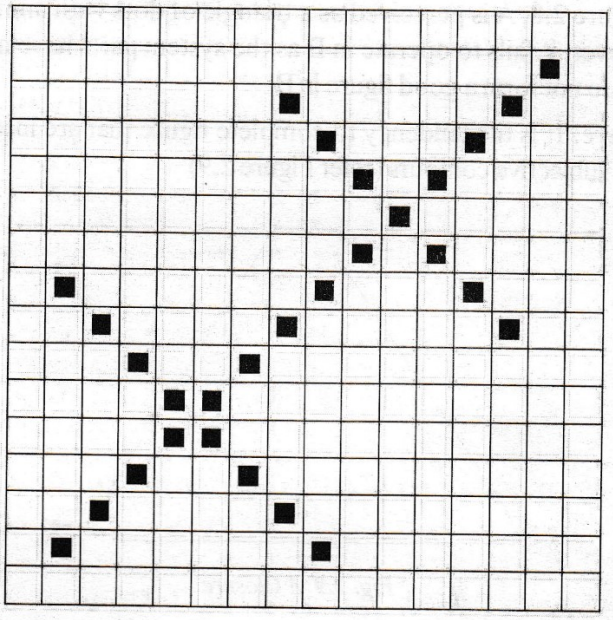

Fig. 2.11 Perception of Common Region

The stimuli sharing a common set of characteristics are likely to be organized as one object in perception. Apart from some factors are within the perceiver that account for organization in perception.

- **Past experience:** Past experience plays an important part in a person's perception. When a person already perceived a group of stimuli as one object, he is more likely to perceive it as the same object in future. If a child has been bitten by a dog, he perceives all dogs as dangerous and run away at their sight. His perception of dog becomes organized in the same way. Another child who has no such experience has a different perception of dogs.
- **Need and motives:** Need and motives are very powerful internal factors that influence perception organization. If a man is hungry, he is more likely to perceive the food object whereas a man having full meal is more likely to perceive objects in the shop other than food objects.
- **Depth perception:** The ability to see the world in three dimensions is called

depth perception. The problem emerge from the fact that how the image of three dimensional world is projected on the two dimensional retina. The retina directly reflects height and width, but depth information is lost and reconstructed on the brain of depth cues, different kind of visual information that logically provide information about some object's depth. There are various cues for perceiving depth in the world, some are as follows:

- **Monocular Cues:** It is known as a pictorial depth cue because they include the kind of depth information found in the photographs and painting. These are extensively used by the artists in their painting. Their cues are as follows:
  - **a. Aerial perspective:** Distant mountains often look fuzzy and building far in the distance is blurring than those that are close. However, the further away an object is the hazier the objects will appear. This is called aerial perspective.
  - **b. Linear perceptive:** When parallel lines appear to be converging at a distance, it is called linear perspective. The converging line means a great distance away from where they start.
  - **c. Relative size:** When objects that people expect to be of certain size appear to be small and are, therefore assumed to be much farther away.
  - **d. Light and shadow**: We are often aware of the source and direction of light. It is generally from above, as sunlight. The shadow cast by one object on another can indicate which object is farther away.
  - **e. Interposition:** If one object seems to be blocking another, people assume that the blocked object is behind the first one and therefore farther away. This is also known as overlap.
  - **f. Texture gradient:** The object lying on a surface that look fine and smooth is texture are perceived at a greater distance than those objects on a rough surface. The pebbles or bricks that textured, but as you look farther off into distance, their texture become smaller and finer.
  - **g. Motion parallax:** The discrepancy in motion of near-far objects is called motion parallax.
  - **h. Accommodation:** Accommodation makes use of something that happens inside the eye. The brain can use this information about accommodation as a cue for distance. Accommodation is also called muscular cue.

2.7.2 The Role of Learning in Perception

The older question about the role of learning in perception had to do with the nativism-empiricism problem. To what extent is perception natively given by way of our inherited structures and capacities, and to what extent is it the result of our experiences with the world of objects? However, a new question is now being

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asked about the reciprocal relationship between learning and perception. This new and contemporary question is: To what extent is learning, merely reorganized perception?

