PSY 310
Physiological Psychology II

Ibadan Distance Learning Centre Series

PSY 310
Physiological Psychology II

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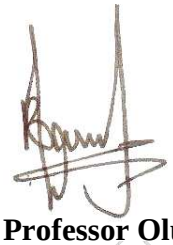
Vice-Chancellor's Message

I congratulate you on being part of the historic evolution of our Centre for External Studies into a Distance Learning Centre. The reinvigorated Centre, is building on a solid tradition of nearly twenty years of service to the Nigerian community in providing higher education to those who had hitherto been unable to benefit from it.

Distance Learning requires an environment in which learners themselves actively participate in constructing their own knowledge. They need to be able to access and interpret existing knowledge and in the process, become autonomous learners.

Consequently, our major goal is to provide full multi media mode of teaching/learning in which you will use not only print but also video, audio and electronic learning materials.

To this end, we have run two intensive workshops to produce a fresh batch of course materials in order to increase substantially the number of texts available to you. The authors made great efforts to include the latest information, knowledge and skills in the different disciplines and ensure that the materials are user-friendly. It is our hope that you will put them to the best use.



Professor Olufemi A. Bamiro, FNSE
Vice-Chancellor

Foreword

The University of Ibadan Distance Learning Programme has a vision of providing lifelong education for Nigerian citizens who for a variety of reasons have opted for the Distance Learning mode. In this way, it aims at democratizing education by ensuring access and equity.

The U.I. experience in Distance Learning dates back to 1988 when the Centre for External Studies was established to cater mainly for upgrading the knowledge and skills of NCE teachers to a Bachelors degree in Education. Since then, it has gathered considerable experience in preparing and producing course materials for its programmes. The recent expansion of the programme to cover Agriculture and the need to review the existing materials have necessitated an accelerated process of course materials production. To this end, one major workshop was held in December 2006 which have resulted in a substantial increase in the number of course materials. The writing of the courses by a team of experts and rigorous peer review have ensured the maintenance of the University's high standards. The approach is not only to emphasize cognitive knowledge but also skills and humane values which are at the core of education, even in an ICT age.

The materials have had the input of experienced editors and illustrators who have ensured that they are accurate, current and learner friendly. They are specially written with distance learners in mind, since such people can often feel isolated from the community of learners. Adequate supplementary reading materials as well as other information sources are suggested in the course materials.

The Distance Learning Centre also envisages that regular students of tertiary institutions in Nigeria who are faced with a dearth of high quality textbooks will find these books very useful. We are therefore delighted to present these new titles to both our Distance Learning students and the University's regular students. We are confident that the books will be an invaluable resource to them.

We would like to thank all our authors, reviewers and production staff for the high quality of work.

Best wishes.

Professor Francis O. Egbokhare
Director

General Introduction and Course Objectives

This course is a general presentation of physiological psychology. It provides introductory information on the different physiological systems involved in behaviour and cognition. The course will allow the students to understand the basic processes and applications of the physiology involved in psychology. In this course, you will learn the anatomy, neurochemistry, and inter-related functions of the central nervous system and the endocrine system that are responsible for behaviour. After going through the series of lectures, you should become aware of the various types of functions controlled and modulated by the brain, how these relate to environmental stimuli and conditions and the effects of drugs and other substances on the brain and behaviour. This course is structured so that you will move from learning about the specific biology of the neuron to more general forms of behaviour. This approach helps you to understand the basic anatomy and functions of the brain so that you can apply as we study the more interesting aspect which is about behaviours.

What is the nominal referent of the pronoun circled?

Physiological psychology is a sub-division of biological psychology that studies the neural mechanisms of perception and behaviour through direct manipulation of the brains of non human animal subjects in controlled experiments. Unlike other sub-divisions within biological psychology, the main focus of physiological psychological research is the development of theories that explain brain behaviour relationships that have translational value. It is sometimes alternatively called psychophysiology and in recent years, also called cognitive neuroscience. (Pinel, 2004).

This course has provided a great help or deal of information about classic psychological issues like sensation and perception, motivation, emotional, attention, learning and memory, language and even consciousness.

Course Objectives

In keeping with the spirit of good learning principles as a result of participating in this course, you should meet the following objectives; to learn the physiology of the nervous system including an understanding of

the neuron, the nerve impulse and the synapse; to describe the structure of the nervous system and label diagrams appropriately; to learn the divisions of the nervous system from the spinal cord to the different parts of the brain as well as nervous system development; to introduce the different physiological systems involved in behaviour (e.g. vision, movement, etc.); to recognise the physiological processes involved in the interpretation of sensory input (perception) and the role that one's experiences play in the process; to learn the behavioural consequences of damage to physiological systems; to understand the nature of human development from a physiological psychology viewpoint and apply it to areas in your own life and to the live of those around you like peers family and other individuals with whom you work in a professional or personal context; to utilise your knowledge of physiological psychology to analyse information in contemporary world; to be able to transmit your knowledge to others effectively; to understand the application of physiological psychology and apply the principles of physiological psychology to the understanding of psychological problems; and finally to become familiar with the ethics involved in research with human and non human subjects, the legal and moral responsibilities of those individuals who work with both people and animals.

LECTURE ONE

A Brief History of Physiological Psychology

Introduction

Research into the physiological basis of human and animal behaviour has a long history dating back to about 40years. This long history has its roots in philosophy and biology. This lecture will make you understand the emphasis they placed on the experimental and the observational tests of ideas and the pragmatic approach that became the basis of physiological psychology.

Objectives

At the end of this lecture, you should be able to:

1. discuss the history of physiological psychology;
2. explain the research techniques in physiological psychology; and
3. explain what is meant by physiological psychology.

Pre-Test

1. Discuss the history of physiological psychology.
2. Identify and explain the research techniques in physiological psychology.
3. Explain what is meant by physiological psychology.

CONTENT

Philosophers like John Locke (1690), John Stuart Mill (1863), for instance, asked questions on how we understand reality and posed the mind–body-relationship which is still with us today. The emphasis they

placed on experimental and observational test of ideas and the pragmatic approach became the basis of physiological psychology. Biologist, on the other hand, devised experimental psychology that provided the necessary tools that are used to investigate the mechanism of the body. The field also provides the framework needed to integrate findings from diverse species. This includes the principles of natural selection, evolution and genetics.

Historically, physiology and psychology began as the same discipline. Thompson (1967), Muller's (1840) doctrine of specific nerve energies and Helmholtz (1877) work on sensory function particularly in the area of learning are good examples of the relationship that existed between physiology and psychology. The works of these physiologists cut across physiology and psychology as they show a strong interest in basic psychological problems and are concerned with areas which are now included in the field of psychology. Thus, before psychology and physiology began to follow separate paths, both fields had influenced each other considerably (Thompson, 1967). The basic inter-relatedness of the brain function and psychology had been emphasized and interest in the physiological basis of behaviour had been awakened in renowned psychologist. For instance, Wundt (1874), investigated and published *The Foundations of Physiological Psychology*; William James (1890) paid considerable attention to the nervous system; Thorndike (1898) investigated quantitative studies on animal learning; Karl Lesley (1929) examined brain mechanism and intelligence and Pavlov (1927) reported the results of conditioned reflexes. All these contributed objective reliable and quantitative measures of behaviour with which physiological psychology took off.

Ultimately, what has been learnt about the physiology of behaviour has been obtained through the efforts of psychologists, cell physiologist molecular biologists, biochemists, endocrinologists, neuro-anatomists, neurologists and neurophysiologists. The connotation of this is that no single academic discipline can comfortably claim the field of physiological psychology as its own. This is the reason why diverse titles, such as physiological psychology, behavioural neuroscience biological psychology, biopsychology and behavioural psychology are used to label the field. These names or titles have approximately the same meaning as physiological psychology.

Research Techniques in Physiological Psychology

The instruments used in physiological psychology to assess the internal functioning of the body arousal and the effects of stress on the body can be classified into two. These techniques are similar and unique. The first set of techniques involves methods that are similar to that employed by the general field of psychology. These include administration of psychological tests, interview of human subjects and experiments with human and animal subjects. The second technique is made up of methods that are unique to physiological psychology. Examples of these are bio-chemical analyses of blood and urine, blood pressure, heart-rate, electrical activity of the brain and other techniques not utilised by the general discipline of psychology. Some physiological measuring instruments unique to the speciality include the Skin Conductance Response (SCR), Electrocardiogram (EKG), Electroencephalogram (EEG), Galvanic Skin Response (GSR), and the Electro-myogram (EMG). The SCR measures arousal; the EKG measures heart rate, while the EEG (which records brain activity) has been utilised to study sleep and electrical activity of the brain. The GSR records the activity of skin sweet glands, while the EMG measures muscle activity. These measuring instruments have been acclaimed because individuals who are examined using these measures cannot distort or control the measure as they do in self report measures utilised by the general field of psychology.

The brain has been termed the power house of human behaviour. If we must know about how the brain works, we should be familiar with the different methods of measuring brain activity and its influence on behaviour. The measurement of brain activity in physiological psychology can be done via two broad approaches. These are the non invasive approach and the invasive approach.

The non-invasive approach makes use of instruments that operate outside the body of the individual, while the invasive approach requires that the instruments be placed inside the brain of the examinee. In some cases, the invasive approach involves removing the brain for examination. The brain is dissected, using histological techniques (tissue preparing techniques), such as fixation, experimental ablation and electric current. Fixation technique is particularly relevant when tissue or other important organs in the body are to be studied. This is because dissected tissues and organs of the body will have to be prevented from decomposition by

bacteria or moulds. A condition that must be met before the fixation technique is used is called perfusion.

Perfusion of a tissue entails the removal of blood from the tissue of the brain and its replacement with another fluid made up of dilute salt solution. The fixation technique itself involves putting tissues or organs to be studied in a fixative usually formalin (an aqueous solution of formaldehyde, a gas). This hardens the very soft and fragile brain and kills micro organisms that could destroy it. Thereafter, it is sliced into sections and stains for the anatomical details to be seen. The experimental oblation technique involves destroying parts of the brain and evaluating subsequent behaviours.

First, the specie to be studied is anaesthetised, the scalp is cut, the part of the scull is removed and the cortex is brought into view. Suction is used to remove liquid from the brain tissue and a vacuum pump to suck away brain tissue. The changes in behaviour are then observed. Brain oblation can also be made possible by using two types of electric current. These are direct current device and radio frequency. Direct current devices create lesions by initiating chemical reactions whose products destroy the cells in the vicinity of electrode tip. Radio frequencies, on the other hand, produce alternating current of a very high frequency that destroys nearby cells with the heat produced by the passage of the current through the tissue. It should be noted that brain ablation can also be attained by the use of chemicals like neuro-toxin (nerve poison), such as kainic acid or ibotenic acid. Invasive experiments are performed on animals while non-invasive ones are carried out on humans.

The measure of hormone level is another unique technique of physiological psychology. Ascertaining the hormonal levels of people has contributed to knowledge in the area of the physiological undertone of the heart attacks, hypertension, ulcers, abnormality in growth and its attendant behavioural consequences.

Physiological Psychology

Physiological psychology is the study of the physiological basis of how we think, connecting the physical operation of the brain with what we actually say and do. It is connected with brain cells, brain structures and components, brain chemistry and how it all leads to speech and action. It is also of course important to understand how we take in information from

our five senses. Most often people conceive of behaviour only in terms of what they can see with their eyes. It is therefore common to hear about overt behaviour, such as reading, fighting, writing, dancing and driving. Behaviour is made up of two vital components. These are overt and covert behaviours, while the other aspect which deals with unobservable neurophysiologic processes is called covert behaviour. The concept of physiological psychology evolved overtime and is deeply rooted in the assumption that most if not all aspects of human and animal behaviour is determined by physiological processes within human and animal organisms. For example, forms of behaviour like sleeping, blinking an eye, taking notes in a lecture and driving a car depends on the integration of so many neurological processes. It is not out of place to say that behaviour cannot be clearly understood without an adequate grasp of the processes that must coordinate effectively for behaviour to be exhibited. Much early knowledge was gained through observing how behaviour changes when different parts of the brain are damaged. Animal experiments always controversial have been used for example by removing or cutting various parts of the brain and observing differences in behaviour.

Physiological psychology covers general area of the brain and behaviour. Physiological psychology seeks to explain the internal biological structures mechanisms and processes as they define and explain inheritance, processes cellular functions nervous system endocrine activities and how all these affects behaviour. The goal of physiological psychology is to create an understanding of how these systems of the body function to produce what human and animals display as behaviour. Physiological psychology can therefore be defined as the study of the neurophysiologic processes underlying brain function and behaviour. It is a scientific study because the quantitative measures of behaviour and the theoretical framework used in behaviour enquiry are devised by experimental psychologists. Besides, its techniques of inquiry are objective, reliable and standardised. This is a vital component in understanding physiological psychology.

Summary

1. Historically, physiology and psychology began as the same discipline
2. No single academic discipline can comfortably claim the field of physiological psychology as its own.
3. The brain has been termed the power house of human behaviour.
4. The instruments used in physiological psychology to assess the internal functioning of the body arousal and the effects of stress on the body can be classified into two. These techniques are similar and unique.
5. The measurement of brain activity in physiological psychology can be done via two broad approaches. These are the non-invasive approach and the invasive approach.
6. Ascertaining the hormonal levels of people has contributed to knowledge in the area of the physiological undertone of the heart attacks hypertension ulcers abnormality in growth and its attendant behavioural consequences.
7. Behaviour is made up of two vital components. These are overt and covert behaviours
8. Physiological psychology covers general area of the brain and behaviour.
9. Physiological psychology can therefore be defined as the study of the neurophysiologic processes underlying brain function and behaviour.
10. It is a scientific study because the quantitative measures of behaviour and the theoretical framework used in behaviour enquiry are devised by experimental psychologists. Besides, its techniques of inquiry are objective, reliable and standardized.

Post-Test

1. Discuss the history of physiological psychology.
2. Identify and explain the research techniques in physiological psychology.
3. Explain what is meant by physiological psychology.

References

Schultz, D.; Schultz, E. S.; (2002). *Psychology and Work Today*, Prentice Hall New Jersey.

Bloom, F.; Nelson, C. A.; Lazerson, A. (2001). *Brain Mind and Behaviour*. Educational Broadcasting Corporation NY

Freeberg, L. (2006) *Discovering Biological Psychology*. Houghton Mifflin Company.

LECTURE TWO

The Neuron

Introduction

A neuron is a nerve cell that is the basic building block of the nervous system. Neurons are similar to other cells in the human body in a number of ways, but there is one key difference between neurons and other cells. Neurons are specialised to transmit information throughout the body. This lecture enables you to understand the basic functions of neurons.

Objectives

At the end of this lecture, you should be able to:

1. define neurons;
2. list the types of neurons; and
3. describe the structure of neurons.

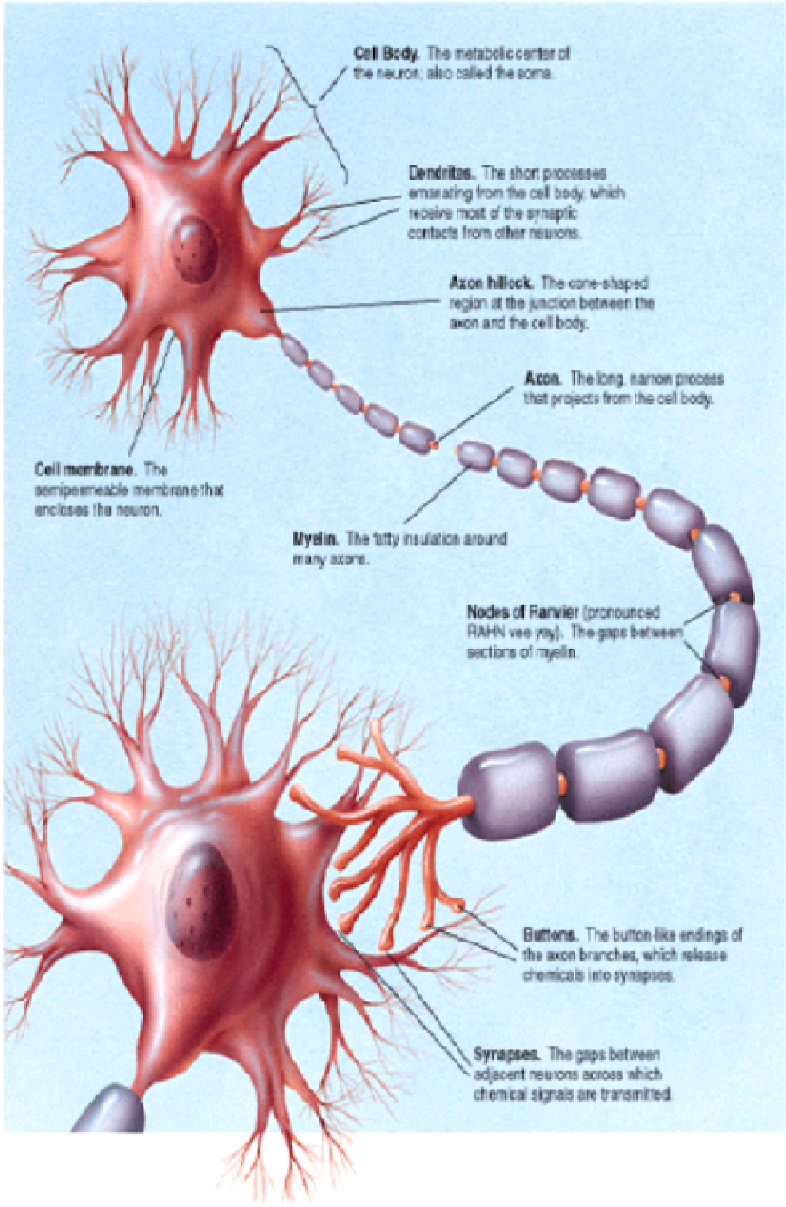
Pre-Test

1. What are neural impulses?
2. Explain the resting potential
3. Explain the action potential.

CONTENT

Neurons are also known as nerve cells or brain cells. They are the core components of the brain, the vertebrate spinal cord and the invertebrate ventral nerve cord and the peripheral nerves. All brain activities hinge on the workings of the brain cells or neurons (Kandel, *et al*, 2000). These highly specialized nerve cells are responsible for communicating information in both chemical and electrical forms.

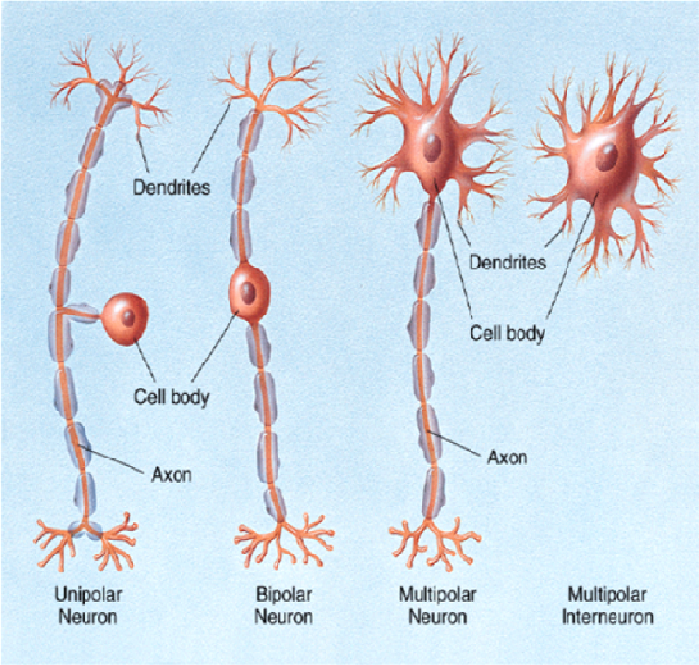
The Major External Features of a Typical Neuron



Types of Neurons:

There are three types of neurons. The sensory neurons respond to input from the senses. They respond to touch, sound, light and numerous other stimuli affecting cells of the sensory organs that send signals to the spinal cord and the brain. Motor neurons send signal to control movement. Motor neurons receive signals from the brain and spinal cord and cause muscle contractions and affect glands. Inter-neurons stand between the neurons that register what is out there and those that control movement. They are responsible for communicating information between different neurons in the body. Generally, neurons respond to stimuli and communicate the presence of stimuli to the central nervous system. Neurons differ in their sizes shapes and characteristics, depending on the function and role of the neuron.

Type Structure of Neurons



The Structure of A Neuron

To understand psychological events, you need to know a few facts about the structure of the neuron. Each neuron has certain parts. There are three basic parts of a neuron; the dendrites, the cell body and the axon.

The Cell Body: The central part of a neuron is called the cell body. Like all cells, it has a nucleus, which regulates the cell's functions and a cell membrane which is the skin of the cell.

The Axon: This is the sending end of a neuron. The axon is a long cable-like structure extending from the cell body along which signals travel to other neurons, muscles or bodily organs. Some neurons have short axons, while others can be quite long. Although each neuron has only one axon, most axons divide into many branches called terminals, so that a neuron can send a message to more than one place at a time. At the end of the terminal s are terminal buttons, which are knob-like structures that release chemicals into the space between neurons when the neurons have been triggered.

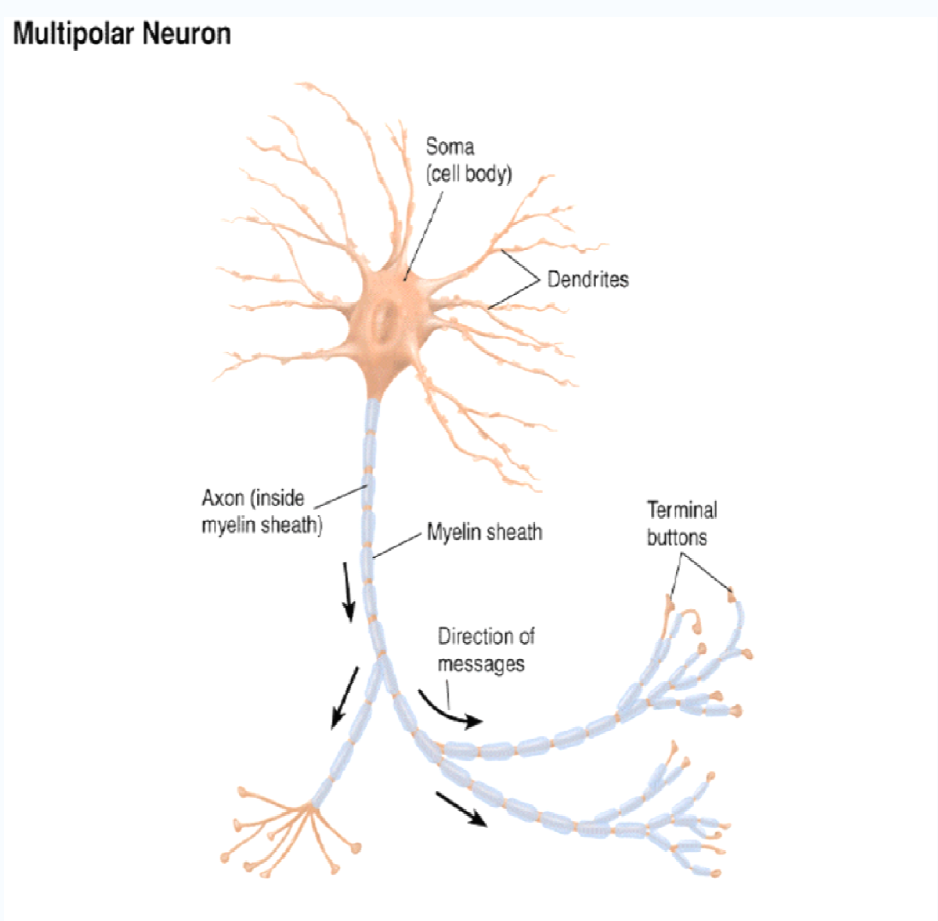
Dendrites: Each neuron has only one axon, but a neuron may have many receiving ends .These are the dendrites. Their name is derived from the greek word "dendron" meaning tree which makes sense when you look at tree-like of the dendrites shape. The dendrites receive messages from the axons of other neurons. Some neurons have few dendritic branches, while others are highly branched to receive a great deal of information.