Learning brings about a qualitative change in regard to adaptation, the most generic and simple form of optimization at an individual scale. It implies the idea of new knowledge, in the sense that the organism links what formerly appeared as an undistinguished whole. In other words, it means the capability to change its own codes of meaning. Finally, we outline some basic ideas for modelling an adaptive sensor embedded in a (partially) autonomous system, which implies the former distinction between adaptation and learning. Cognition transfers progressively the functions of phylogenetic adaptation to the spatial and temporal scale of the lifetime of an organism (plasticity and structural change as learning in the cognitive subsystem). It establishes a new relation in the activity of the organism in its environment. This process appears internally as a functional hierarchisation, where the cognitive system operates as a function for the general regulation of the rest of them. Both aspects—the relation of the organism with its environment and the organization of its functions—are coupled in the development of a rich and versatile universe.

2.7.3 Perceptual Illusion

Perpetual illusions are misconceptions resulting from misinterpretation of sensory information. Sensory illusions are also known as false perception, e.g., in a dark night a rope is perceived as a snake. Illusion is a normal phenomenon perceived by all human beings.

Illusion of motion

Sometimes pupils perceive an object as moving when it is actually still. This is called the auto kinetic effect. A small stationary light in a darkened room will appear to move or drift because there are no surrounding due to indicate that the light is not moving. Another is the stroboscopes motion seen in motion picture. Another illusion related to stroboscope motion is the phi-phenomenon, in which light turned on and off in a sequence appear to move theatre marquee signs. For example, the best example of movement illusion is a series of blinking lights indicating direction.

Geometrical illusion

There are quite a few illusions that can be demonstrated by drawing some lines, Muller layer illusions is the most important example of that. In Figure 2.12, the two lines are exactly the same lengths and they are identical, but one looks longer then the other.

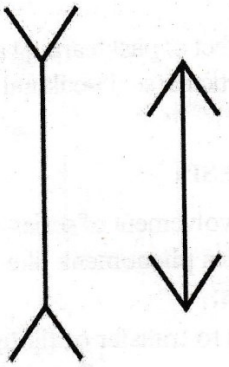

Fig. 2.12 Geometrical Illusions

Moon Illusion

The moon on the horizon looks far bigger than moon in the zenith. The retinal image is the same for both the horizon. This happens due to size distance relationship.

2.8 DETERMINANTS OF PERCEPTION

There are many different stimuli in the world which will catch our attention and result in perceptual organization. The stimulus characteristics are important as our own initial needs.

Content

A given stimulus may provide radically different perception because of the immediate content. The content creates an expectation in our brain that influences our perception at a particular movement. For example, suppose in a noisy condition we hear a sentence, 'eel is moving.' We will perceive the word 'eel' as 'wheel' because of the content provided by the later part of the sentence. Similarly, verbally provided a stimulus, 'eel the orange', one will perceive 'eel' as 'peel'. This is because the later word 'orange' provides an expectation for the perception of earlier word.

Perceptual set

Perceptual set refers to our mental expectancies and predisposition to perceive one thing and not another. Our education, social and cultural experiences shape our perception. Our learnt assumptions and beliefs help us in organizing our perception. Similarly, stereotypes (a generalized belief about a group of people) help us to perceive people we meet first time. Much of our social interaction is determined by the stereotypes we hold about individuals and groups.

Motives and needs

Personal views matters a lot in perceiving things available in the environment.

Socio and cultural factors

Our perceptions reflect the effect of past learning and, therefore, if learning and socialization takes place in a particular socio-cultural background it will be reflected in our perception.

Extra sensory perception (ESP)

The perception without the involvement of series is called ESP. It is perception without stimulation. It includes phenomena like telepathy, clairvoyance and telekinesis, which are as follows:

- **Telepathy:** It refers to transfer of thought between two persons at different places.
- **Clairvoyance:** Perceiving objects and events without the involvement of senses.
- **Telekinesis:** Controlling objects without touching them.

ESP is considered a para-psychological phenomenon. Psychologists with scientific attitude are generally sceptical about the phenomena of ESP.

2.8.1 Attention

Attention can be described as a process that brings some stimuli into the focus. As a result, those stimuli become distinct and clear; objects that lie outside. The time of light remains out of focus, either we do not observe them at all or they appear very hazy. Attention may also be further described as a process of adjustment of the organism to the stimulus situation. When one attends to a noise coming from a distance, his auditory receptors become specially prepared to receive the stimulus. Hence, attention is a condition of preparedness or alertness. When one is attentive, some organs become specially prepared to receive the stimulus.