Structural classification

Polarity

Most neurons can be anatomically characterized as:

- **Unipolar**: dendrite and axon emerging from same process.
- **Bipolar:** axon and single dendrite on opposite ends of the soma.
- **Multipolar:** more than two dendrites:



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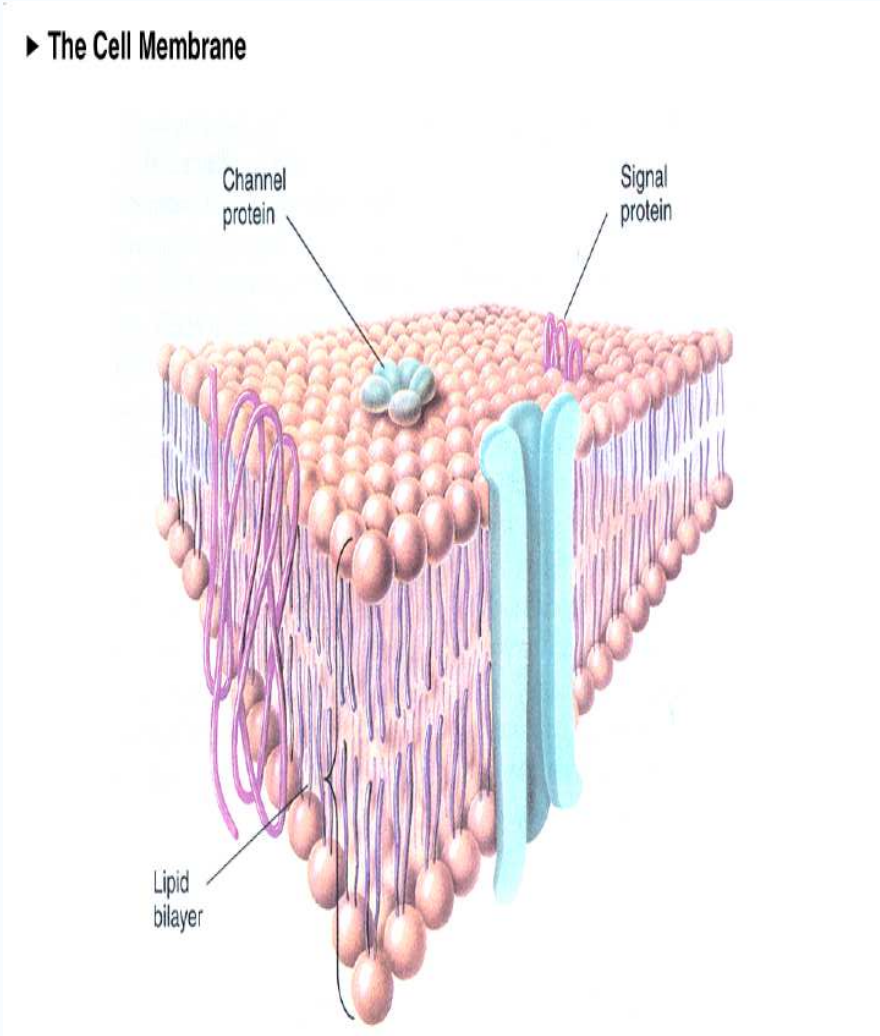


Functional classification

- **Afferent neurons**: convey information from tissues and organs into the central nervous system and are sometimes also called sensory neurons.
- **Efferent neurons:** transmit signals from the central nervous system to the effectors cells and are sometimes called motor neurons.

- **Interneurons**: connect neurons within specific regions of the central nervous system.

Afferent and efferent can also refer generally to neurons which, respectively, bring information to or send information from the brain region.

Neural Impulses

In order for neurons to communicate, they need to transmit information both within the neuron and from one neuron to the next. This process utilizes both electrical signals as well as chemical messengers.

The Resting Potential: When neurons are at rest, they maintain a negative charge within. This negative charge is called the resting potential. This potential arises because of how ions are distributed inside and outside the cell. Ions are atoms that are positively or negatively charged. During rest, more positively charged ions, which are also called cation and which consists mostly sodium ions, are outside the neuron than inside it. The more negatively charged ions called anions are inside the neuron.

The Action Potential: The dendrites of the neuron receive information from sensory Receptors or other neurons. This information is then passed to the cell body onto the axon. Once the information has arrived at the axon, it travels down the length of the axon in the form of an electrical signal known as an action potential. The membrane covering the axon has very small holes or pores called channels. The channels are open and close. When particular channels are open, particular ions either flow into the cell from inside the cell to the surrounding fluid. When a neuron receives enough stimulation from other neurons, some of the channels in the cell membrane open, allowing a complex exchange of ions that change the charge in the axon. This exchange works its way down to the end of the axon. It finally causes terminal buttons to release chemicals that will affect other neurons. When this occurs, the neuron is said to fire. The shifting in charge that moves down the axon is known as an action potential. Action potential obeys the all or none principle.

The All or None Principle: The conduction of nerve impulse is an example of an all or none response. In other words, if a neuron responds at all, then it must respond completely. The greater the intensity of

stimulation does not produce a stronger signal but can produce more impulses per second. There are different types of receptor response to stimulus. Slowly adapting or tonic receptors most often respond to steady stimulus and produce a steady rate of firing. These tonic receptors most often respond to increased intensity of stimulus by increasing their firing frequency, usually, as a power function of stimulus plotted against impulses per second. This can be likened to an intrinsic property of light where to get greater intensity of a specific frequency (colour) there has to be more photons, as the photons can't become "stronger" for a specific frequency.

There are a number of other receptor types that are called quickly adapting or phasic receptors where firing decreases or stops with steady stimulus. An example of this is skin. When touched by an object, it causes the neurons to fire, but if the object maintains even pressure against the skin, the neurons stop firing. The neurons of the skin and muscles that are responsive to pressure and vibration have filtering accessory structures that aid their function. The Pacinan corpuscles are one such structure. They have concentric layers like an onion which form around the axon terminal when pressure is applied and corpuscles is deformed; mechanical stimulus is transferred to the axon, which fires. If the pressure is steady, there are no more stimuli. Thus these neurons typically respond with a transient depolarisation during the initial deformation and again when the pressure is removed, which cause the corpuscles to change shape again. Other types of adaptation are important in extending the function of a number of other neurons. (Eckert, *et al*, 1983).

In summary, in all or none principle, it is either an action potential occurs or not. Many neurons can fire hundreds of times a second because chemical reactions reset them so that they can fire again if they receive adequate stimulation.

The Threshold: The voltage at which a neuron fires or breaks away with an action potential is called the threshold of excitation. The existence of a threshold of excitation implies that the generation of a nerve impulse requires an adequate stimulus. If the threshold level for depolarisation or extinction is not reached, the neuron will not fire. This is about 65mv for most axons firing in neurons. This operates the all or none law. The *all or none law* states that a neuron either fires or does not fire. A neuron fires only if the intensity of a stimulus is adequate. Besides, once it is triggered,

it is transmitted down the length of the axon with full force and remains the same size even when the intensity of a stimulus is adequate. Reaching the threshold for an action potential is similar to pulling the trigger of a gun. As you squeeze the trigger, nothing happens until you reach a critical point. At that point, a sequence of events begins that leads to the firing of the gun, and no actions will stop the sequence once it is initiated.

The Neuron Doctrine

The neuron doctrine is the new fundamental idea that neurons are the basic structural and functional units of the nervous system. The theory was put forward by Santiago Ramony Cajal in the late 19th century. It holds that neurons are discrete cells (not connected in a meshwork) acting as metabolically distinct units. As with all doctrines, there are some exceptions. For example, Glia cells may also play a role in information processing (Witcher and Harris, 2007). Also, electrical synapses are more common than previously thought (Connors and Long, 2004). This means that there are direct cytoplasmic connections between neurons. In fact, there are examples of neurons forming even tighter coupling. The squad giant axon arises from the fusion of multiple neurons that retain individual cell bodies. Crayfish giant axon consists of a series of neurons with high conductance and separate junctions. Cajal also postulated the law of dynamic polarisation which states that a neuron receives signal at its dendrites and cell body and transmits them as action potentials along the axon in one direction away from the cell body (Sabbatini, 2003). The law of dynamic polarisation has important exceptions; dendrites can serve as synaptic output sites of neurons (Djuristic, *et al*, 2004) and axons can receive synaptic inputs.

Summary

1. The neuron doctrine is the new fundamental idea that neurons are the basic structural and functional units of the nervous system. The theory was put forward by Santiago Ramon Y Cajal in the late 19th century
2. A neuron is a nerve cell that is the basic building block of the nervous system.
3. These highly specialized nerve cells are responsible for communicating information in both chemical and electrical forms.
4. There are three types of neurons:
   a. The sensory neurons respond to input from the senses. They respond to touch, sound, light and numerous other stimuli affecting cells of the sensory organs that send signals to the spinal cord and the brain.
   b. Motor neurons sends signal to control movement. Motor neurons receive signals from the brain and spinal cord and cause muscle contractions and affect glands.
   c. Inter-neurons stand between the neurons that register what is out there and those that control movement. They are responsible for communicating information.
5. There are three basic parts of a neuron; the dendrites, the cell body and the axon.
6. When neurons are at rest, they maintain a negative charge within, this negative charge is called the resting potential.
7. Action potential obeys the *all or none principle*.
8. The voltage at which a neuron fires or breaks away with an action potential is called the threshold of excitation.
9. Reaching the threshold for an action potential is similar to pulling the trigger of a gun. As you squeeze the trigger, nothing happens until you reach a critical point.

Post-Test

1. What is a neuron?
2. Explain resting potential and action potential
3. Describe the structure of a neuron.

References

Schultz, D.; Schultz, E. S.; (2002). *Psychology and Work Today*. Prentice Hall New Jersey.

Bloom, F.; Nelson, C. A.; Lazerson, A. (2001). *Brain, Mind and Behaviour*. Educational Broadcasting Corporation, NY.

Freeberg, L. (2006). *Discovering Biological Psychology*. Houghton Mifflin Company.

LECTURE THREE

The Synaptic Transmission

Introduction

By means of different patterns of synaptic connections between neurons, synaptic circuits are constructed during development to carry out the different functional operations of the nervous system. The human brain contains about 100 billion neurons and the average neurons form something on the order of 1000 synapses than there are stars in our galaxy. (Kandel and Sielgelbaum, 1995).This lecture provides a better understanding of the synaptic transmission.

Objectives

At the end of this lecture, you should be able to:

1. explain synapse;
2. identify the forms of synapse;
3. explain what is meant by Glia cells; and
4. describe neurotransmitters

Pre-Test

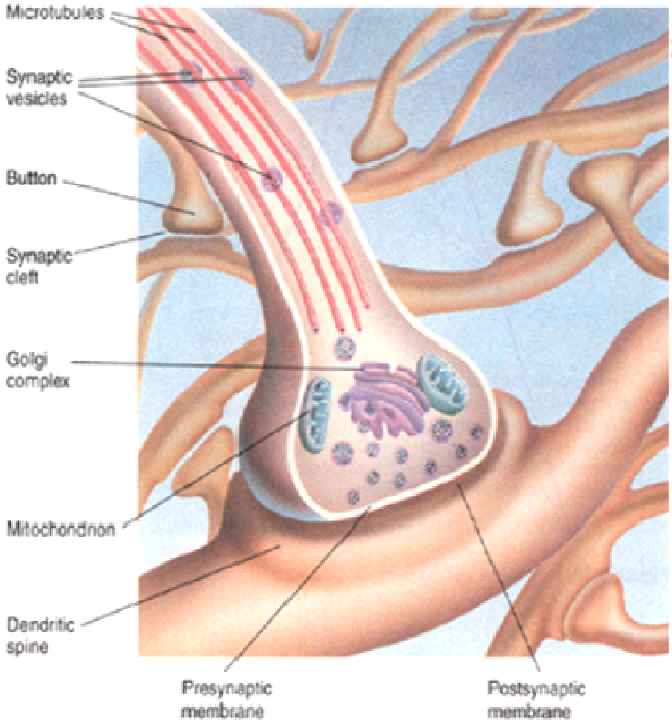
1. Explain synapse
2. Mention the forms of synapse
3. What are neurotransmitters?
4. Describe Glia cells.

CONTENT

The Synapse

Neurons do not come into direct contact with one another. They are separated by tiny gaps called synapse. The synapse is the smallest and most fundamental information processing unit in the nervous system. Synapse takes one or two forms of electrical synapse or chemical synapse. Electrical synapse directly stimulates adjacent cells. Chemical synapse stimulates adjacent cells through the use of chemical messengers (Freberg, 2006).

Anatomy of a Typical Synapse



Electrical Synapses

Electrical synapses between two cells are not only found in animals but in plants as well, and this suggests that they are very ancient in terms of evolution. The gap between an electrical synapse is quite small. It is only

3.5mm wide. In contrast, the average gap between pre-synaptic neuron and post synaptic neurons at a chemical synapse is about 20mm wide. The pre-synaptic and the post-synaptic cells at an electric synapse are joined by special protein channels that essentially connect the two cells. These channels make it possible for positive current from the neuron pre-synaptic to flow directly into the postsynaptic neuron. The main advantage of the electrical synapse is speed. Transmission of a message from one cell to another is nearly instantaneous. In contrast, chemical synapse takes between 0.3mm to several milliseconds in order to complete the series of steps involved with transmitting the message from one cell to the next.

Although electrical synapses are fast, chemical synapses have the advantage of providing a much greater variety of responses. The only type of message that can be sent at an electrical synapse is an excitatory one. Excitation means that only one cell can tell the next cell to produce an action potential. Another major advantage of chemical synapses over electrical synapses is that a very small pre-synaptic neuron, using a chemical messenger, can still influence a large post-synaptic neuron. In the case of an electrical synapse, it takes a very large pre-synaptic neuron to influence a tiny post-synaptic neuron, and this is simply due to the electrical requirements of this type of transmission.

Chemical Synapses

In chemical synapse, neurotransmitter substance released by the pre-synaptic neuron floats across the synaptic gap to receptor molecules embedded in the synaptic membrane of the post-synaptic cell. Although, this takes more time than transmission at an electrical synapse, it allows neurons to send a much variety of information. The argument that neurons communicate with each other via a chemical transmission process is therefore robust. Discussion of signalling at chemical, synapse involves two steps; the first step is the release of neurotransmitter chemicals by the synaptic cell. The second step is the reaction of the postsynaptic cell to the neurotransmitters. Chemical synapses are found only in between nerve cells or between nerve cells and the gland cells, and the muscle cells that they innervate. The post-synaptic membrane contains receptors from the transmitter substance released from the pre-synaptic terminal. Prior to release, molecules of neurotransmitters are stored in synaptic vesicles. The vesicles contain substances involved in the chemical transmission process of the neurons called neurotransmitters. The process by which the vesicles

release, their contents is known as *exocytosis*. After its release the transmitter acts on a receptor in the post synaptic membrane. There is also a deactivation of the neurotransmitter. The neurotransmitter is either destroyed or taken back into the terminal from which it came, where it can be re-used or degraded and removed.

Neurotransmitters

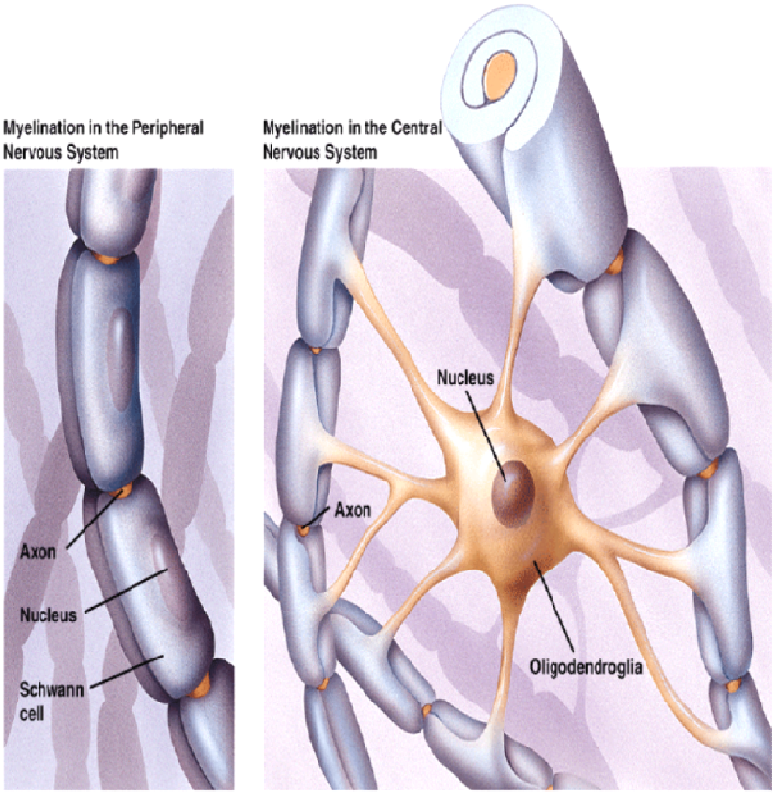
Neurotransmitters are specialised chemicals that carry neural information. Neurotransmitters act on neurons in their own immediate vicinity generally at a synapse. A neurotransmitter can be thought of as a key and a receptor as a lock. The same type of key can in principle be used to open many different types of locks. Receptors can be classified broadly as excitatory (causing an increase in firing rate,) inhibitory (causing a decrease in firing rate), or modulatory (causing long lasting effects not directly related to firing rate). In principle, a single neuron releasing a single neurotransmitter can have excitatory effects on some targets while having inhibitory effects on others. Some of the major transmitters substances that have been identified include: nor-ephinedrine (NE) (also known as nor-adrenaline) 5-hydroxyltryptamine (5HT) (also known as serotonin) Dopamine (DA) gamma-amino butyric acid (GAMA), Acetylcholine (ACH) and are used excitatory neurons to stimulate postsynaptic neurons, while others such as GABA have inhibitory effect.(Uguru-Okorie,1990). The tiny space that separates the pre-synaptic space or synaptic cleft contains the extra-cellular fluid that provides a medium through which the neurotransmitter substances can diffuse to the post-synaptic membrane. When an axon fires or propagates an action potential, a number of synaptic vesicles migrate to the pre-synaptic. They adhere to the membrane and rupture. The rupture spills their content into the synaptic cleft, thus releasing the chemicals into the gap. (Sollner and Rothman, 1994; Shira and Nichols, 1993.)

Following this, the chemicals diffuse through the synaptic fluid to reach the postsynaptic membrane. After the nerve impulse has crossed the synaptic gap and the impulse transmitted to the postsynaptic neuron, the neurotransmitters are destroyed by an enzyme or re-absorbed into the pre-synaptic vesicles (Smith, 1998). This process moderates the message transmission function of the neuron. The valuable and useful message transmission function of the neuron is further highlighted in the next section, which discusses its parent structure, the nervous system.

Other Cells and Structures of The Nervous System

We have discussed characteristics of neurons and how they communicate. It must be noted that neurons are not only the cells making up the brain. There are other non-neural cells, even though neurons are the most important. The cellular machinery of the brain also depends on the active participation of the Glia, vascular elements and the connective tissue elements.

Myelination of PNS and CNS Axons



Glia

The extracellular space between the nerve cells is fixed with specialised support cells called Glia. Unlike the neurons, glia does have the capacity to divide and form new cells. The glia, whose name comes from the Greek word for glue, serves a variety of support functions for neurons. In the human nervous system, there are at least 10 to 50 glia for every neuron

(Freberg, 2006). Glia are generally categorised by size. The macroglia are the largest varieties of glia cells, while the microglias are the smaller varieties. There are three primary types of microglia, which are astrocytes, oligodendrites and schwann cells. The astrocytes provide a variety of support functions to neurons whereas the oligodendrites and Schwann cells supply the myelin covering that insulates axon fibres.

Astrocytes derive their name from their star-like shape. Astrocytes are the most common type of glia in the brain. Astrocytes are thought to clean up excess transmitters and ions from the extracellular spaces, thereby helping to keep the intractions that take place on the neurons surfaces free of background chemical noise. Astrocytes may also contribute glucose to very active nerve cells, and they may redirect the flow of blood and therefore the transport of oxygen to especially active regions. This glia may also be important in providing some of the signals essential for the regulation of synaptic function. Although none of these proposals is yet certain, scientist do know that after minor damage to the brain, astrocytes scavenge the dying neurons, an action that helps limit the spread of toxic substances (Bloom, *et al*, 2001).

Oligodendrites type of glia is better defined by their function than by their shape. Some axons are insulated in a way that customises them for rapid conduction of electrical impulses. This cellular insulation called mylin is a compact wrapping material consisting of layers of membrane that project from the oligodendrites cell body. Oligodendrites and Schwann cells provide the myelin covering that insulates some axons (Peters, Paky and Webster, 1991). Oligodendrites provide the myelin in the central nervous system. Schwann cells supply the myelin for the peripheral nerves exciting the brain and spinal cord. A single oligodendrites put out a number of processes that wrap themselves around the axon of adjacent neurons. Because a single oligodendrite may myelinate axons from an average of 15 different neurons, this microglia contribute to the stability of the brain and the spinal cord.

Schwann Cells

In the peripheral nervous system, the glia cell that forms myelin is known as the Schwann cell and has slightly different synthesising abilities and chemical properties from those of the oligodendrites. A single Schwann cell provides myelin for only one potential axon. It takes a large numbers of Schwann cells to myelinate a peripheral nerve (Freeberg, 2006).