Besides receptor adjustment, there is also effecter adjustment in attention. The muscles of the body are specially prepared to attend to the object of attention, or to engage in the activity that is in the focus of attention.

Attention also involves mental preparedness or alertness. When some one give attention to a task, the mental activities related to the task become especially acute. This increase in mental alertness is noticed in improvement in the performance of the task. Attention is known as central process and perception is not possible without attention process. However, attention precedes perception. It senses various functions that are as follows:

- **Alerting function:** Attention in this sense refers to state of focussed awareness with readiness to respond. (e.g., if asked some questions). Distraction occurs when some interference (e.g., loud noise) disturbs an individual while doing some work.
- **Selective functions:** Selectivity refers to a process by which attention is focussed in stimulus or stimuli of ongoing interest and other stimuli are ignored.

Selective attention cut as a filter that allows some information in and the other out.

- **Limited capacity channel:** We have limited capacity to process information that is available in the outside world. We have limited capacity to process the in coming information. When we process the task one at a time it is called serial processing, carrying two tasks simultaneously is not possible.
- **Vigilance function:** Maintaining attention on a task continuously for some time, e.g., looking at the light on a rader screen, is called vigilance or sustained attention.

2.8.1.1 Determinants of attention

The determinant of attention may be external/objective or they may be internal/ subjective.

External or objective determinant

- **Intensity/strength of the stimuli:** A more strong or intense stimulus is more likely to arouse attention then a less strong or weak stimulus. Our attention is easily directed to a loud sound, a bright light or a strong smell.
- **Size of the stimulus:** A large object is more likely to catch the attention of a person then to a small object.
- **Duration of the object:** A light or sound catches our attention if the stimulus is continuous, it is less likely to hold the attention as compared to the stimulus that comes and goes at interval.
- **Moving object:** This catches our attention more easily then sameness and absences of change. An advertisement in white and black or red and green, is more likely to attract attention then the same advertisement in white and red, green or yellow.

Internal or subjective determinants

- **Interest:** Objects, activities or tasks that we like catch or hold our hold attention.
- **Needs desires:** Objects and activities that fulfill desires, or serve some purpose that a person is more likely to be attracted to, e.g., if one may like a particular type of game. The fruit and article used in the game are more likely to catch his attention then other objects.
- **Goals of the individual:** A particular goal of an individual attracts his attention with that specified goal, such as the sight of an object of food is more likely to strike the attention of a hungry man as compare to normal people. If a person goes out to buy a pair of shoes, his attention will be attracted more by shoe shops then any other shops.

Important facts about attention

If a very mild stimulus is present, like the ticking of time peace heard from a distance, or a point of distant light, the ticking or the light may appear to come and

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go. At one moment it is within our attention, at the next movement it passes out of our attention. This is called fluctuation of attention.

Shift of attention

We cannot hold our attention for a long period of time. A child's attention is weary and is always shifting. It flits from object to object. It can not remain fixed on the same object. An adult can concentrate his attention. When the shift of attention is limited to related objects and attention, it is said to be observed or concentrated, unrelated objects or activities fail to catch attention. When unrelated stimuli attract and hold once attention, attention is said to be distracted. As interests develop in certain types of objects or activities, attention to the objects and activities become effortless, spontaneous and involuntary.

The more the objects one can hold in a single cut of attention, the more the number of objects one can grasp in a single moment of attention, and thus, the larger his grasp of attention. Individuals differ in their spans of attention. Experiments have been done on the span of attention for letter or digits. It has been found that most persons can attend to four to five letters in our moment of attention out of a much larger number. However, some persons have been noticed to grasp seven or eight letters or digits in a single moment of attention.

A person's span of attention has influenced his speed of reading. A fast reader can grasp many more words in one glance than a slow reader.

Check Your Progress

15. What is the main principle of the gestalt psychologists?
16. What does the Law of Pragnauz state?
17. Define contiguity.
18. What is perpetual illusion?
19. Fill in the following Blanks:
    (i) Gestalt psychologists identified _____ which determined our perceptual organization.
    (ii) The discrepancy in motion of near and far objects is called _____.
    (iii) The _____ has a shape while the _____ is relatively shapeless.
    (iv) Distance and depth are perceived with the help of _____.
    (v) The three categories of cues are _____, _____ and _____.