We can see the importance of myelin by studying conditions in which it is damaged. The diseases multiple sclerosis (MS) involves a progressive demylination of the nervous system. The end-result is neural signalling that may not work properly, leading to range of symptoms from mild (increased fatigue) to more severe (mobility problems) to death. Oligodendrites and Schwann cells differ in their reactions to injury. The Schwann cells actually help to guide the regrowth of damaged axons, whereas the oligodendrites lack this capacity.

Microglia

You may not like the idea of having brain debris. However, like any other cell, neurons and glia do die. Rather than leave the debris lying around where it might interfere with neural function, the microglia serve as the brain's cleanup crew. Like certain astrocytes, these tiny cells are mobile and can travel to locations of injury where they digest the debris.

Vascular Elements

Among the other neuronal cells of the nervous system are those of the blood vessels like the arteries, veins and capillaries, which make an essential contribution to its vitality. The brain receives a privileged share of oxygenated blood. In fact, all the muscles of your body together when fully active draw only about 25 percent more oxygen than the brain does. The blood vessels of the central nervous system are unlike those of the rest of body in that they lack the ability to transport large molecules across their walls.

Connective Tissue Elements

These non-neuronal cells line the outer and inner surfaces of the central nervous system. Within the bony continues of the surfaces of the skull and the spinal cord, the CNS is sealed into a form fitting, fluid filled stocking of membranes called the meninges made up of conventional connective tissues found elsewhere in the body. The fluid is the cerebrospinal fluids. THE meninges and the cerebrospinal fluid act as a shock absorber system to soak up the twists, turns, bumps and other insults to the body that would severely hamper the integrity of the nervous system where they are to be transmitted full force.

Summary

1. The synapse is the smallest and most fundamental information processing unit in the nervous system.
2. Synapse takes on or two forms electrical synapse or chemical synapse.
3. The gap between an electrical synapse is quite small. It is only 3.5mm wide.
4. In contrast, the average gap between pre-synaptic neuron and post synaptic neurons at a chemical synapse is about 20mm wide.
5. In chemical synapse neurotransmitter substance released by the presynaptic neuron floats across the synaptic gap to receptor molecules embedded in the synaptic membrane of the post synaptic cell.
6. Neurotransmitters are specialised chemicals that carry neural information.
7. The extracellular space between the nerve cells is fixed with specialised support cells called glia.
8. Glia are generally categorised by size. The microglias are the largest are the smaller varieties.
9. There are three primary types of microglia which are astrocytes, oligodendrites and Schwann cells.
10. In the peripheral nervous system, the glia cell that forms myelin is known as the Schwann cell.

References

Schultz, D.; Schultz, E. S.; (2002). *Psychology and Work Today*. Prentice Hall New Jersey.

Bloom, F.; Nelson, C. A.; Lazerson, A. (2001). Brain, Mind and Behaviour Educational Broadcasting Corporation, NY.

Freeberg, L. (2006) *Discovering Biological Psychology*. Houghton Mifflin Company.

LECTURE FOUR

Major Anatomical Divisions and Subdivisions of the Brain

Introduction

The human brain is divided into parts. Each part plays different functions that act together to organise the wide range of integrated behaviour human-being evince. The anatomical organisation of the brain is largely hierarchical, but its operational organisation is not [Bloom et al, 2001].

Many parts of the brain have been mainly grouped into three; namely, the Hindbrain, the Midbrain and the Forebrain. The subdivisions are discussed when each of the major parts is taken up. Students should visit the human laboratory in the University to view a specimen of the brain for details. This will serve as a good background for reading and understanding this lecture.

Objectives

At the end of this lecture, you should be able to:

1. identify the parts of the brain;
2. describe the cerebrum;
3. describe the thalamus; and
4. describe the midbrain, and the hindbrain.

Pre-Test

1. Enumerate the anatomical organization of the brain
2. List the parts of the human brain
3. Describe the cerebrum and the hindbrain.

CONTENT

Overview of the Human Brain

The human brain is a unique and complex structural part of the human body. It facilitates vital and complicated physiological and psychological functions. The human brain is unique because it contains billions of neurological connections that work together to carry out complex functions. Different parts of the brain are responsible for specific functions. Injury affecting any one part of the brain may rob a person of many essential facilities. Familiarity with the brain anatomy provides better understanding of how traumatic brain injury impairs brain function and how it affects a person's behaviour, consciousness and quality of life. The brain weighs about 2.75 pounds and has a whitish pink appearance.

The brain is made up of many cells, and it is the control center of the whole body. The brain flashes messages to all the other parts of the body. The messages travel in very fine threads called nerves.

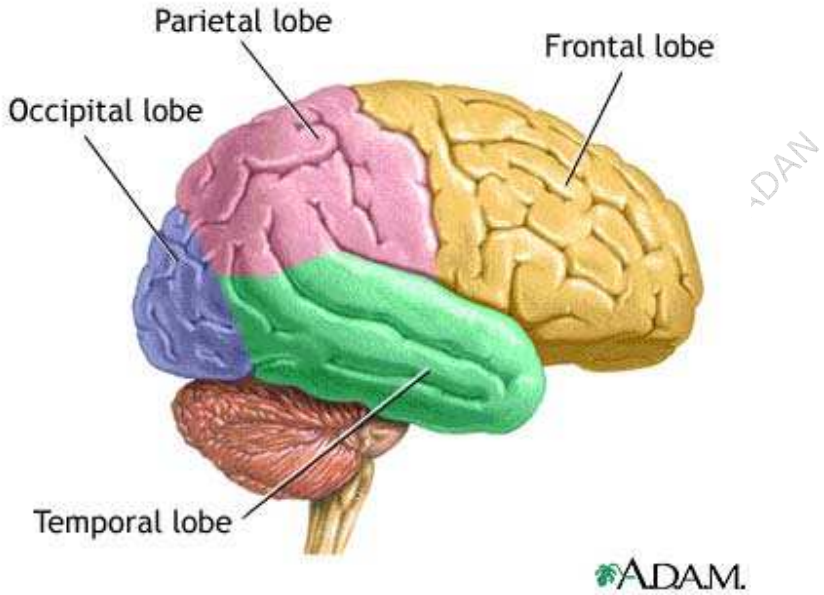
The nerves and the brain make up a system somewhat like telephone poles carrying wires across a city. This is called the nervous system. Some nerves are directly linked to the brain. Others have to reach the brain through a sort of power-like down the back and this is called the spinal cord. The brain and spinal cord make up the central nervous system. The brain doesn't just control your organs, but can also think and remember. That part of the brain is called the mind. Twenty-eight [28] bones make up the skull. Eight of these bones are interlocking plates. These plates form the cranium.

The cranium provides maximum protection with minimum weight, the ideal combination. Another way the brain keeps itself safe is by keeping itself in liquid. Nearly one-fifth of the blood pumped by the heart is sent to the brain. The brain then sends the blood through an intricate network of blood vessels to where the blood is needed.

Specialised blood vessels called Choroid Plexuses produce a protective cerebrospinal fluid. This fluid is what the brain literally floats in. A third protective measure taken by the brain is called the Blood Brain Barrier. This barrier consists of a network of unique capillaries. These capillaries are filters for harmful chemicals carried by the blood, but they do allow oxygen, water and glucose to enter the brain.

The brain is divided into three main sections; the forebrain, the midbrain and the hindbrain. The forebrain consists of the cerebrum,

thalamus and hypothlamus [part of the limbic system]. The midbrain consists of the tectum and tegmentum



Source: Fitch, R. H. (2008) Psyc 2200, Section 002 (Formerly Psyc 257) Textbook Support Biopsychology News Wesbsite: http://www.Biopsychology.Com.

Cerebrum

The cerebrum or cortex is the largest part of the human brain associated with higher brain functions, such as thought and action. It lies anterior to the midbrain, and it is understood to have two areas, which are cortical and subcortical. The thin top layer of the forebrain is the cortex, while the sub-cortex includes all structures underneath the cortex. These are the thalamus, hypothalamus, the limbic system and the basal ganglia. All structures of the forebrain are divided by a deep furrow into two halves, known as the left and right hemispheres. The two hemispheres look mostly symmetrical, yet it has been shown that each side functions slightly different than the other. Sometimes, the right hemisphere is associated with creativity and the left hemisphere is associated with logic abilities. The corpus callosum is a bundle of axons, which connects these two hemispheres.

The Thalamus

Is often compared with a switching center but could also be likened to an air line hub where planes converge and then take off for far-flung destination [Kosslyn and Rosenberg, 2006].The sensory systems such as vision and hearing and the motor system that control muscles have neural connections to the thalamus, which routes their signals to other parts of the brain. The thalamus is also involved in attention; as a matter of fact, at this very second, your thalamus is allowing you to fix your attention on each word you read. The thalamus is also involved in sleep control. The thalamus plays such a critical role in daily life that if it is badly damaged, the patient will die, even if the cortex remains untouched.

The Hypothalamus

The hypothalamus sits under the thalamus. It is a very small structure making up only 3% of the brain [Hoffman and Swaab, 1992]. The small size of this structure shouldn't fool you. It is absolutely critical for controlling many bodily functions such as eating and drinking, keeping body temperature, blood pressure and heart rate within proper limits and governing sexual behaviour [Swaab, 2003]. The hypothalamus also regulates hormones, such as those that prepare an animal to fight or to flee when confronted by danger. Like the thalamus, the hypothalamus consists of clusters of neurons. The hypothalamus sends out neural messages and chemical messages. Neural messages from the hypothalamus regulate activities of the Autonomic Nervous System [i.e. the sympathetic and parasympathetic nervous systems] and other areas of the brain. The chemical messages of the hypothalamus regulate the activities of some glands of the endocrine system. An injury damage or disorder of the hypothalamus can result in problems such as memory loss, depression, low body temperature overacting, diabetes and chronic drowsiness [Martin and Riskind, 1992].

The Limbic System

Is situated very close to the hypothalamus. It separates the thalamus from the cortex and it includes separate entities like the amygdala and hippocampus. All the structures of the limbic system are involved in the control of emotion and motivation, temperature, food and water intake and the maintenance of homeostasis. The amygdala is an almond shaped

structure, situated near the hippocampus [Its name means almond in ancient Greek]. The amygdala plays a special role in emotion such as fear and anger [Morris & Dolam, 2002] and even affects whether one can read, emotions in facial expression [Adolph, et al, 1996]. The Hypothalamus and Amygdala play crucial roles bridges between the central nervous system and the peripheral nervous system. Both are key components of the limbic system.

Basal Ganglia

Basal Ganglia are positioned on the outer-sides of the Thalami. It is involved in planning and producing movement [Iansek & Porter, 1980]. People with Parkinson disease often have abnormal basal ganglia; the functioning of these structures depends crucially on dopamine. The basal ganglia also play a critical role in a particular type of learning: forming a habit. The neurotransmitter, dopamine is central to the operation of this structure.

The Midbrain

The midbrain lies above the medulla and pons and between the forebrain and the hindbrain. It surrounds the cerebral aqueduct [the fourth ventricle of the midbrain] and contains four structures; they are the Tectum, Substantial Nigra, the Tegmentum and the Reticular Activity System [RAS].

The tectum is made up of two pea-shaped nuclei located at the roof of the midbrain; on the dorsal surface of the midbrain are four prominent bumps. The upper pair is known as the Superior Colliculi. The Superior Colliculi received input from the optic nerves leaving the eye. The other pair of bumps is known as the Inferior Colliculi. These structures are involved with hearing or audition. The structures are also involved with auditory reflexes, such as turning the head in one direction of a loud noise. The Inferior Colliculi also appears to participate in the localization of sounds in the environment by comparing the timing of the arrival of sounds at the two ears.

The Substantia Nigra, whose name literally means “black stuff” due to the pigmentation of the structure, is closely connected with basal ganglia of the forebrain. Degeneration of the Substantia Nigra occurs in Parkinson’s disease, which is characterised by difficulty in moving. The

substantia Nigra is involved with processing motor information coming from higher brain centers. It is also responsible for controlling neuromuscular activities. As such, its removal damage or injury results in sensory motor dysfunction [Uguru-Okorie, 1990].

The tegmentum connects the hindbrain and the forebrain via it's ascending and descending fibre tract. It also contains nuclei which plays an important role in the control of eye muscles. The Reticular Activating System, though classified as a structure of the midbrain, is diffuse and runs from the medulla and pons through the midbrain to the forebrain [Smith, 1998].

This structure is responsible for wakefulness and arousal [Steriade, 1996] The role of the Reticular Activating System [RAS] as a midbrain structure lies in the effects of its nerve fibres that ascend to the cerebral cortex, activates the cortex to produce a diffuse state of arousal.

The Hindbrain

The major parts of the hindbrain are the pons [bridge], the medulla oblongata and the cerebellum. The structures within the pons, medulla and cerebellum generally interact with telencephalon structures by relays through the midbrain and the diencephalons, with some exceptions. The fields and nuclei of the pons and medulla, which control respiration and heart rhythms, are critical to survival. The cerebellum stores the basic repertoire of learned motor responses. Because the cerebellum is attached to the roof of the hindbrain, it is thought to receive and modify information related to body and limb position before that information makes its way to the thalamus and cortex. The hindbrain, midbrain and diencephalons together are also called the brainstem. This stem contains almost all of the connections between the cerebral cortex and the spinal cord [Bloom, et al, 2001]. The gradual swelling of tissue above the cervical spinal cord marks the most caudal portion of the brain called the medulla**.**

The Medulla

Like the spinal cord contains large quantities of white matter. The vast majority of all information going to and from higher structures of the brain must still pass though the medulla. Instead of the butterfly appearance of the gray matter in the spinal cord, the medulla contains a number of

nuclei, or collection of cell bodies with a shared function. These nuclei are suspended within the white matter of the medulla. Some of these nuclei contain cell bodies whose axons make up several of the cranial nerves serving the head and the neck area. Other nuclei manage essential functions, such as breathing heart rate and blood pressure. Damage to the medulla is rapidly fatal due to its control over these vital functions. Along the midline of the upper medulla, there is the caudal portion of a structure known as the reticular formation.

The Reticular Formation

Is a complex collection of nuclei that runs along the midline of the brain stem. The structure gets its name from the Latin *reticulum* or *network*. The reticular formation plays an important role in the regulation of sleep and arousal.

The Pons

Immediately rostral to the medulla is the Pons. Pons means "bridge" in Latin and one of the roles of the pons is to form connections between the medulla and the higher brain centers. In addition, the pons form connections with another hindbrain structure, the cerebellum. As in the medulla, large fiber pathways with embedded nuclei are found in the pons. Among the important nuclei found at this level of the brainstem are the *cochlear nucleus and the vestibular nucleus*. The fibers communicating with these nuclei arise in the inner ear. The cochlear nucleus receives information about sound and the vestibular input helps to keep our balance [or makes us feel motion sickness on occasion]. The reticular formation which began in the medulla continues through the level of the pons. The pons contains a number of other important nuclei that have wide ranging effects on the activity of the brain. Nuclei located within the pons are necessary for the production of rapid-eye-movement [REM] sleep. The raphe nuclei and locus coeruleus project widely to the rest of the brain and influence states of arousal and sleep (Freeberg, 2006].

The Cerebellum

The cerebellum looks almost like a second little brain attached to the dorsal surface of the brainstem. Its name *cerebellum* actually means *little brain* in Latin. The internal structure of the cerebellum looks like a tree

when viewed with a sagittal section. White matter or axons form the trunk and branches while gray matter or cell bodies form the leaves. The cerebellum is responsible for co-coordinating voluntary movements, maintaining muscle tone and regulating balance. Input from the spinal cord tells the cerebellum about the current location of the body in three dimensional spaces. Input from the cerebral cortex by way of the pons tells the cerebellum about the movements you intend to make. The cerebellum then processes the sequences of muscle movements required to carry out the plan.

Damage to the cerebellum primarily affects skilled movements. The patient's speech may be affected as well. Some words may be slurred whereas others may be explosively produced. Alcohol has rather quick adverse effects on the cerebellum. Most sobriety tests such as walking a straight-line or pointing in a particular direction are actually tests of cerebellar function. Because the cerebellum is one of the first brain structures affected by alcohol, its status is useful in assessing level of a person's intoxication. Along with the vestibular system, the cerebellum contributes to the experience of motion sickness. Lesions of the nodulus; a small section on the inferior surface of the cerebellum, abolish motion sickness in dogs.

Summary

1. The human brain is a unique and complex structural part of the human body. It facilitates vital and complicated physiological and psychological functions.
2. The brain weighs about 2.75 pounds and has a whitish pink appearance.
3. The nerves and the brain make up a system somewhat like telephone poles carrying wires across a city. This is called the nervous system. Some nerves are directly linked to the brain.
4. Injury affecting any one part of the brain may rob a person of many essential facilities.
5. The brain is divided into three main sections; the forebrain, the midbrain and the hindbrain.
6. Twenty-eight [28] bones make up the skull. Eight of these bones are interlocking plates. These plates form the cranium.
7. The Forebrain consists of the cerebrum, thalamus and hypothalamus [part of the limbic system].
8. The midbrain lies above the Medulla and Pons and between the Forebrain and the hindbrain. It surrounds the cerebral aqueduct =[the fourth ventricle of the midbrain] and contains four structures, they are the tectum, substantial nigra, the tegmentum and the reticular activity System [RAS].
9. The tectum is made up of two pea-shaped nuclei located at the roof of the midbrain.
10. The tegmentum connects the hindbrain and the forebrain ……. It's ascending and descending fibre tract. It also contains nuclei which plays an important role in the control of eye muscles
11. The substantial nigra, whose name literally means "black stuff" due to the pigmentation of the structure, is closely connected with basal ganglia of the forebrain. Degeneration of the substantial nigra occurs in Parkinson's disease which is characterised by difficulty in moving.
12. The substantial nigra is involved with processing motor information coming from higher brain centers. It is also responsible for controlling neuromuscular activities. As such, its removal, damage or injury results in sensory motor dysfunction.

Post-Test

1. Discuss the anatomical organisation of the brain
2. Identify the parts of the human brain
3. Describe the forebrain, the midbrain and the hindbrain

References

Schultz, D.; Schultz, E. S.; (2002). *Psychology and Work Today*. Prentice Hall New Jersey

Bloom, F.; Nelson, C. A.; Lazerson, A. (2001). *Brain Mind and Behaviour*. Educational Broadcasting Corporation NY.

Freeberg, L. (2006). *Discovering Biological Psychology*. Houghton Mifflin Company.

LECTURE FIVE

Vision I

Introduction

The processes of sensation and perception lie at the root of our experience of being alive, serving as the foundation for most of what we know and do. If we cannot sense the world, then for all practical purposes, it does not exist for us. If we sense it incorrectly, our world will be bent and distorted. To understand mental processes and behaviour, therefore, we must understand how our senses allow us to make contact with the world.

Objectives

At the end of this lecture, you should be able to:

1. explain visual sensation and perception;
2. describe the anatomy of the eye;
3. describe colour vision; and
4. identify visual problems.

Pre-Test

1. Explain visual sensation and perception
2. Describe the anatomy of the eye.

CONTENT

Visual Perception

Visual perception is not accomplished in one fell swoop but in two broad phases. First, visual sensations are evoked by an object or event. Second, you actually perceive the stimulus perception occur when you've

organised and interpreted the sensory input as signalling a particular object or event.

Sensations: Psychologist defines sensation as the registration of properties of an object or event that occurs when a type of receptor [such as those at the back of the eye, in the ear, on the skin] is stimulated. Sensations arise when enough physical energy strikes a sense organ so that receptor cells send neural impulses to the brain. Receptors in general are like locks which are opened by the appropriate key; for sensory receptors, the appropriate physical energy or molecule serves as the key. In the study of vision, the entire cell that responds to physical stimulation is called a receptor and not just the parts that register the input. It is the signals sent by these receptors that cause you to become aware of the outside world. Visual sensation arises in the eye and in the first parts of the brain that register visual input.

Perception

Perception relies on two phases of processing [Marr, 1982; Nakayama, *et al*, 1995]

1. **Organisation into coherent units**: You don't see isolated blobs and lines; you see surfaces and objects. At the outset, you must organise patches of colour, texture, edges and other basic visual elements into coherent units, which usually correspond to surfaces and objects, such as the haystacks in a monet painting. As part of this process, you need to register the sizes and locations of objects.
2. **Identifying what and where**: But these surfaces and objects don't have meaning; they are just surfaces and forms. The processes that organise the input are a prelude the final task of perception, which is to recognise and identify what you see, to realise, you are seeing a haystack and not a honey comb. In addition to identifying what the object is, you need to identify where in space the object is; so you can get into your car when it is parked but avoid cars when crossing the streets.

The sense of vision sight is one of the five classical senses, which assumes greater importance than any other sensory system. This is so because we obtain more information about our environment in what we see than what we hear or smell. The brain is also related to vision

activities than other activities of sensory perception. The eye is the organ of the sense of sight.

The Human Eye

The human eye is roughly a sphere with a diameter just under an inch similar to a small ping-pong ball. The "white" of the eye or sclera provides a tough outer covering that helps the fluid-filled eyeball maintain its shape. Eyes are located in the bony orbit of the skull, which can deflect many blows. In addition, the eye is cushioned for support and protection by fat. When people are starved, they show a characteristic hallow-eyed look due to the loss of this important fat cushion. The orbital cavity is almost spherical in shape and is about 2.5cm in diameter. The eye is also protected by the eyelids. The eyelids can be opened and closed either voluntarily or involuntarily. Involuntary closure of the eyelids or a blink protects the eye from incoming objects. In addition, blinks moisten and clean the front of the eye. A tear is another feature of the eyes protective system. Tears are primarily produced in the lacrimal gland at the outer corner of each eye. The fluid is composed of water and salt, and it also contains glucose proteins and substances that kill bacteria. Tears flush away dust and debris and moisten the eye so that the eyelids don't scratch the surface during blinks. When we cry in response to any emotional event, the composition of these tears is somewhat different.

The Anatomy of the Eye

Structurally, the two eyes are separate but unlike the ears, some of their activities are co-ordinated so that they function as a pair. It is possible to see with only one eye but three dimensional visions is impaired when only one eye is used, especially in relation to distance. There are three layers of tissue of the eye. The outer fibruous layer is made of sclera and cornea. The middle vascular layer or Uveal Tract is made of the choroids, ciliary body and iris. The inner nervous tissue is made up of retina. The structures inside the eyeball are the lens, aqueous fluid/humor and vitreous fluid/humor.

The Choroids: The choroid is deep chocolate brown on colour. Light enters the pupil and stimulates the nerve endings in the retina. It is then absorbed by the choroids. The choroid is very rich in blood vessels.

The Ciliary Body: This consists of ciliary muscles and secretary epithelial cells. The contraction and relaxation of the ciliary muscle change the thickness of the lens, which bends or refracts light rays entering the eye to focus them on the retina. The epithelial cells secret aqueous into the anterior chamber of eye.

Anatomy of The Eye

The Public: Light enters the eye through an opening called the pupil. Surrounding the pupil is a circular muscle called the iris.