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2.9 STATES OF CONSCIOUSNESS

Consciousness is an awareness of external events and internal sensations, including awareness of the self and the thoughts about various experiences. The content of our awareness change from moment to moment. Information moves rapidly in and out of consciousness. William James (1890–1950) described the mind as a stream of consciousness, a continuous flow of changing sensation, images, thoughts and feelings. Our mind can jump from a topic to another.

The flow of sensation, images, thoughts and feelings can occur at different levels of awareness as explained:

- **High-level consciousness:** It represents the most alter states of human consciousness in which individuals actively focus their efforts towards a goal (Cooper and others, 2002; S. Monsell and J. Driver, 2000). Controlled processes require selective attention, the ability to focus on a specific aspect of experience while ignoring others.
- **Low-level consciousness:** It includes automatic processing that requires little attention, as well as day dreaming and does not interfere with other ongoing activities. Automatic processes require less conscious effort then controlled processes (L.J. Trainor, K.L. McDonald and C. Alain, 2002). Another state of lower-level awareness is daydreaming, which lies somewhere between active consciousness and dreaming while asleep.
- **Alter states of consciousness:** Alter states of consciousness are mental states which can be produced by drugs, trauma, fatigue, hypnosis and sensory deprivation. In some cases, the drug used may create a higher level of awareness. It is believed that caffeine increases alertness. Awareness may also be altered to a lower level.
- **Subconscious awareness:** It can take place while we are awake or while we are asleep (A.R. Damasio, 2001). Csikszentmihalyi, (1995) believes that creative ideas often incubate for sometime below the threshold of conscious awareness before they emerge. When an idea is incubating, our mind may be processing information even though we are not aware of it.

  Subconscious information processing can occur simultaneously along many parallel tracks, e.g., when a man is running down the street we are consciously aware of the event, but not of the subconscious processing of object identity (a man), its height, colour, weight, etc.; whereas, conscious processing is serial.

2.9.1 Sleep and Dream

Sleep and dream could also be viewed as low levels of consciousness, even though our level of awareness is lower then when we day dream (M. Schredl and R. Hoffman, 2003).

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Research has also found that when people are clearly asleep (as determined by physiological monitoring devices), they are able to respond to faint tones by pressing a handheld button (Ogilvy and Wilkinson, 1988). The presentation of pure auditory tones to sleeping individuals activated auditory processing regions of the brain, whereas participants names activated language areas, the Amy data, the prefrontal cortex (R. Stickgold, 2001).

Unconscious

Unconscious thought is a reservoir of unacceptable wishes, feeling and thoughts that are beyond conscious awareness, S. Freud (1917). According to Freud, unconscious thoughts are too laden with anxiety and other negative emotions for consciousness to admit them. Freud's concept of unconscious mind was not accepted by all.

Sleep: A biological rhythm

Sleep is the periodic physiological fluctuation in the body. Most of the time we are unaware of most biological rhythms, but they can influence our behaviour. The rhythms are controlled by biological clocks, which includes the following:

- **Seasonal cycle:** Examples of seasonal cycles are migration of birds, the hibernation of bears and seasonal fluctuation of humans eating habit. Other examples are as follows:
  - o Twenty-eight-day cycle, such as moment menstrual cycle.
  - o Circadian rhythms: Twenty-four-hour cycles, sleep/walk cycle and change in body temperature, blood pressure, etc.
- **Desynchronizing the biological clock:** Biological clock can throw off their regular schedules (Jensen and others, 2003). Circadian rhythms may also become desynchronized when shift workers change their work hours (Ahasan and others, 2001). Problems related to shift work most often affect night shift workers who never fully adjust to sleeping in the day time.
- **Resetting the biological clock:** Strategies for shift workers who need to reset their biological clocks include splintery sleep between after-works morning naps and a nap before they have to work late. Afternoon naps increase the number of hours of sleep, increasing the amount of light in the work place and going to sleep in complete darkness.

Importance of sleep

When we do not get proper sleep we are not able to function physically or mentally. Following are the important functions of sleep:

- **Restoration:** Sleep is fundamental mechanism for survival. Researches prepared that sleep restore, replenish and rebuild our brain and body, which can feel depleted by the day's waking activities.

  Many body cells indeed show increased production and reduced breakdown of proteins during deep sleep (National Institute of Neurological