The Iris: This is the circular muscle that adjusts the size of the pupil. The iris changes the size of the pupil to let in more or less light.

The Cornea: This is the transparent covering over the eye, which serves partly to focus the light onto the back of the eye.

The Len: The light is also focused by the lens. Unlike a camera lens, the lens in a human eye flexes. The muscles can adjust the lens into a more or less round shape to focus light from objects that are different distances away.

Accommodation: Is the automatic adjustment of the eye for seeing at particular distances. This occurs when muscles change the shape of the lens so that it focuses light on the retina from near or far away objects. The world appears sharp and clear because we are constantly moving our eyes and what we choose to look at, can quickly be brought into focus. With age, the lens thickens and becomes less flexible, [Fatt & Weissman, 1992] often causing older people to have trouble seeing nearer objects, such as reading material.

Retina: This is a sheet of tissue at the back of the eye containing cells that convert light to neural impulses. This tissue is almost as thick as a piece of paper [Wassle, 2004]. The central part of the retina contains densely packed cells that transform light to nerve impulses and this region is called the Fovea. In the retina, there are two kinds of cells which are important for converting light to nerve impulses; they are the rod and cones.

Fovea: The Fovea gives us the sharpest images. We are not usually aware of how fuzzy our world looks. Most of the time, we notice only the images that strike the fovea, which are sharp and clear, but much of what we see is in fact not very sharply focused. The Fovea is the small, central region of the retina with high density of cones and the highest resolution.

Rods

This is a cell found in the retina. They look like little rods and are extraordinarily sensitive to light, but they only allow us to see shades of gray. Each eye contains between 100 million and 120 million rods. These rod shaped retinal cells are very sensitive to light but register only shades of gray.

Cones

This is a cell found in the retina. They look like cones. They are not as sensitive to light as the rods. They are of 3 types and each of the three types of cones responds most rigorously to a particular wave length of light which allows us to see colour. Each eye contains between 5 million and 6 million cones [Bealty, 1995; Dowling, 1992]. The cones are densest near the Fovea, but the rods are everywhere within the retina except in the Fovea. In very dim light, there isn't enough light for the less light sensitive cones to work, so night vision is based on the firing of the rods alone. That is why a red apple looks black, and an orange cat looks grey under a moonlit night sky. Cone-shaped retinal cells respond most strongly to one of three wavelengths of light; the combined outputs from cones that are most sensitive to different wavelengths play a key role in producing colour vision. The rods allow us to see with less light but not in colour; the cones allow us to see colours but are not as light sensitive as the rods.

Optic Nerve

These are a large bundle of nerve fibers carrying impulses from the retina into the brain. The optic nerve is almost as thick as your little finger. There is no rod or cones at the place where the optic nerve exits the retina, which causes a "blind spot" in what you can see, laid out in front of you. Because the brain completes patterns that fall across this blind spot, you are not aware of it as you look around every day.

Transduction

The eye converts the electromagnetic energy that is light into nerve impulses. This conversion process is called transduction. The critical step in transduction occurs at the retina.

Dark Adaptation

This is the process whereby exposure to darkness causes the eyes to become more sensitive, allowing for better vision in the dark. When you first enter a darkened theatre, you can't see a thing you may have noticed, though, that the risk of tripping or bumping into someone is a lot less, if you wait for a brief time, because you soon can see much better. In fact, after about 30 minutes in the dark, you are about 100,000 times more sensitive to light than you are during full daylight. In ideal conditions, the rods can respond when they receive a single photon, the smallest unit of light.

This process is called dark adaptation. Part of the increased sensitively to what light there is, arises because your pupil enlarges when you are in darkness; in fact, it can expand to let in about 16 times as much light as enters in full daylight. In addition, the rods actually become more sensitive as your eyes remain in the dark because your genes cause the production of a crucial chemical called rhodopsin that responds to light. Because of the way the rods are arranged on the retina, if you want to see best at night, look slightly to the side of what you want to examine [Freeberg, 2006].

Circadian Behaviour: This is a behaviour that follows the daily pattern of light, such as walking and sleeping. Berson and colleagues [2002] found that certain ganglion cells in the retina respond to illumination in just the right ways to the observed effects of light on behaviour. Thus, rods and cones are not the whole story; we have not two but three kinds of cells that tranduce light into neural impulses.

LECTURE SIX

Vision II: Colour Vision

Introduction

Colour plays a key role in our appreciation of beauty in art, nature and people. One way to tell whether an apple is ripe is to look at its colour. Certain colours are associated with objects or feelings. Yellow is associated with madness, sickness and fear and a reddish purple with liveliness [Herrera, 1983]. This lecture enables students to understand, among others, that colour is not just a "luxury feature" of vision; for one thing, colour helps us make the fundamental distinction between shadows that are cast by objects versus variations in how light is reflected from objects [Kingdom, *et al*, 2004].

Objectives

At the end of this lecture, you should be able to:

1. explain colour vision;
2. describe the variability of colour; and
3. identify visual problems.

Pre-Test

1. Explain colour vision
2. Describe the variability of colour
3. Identify visual problems.

CONTENT

Colours vary in three separate ways.

Hue

Different wavelengths of light produce sensations of different colours. This aspect of colour is called hue.

Saturation

The purity of the input produces the perception of saturation that is how deep the colour appears.

Lightness

The amplitude of the light waves produces the perception of lightness or brightness, that is, how much light is present. Different combinations of valves on these three dimensions produce the incredibly rich palette of human colour vision, which is more varied than that used by any painter. Colour arises through the operation of two distinct types of processes.

Colour Mixing

Observations reported by Young and Helmholtz in the 19th century focused on the phenomena such as the mixing of colours to produce new colours [for example mixing yellow and blue paint produces green]. These researchers believed that the brain registers colour by combining responses to separate wavelengths. In particular, they argued that the eye contains three kinds of colour sensors, and each most sensitive to a particular range of wavelength which could be long, medium or short. This view was therefore called the trichomatic theory of colour vision.

Trichomatic Theory of Colour Vision

This is the theory that colour vision arises from the combinations of neural impulses from three different kinds of sensors, each of which responds maximally to a different wavelength.

A Colour Tug- of- war

Hering Ewald, a German physician in the 20th Century noticed that some colours cannot be mixed. For example, you can't make reddish-green [it becomes mud] or yellowish-blue [it becomes green]. This and similar observations led Hering to develop the opponent process theory of colour vision.

The Opponent Process Theory of Colour Vision

This theory proposed that if colour is present, it causes cells that register it to inhibit the perception of the complementary colour [such as red versus green].

Afterimage

This is the image left behind by a previous perception.

An afterimage occurs when one member of a pair of opponent cells inhibits the other; for example, green inhibits red, and then releases it. In the process, the previously inhibited hue [red] temporarily overshoots the mark, creating an afterimage.

Opponent Cells

These are cells that put the colours in a pair most notably blue/yellow or red/green, against each other. When you gaze at a lovely green lime, for example, your opponent cells are making it difficult for you to see the red of a delicious apple.

This is the sort of effect Hering predicted. This opponent process helps you to distinguish among colours that have similar wavelengths such as green and yellow. This mechanism explains why you can't see greenish-red or yellowish blue. Seeing one member of a pair inhibits seeing the other. It also explains why you see afterimages.

Colour Blindness

This is an inability, either acquired [by brain damage] or inherited to perceive certain hues]. People who have colour blindness are either unable to distinguish two or more hues from each other or in more serious cases, unable to see hue at all. Most colour blindness is present from birth. Rather than being completely insensitive to hue, most colour-blind people are unable to distinguish red from green. Researchers have identified specific genes that lead to colour blindness [Tanabe, et al 2001]. Some people only become colour blind after a particular part of their brains is damaged.

Visual Problems

The visual system is so complicated, and it does not always work perfectly. It is estimated that less than a third of the world's population has perfect vision [Seuling, 1986]. Problems in the visual system affect both absolute and relative thresholds and can also distort the stimuli reaching the retina.

Visual Activity Problems

This includes Myopia, Hypermetropia and Astigmatism

Myopia

This is also referred to as near sightedness. It causes people to have difficulty in focusing on distant objects. Myopia is caused by an eyeball that is too long to focus the image on the retina properly. In the United States, this problem affects one in five people. Myopia can be corrected by external lenses, either eyeglasses or contact lenses that focus the image correctly on the retina. Lazer surgery can be used to correct the lens of the eye itself. Time spent reading is correlated with Myopia [Young, 1981] but remember that correlation does not imply causation.

Hypermetropia

This is also referred to as farsightedness. Hypermetropia causes people to have difficulty in focusing on near objects. Such farsightedness usually results from an eyeball that is too short, or a lens that is too thin, to allow the image to focus on the retina properly. It is possible to be near-sighted in one eye and be far-sighted in the other.

Astigmatism

This is a defect in the curvature of the cornea or lens causing blurriness. Astigmatism, like near-sightedness and far-sightedness, can be corrected with eyeglasses [and sometimes with contact lenses].

Cataract

This is a cloudy part of the lens of the eye, which can cause serious visual problems including blurred vision, distorted images, sensitivity to light and glare and outright blindness [Congden, *et al*, 2003). About 70% of

Americans over 75 years have [or have had] a cataract. Cataracts are responsible for a least half of all incidents of blindness [Riordan-Eva, 1992]. Surgery can correct cataracts by removing the lens and replacing it with a substitute lens.

Macular Degeneration

The macular is a small region surrounding and including the Fovea. We are able to see objects with high resolution in the centre of the visual field courtesy of receptors in the macular Smoking not only can cause cataracts but can also cause the macula to degenerate. This causes irreversible blindness in the centre of the visual field [DeBlack, 2003; Kelly, et al, 2004].

Amblyopia

Lazy eye or Amblyopia occurs when one eye cannot focus on objects. In a patient with untreated amblyopia if left untreated, the brain will learn to ignore the input from the less functional eye. Binocular depth perception will be permanently lost.

Blindness

Blindness or total loss of vision can occur as a result of damage at many levels. Damage to the eye or optic nerves could prevent input to normally functioning visual cortical areas. If the cortical systems are still operating properly, treatments that improve input may restore some vision. Other individuals are blind due to cortical damage. In these cases, the patient may have a scotoma or region of blindness that will depend on the location and amount of cortical damage.

Visual Agnosias

These are disorders in which a person can see a stimulus but has difficulty recognising what is seen. The word 'agnosia' comes from the Greek for "without knowledge"

Prosopagnosia

In prosopagnosia, vision is retained but the person cannot recognise the faces of people he or she knows [Socks, 1985]. Patients with prosopagnosia can tell one face apart from another and can tell the gender of the people

from pictures of their faces. Inspite of these skills, these patients can't recognise faces as people that they know, not even their own image in the mirror. The fusiform face area is probably responsible for facial recognition. Prosopagnosia is usually associated with damage in this area.

Visual Perception

We can divide the steps of visual perception into two phases. In phase one, the outputs from sensory processing are organised. In phase 2, these organised units are recognised and identified.

Perceptual Organisation

In perception, separating figure from ground involves organising regions into shapes that are likely to correspond, to objects or their parts. A critical part of this process is taking fragmentary outputs from sensory processing and organising them into edges.

Figures: In perception, figures are a set of characteristics [such as shape, colour, and texture] that corresponds to an object.

Ground: In perception, a ground is the background which must be distinguished in order to pick out figures. Gestalt Psychologists discovered a set of laws that describe how the brain organises the input from the eyes [Koffica, 1935; Weitheimer, 1923].

Gestalt Laws of Organisation

This comprises a set of rules describing the circumstances, such as proximity, good continuation, similarity, closure and good form under which marks will be grouped into perception units.

Proximity: Marks that are near one another tend to be grouped together. For example, we see xxx xxx as two groups and xx xx xx as three groups even though both sets have the same total number of x marks.

Continuity: This is also called good continuation. Marks that fall along a smooth curve oral straight line tend to be grouped together. So we see ------ as a single line and not four separate dashes, and we see ----- ---- as two separate lines because all eight of the dashes do not fall on the same plane.

Similarity: Marks that look alike tend to be grouped together. For example, we see xxx_{xxx} as two groups. Whether the elements are the same

or different colours also affects similarity; this is another reason colour vision is so important.

Closure: We tend to close any gaps in a figure so a circle with a small section missing will still be seen as a circle.

Good Form: Marks that form a single shape tend to be grouped together. For example, we see [ ] as a single shape but not [-.

Ambiguous Figure: Sometimes, a figure can be organised and perceived in more than one way.

Perceptual Constancy: This is a perception of characteristics, and it occurs when an object or quality [such as shape or colour looks the same even though the sensory information striking the eye changes]. Objects in the world appear to keep their shapes, their sizes, their colours and so on even when you view them in very different positions or circumstances.

Size Constancy: This occurs when you see an object [such as a car] as maintaining the same actual size even when seen at different distances, and its image has different sizes.

Shape Constancy: This occurs when you see an object as the same shape even when you view it from different angles.

Colour Constancy: Occurs when you see colours as constant [green as green red as red] even when the lighting changes. Colour constancy arises in part because of experience.

Colour Contrast: Perception does not occur in vacuum. In the case of colour contrast, colours can look very different depending on their context. Colour contrast is primarily an effect of the ……. of colour processing in the visual system. Colour contrast refers to the fact that colours can look different depending on the surrounding colours.

The Perception of Depth: The visual system uses a number of cues to provide a sense of depth. Several of these cues are monocular, requiring the use of only one eye. We also have binocular [two-eye] depth cues that are even more effective. When eyes face front, as in humans and other predatory species, the two eyes produce overlapping but slightly different images of the visual field.

Retinal Disparity: This represents the slightly different views of the visual field provided by the two eyes. In other words, the differences between the images projected onto the retinas of both eyes result in retinal disparity. Because retinal disparity increases with distance of the object

from the viewer, we can use the degree of disparity as a strong cue for depth.

Binocular Cells: These are cells in the cortex that respond to input from both eyes. Binocular cells respond most vigorously when both eyes are looking at the same features of a visual stimulus [Hubel & Wiesel, 1962]. Binocular cells also respond to degrees of retinal disparity. Some cells fire more when their preferred features appear to be an identical distance. Others fire more when the preferred features are seen by different parts of the two eyes. These cells are known as disparity selective cells.

Disparity Selective Cells: These are binocular cortical cells that respond when their preferred features are seen by different parts of the two eyes.

Summary

1. Visual perception is not accomplished in one fell swoop but in two broad phases
2. First visual sensations are evoked by an object or event
3. Second you actually perceive the stimulus
4. Structurally, the two eyes are separate but unlike the ears, some of their activities are coordinated so that they function as a pair.
5. Light enters the pupil and stimulates the nerve endings in the retina. It is then absorbed by the choroids.
6. The eye converts the electromagnetic energy that is light into nerve impulses. This conversion process is called transduction
7. Dark adaptation is the process whereby exposure to darkness causes the eyes to become sensitive allowing for better vision in the dark.
8. The opponent process theory of colour vision proposes that if colour is present, it causes cells that register it to inhibit the perception of the complementary colour.

Post-Test

1. What is meant by colour blindness?
2. List the major anatomical functions of the eye.
3. Describe the Gestalt Laws of organisation.

References

Schultz, D.; Schultz, E. S.; (2002). *Psychology and Work Today*. Prentice Hall New Jersey

Bloom, F.; Nelson, C. A.; Lazerson, A. (2001). *Brain Mind and Behaviour*. Educational Broadcasting Corporation NY.

Freeberg, L. (2006). *Discovering Biological Psychology*. Houghton Mifflin Company.

LECTURE SEVEN

The Ear

Introduction

The ear is the organ of hearing and it essentially responds to sounds. Hearing is the sense that allows members of our sociable species to communicate in hearing and interpreting speech. Hearing also gives us other information about the world that is vital to our survival. Like vision, it is a multilevel system, with primary receptors, intermediate-level relays, a primary cortical representation and many higher integrative arrears as well. The sense of "audition" or hearing helps us to identify objects in the environment and to determine where objects are in relation to our bodies.

Objectives

At the end of this lecture, you should be able to:

1. explain auditory perception; and
2. list and discuss hearing disorders.

Pre-Test

1. What do you understand by auditory perception?
2. Discuss hearing disorders?
3. What is meant by conduction Loss?

CONTENT

Sound begins with the movement of an object in space for humans. The Medium that carries sound is usually the air, but we can also perceive the sound that travels through liquids and solids. Like light, sound interacts

with the environment as it travels from its source to the perceiver. Fabrics absorb sound waves and can be helpful in reducing noise. The height or amplitude of the wave indicates the intensity of a sound. Low amplitude waves are characteristic of soft sounds and high amplitude waves are perceived as loud. The frequency of the wave or the number of cycles per unit of time indicates wavelength. Wavelength usually time corresponds to the perceived pitch of a sound.

Long wavelengths are perceived as having low pitch whereas short wavelengths produce sounds with higher pitch. The simplest type of sound wave is a pure tone, which has a single frequency. Most sounds consist of combinations of waves. Waves that do not regularly repeat themselves are perceived as noise as opposed to identifiable tones. Sound intensity is measured in units called decibels [dB]. While a whisper is about 30 decibels, a live band blasts about 710 decibels. The higher the decimal level, the more intense the sound and the greater the danger of damaging the organ of hearing. This is why people who work near noisy equipment are always advised to wear ear protecting equipment.

The unit used to measure the frequency of sound is the Hertz [H_z] A 500 H_z sound completes 500 cycles in one second. Speech and music are made up of complex combinations of frequencies.

The Structure and Function of The Auditory System

The Structure of the Human Ear

The components that make up the ear are generally divided into three parts; the outer, the middle and the inner ear. Each part of the ear serves specific purpose in the task of detecting and interpreting sound.

The Outer Ear

The outer ear consists of the structures visible outside the body, such as the pinna.

Pinna

The pinna is the visible part of the outer ear. The pinna serves to collect and focus sounds, just like a funnel. The pinna also plays an important role in locating the source of sound. Movement of the pinna allows some species to further localise sounds or to indicate emotional states, as when a

dog puts its ears back while snarling. Sound collected by the pinna is formed primarily of cartilage and is attached to the head by muscles and ligaments. The deep central portion of the pinna is called the concha, which leads into the external auditory canal, which in turn leads to the tympanic membrane. The tympanic membrane or eardrum forms the boundary between the outer-ear and middle ear. The boundary between the middle ear and the inner ear is formed by another membrane, the oval window.

The middle ear is an air-filled cavity, which contains three interlocking bones called the ossicle. Theses are the smallest bones in the body. Each of these tiny bones is about the size of a single letter of print in this text. The purpose of these bones is to transfer sound energy from the outside ear to the fluid in the inner ear without loosing acoustic energy. The bones are called the malleus [Latin for Hammer], the incus [anvil] and the stapes [stirrup]. The ossicle attached to the tympanic membrane is the malleus, which forms a rigid connection with the incus.

The incus forms a flexible connection with the stapes. The flat bottom of the stapes, the footplate is connected to the oval window [a second membrane, covering a hole in the bone of the skull]. The middle ear solves the transfer problem in two ways. First, the connections between the ossicles are hinged, and this creates a lever action that increases the force of the vibration that the stapes bone delivers to the oval window. Second, force applied to the much smaller oval window produces much more pressure than the same force applied to the large tympanic membrane. With both force and pressure increased at the oval window, and pressure increased at the oval window, the ear can recover about 23dB of the 30dB that would otherwise be lost when sound is transferred from the air in the middle ear to the fluid in the inner ear.

The movement of the tympanic membrane and the ossicles is restricted by two small muscles, the tensor tympani and the stapedius. When the auditory system is subjected to very loud sounds that are potentially harmful to the inner ear, the two sets of muscles, the tensor tympani and the stapedius muscles contract and, in so doing, reduce the magnitude of the vibration transmitted through the middle ear. The responses of these muscles to loud noises are known as the acoustic or middle ear reflex.

The Inner Ear

The inner ear contains two sets of fluid-filled cavity embedded in the temporal bone of the skull. One set is known as the semicircular canal, and the other set is known as the cochlea [‘snail’ in Greek].

The balance portion of inner ear consists of three semi-circular canals and the vestibule. The inner ear is encased in the hardest bone of the body. Within this ivory hard bone, there are fluid hollows. Within the cochlea are three fluid-filled spaces; the tympanic canal, the vestibular canal and the middle cannal. The eight cranal nerves come from the brain stem to enter the inner ear. When sound strikes the ear drum, the movement is transferred to the footplate of the stapes; which presses into one of the fluid-filled ducts of the cochlea.

The fluid inside this duct is moved to flow against the receptor cells of the organ of corti, which fire. These stimulate the spiral ganglin which sends information through the auditory portion of the eight cranial nerve to the brain.

The organ of corti is a structure within the cochlear duct responsible for translating vibrations in the inner ear into neural messages.

Hair cells are also the receptor cells involved in balance; although, the cells of the auditory and vestibular systems of the ear are not identical, vestibular hair cells are stimulated by movement of fluid in the semicircular canals and the utricle and saccule. Firing of the vestibular hair cells stimulates the vestibular portion of the eight cranial nerve.

Auditory Perception

Perception of Pitch

Normally, we associate pitch [the high or low] quality of a sound with frequency, but pitch can also vary due to other factors other than frequency, such as the intensity or context. Pitch helps us to distinguish between low and high sounds. Pitch depends on the frequency of a sound wave. Frequency is the number of wavelengths that fit into one unit of time.

Frequencies are measured in hertz. High sounds time have high frequencies, and low sounds have low frequencies.

Loudness Perception

Our ability to detect loudness or intensity varies with the frequency of a sound. Auditory neurons can respond to higher levels of intensities by increasing their rate of response.

Localisation of Sound

Our primary means of localising sounds in the horizontal plane [in front behind and to the side] is a comparison of the arrival times of sounds at each ear. The differences in arrival time are quite small between O msec for sounds that are either straight ahead or behind you to 0.6msec for sounds coming from a point perpendicular to your head on either side. Because arrival times from sounds immediately in front or behind you are identical, these sounds are very difficult to localise accurately. Distinction between arrivals times of sound at each ear are made by neurons in the superior olive. These neurons are known as binaural neurons because they receive input from both ears.

The human ear is able to hear frequencies if 20 to 20,000 hertz. Thunder has a frequency of only 50hertz, while a whistle can have a frequency of 1,000 hertz.

Intensity

Sound is a wave and waves have amplitude or height. Amplitude is a measure of energy. The more energy a wave has, the higher its amplitude. The same sound is more intense if you hear it in a smaller area. In general, we call sounds with a higher intensity louder. Loudness cannot be assigned with numbers but intensity can. Intensity is measured in decibels.

Hearing Disorders

Hearing loss arises from a wide variety of cases and affects nearly 20 millions of Americans [Sekuler & Blake, 2002]. A person is considered legally deaf when speech sounds of 82dB or less cannot be heard. Age-related hearing loss may result from a variety of factors, including poor circulation to the inner ear or the cumulative effect of a lifetime of exposure to loud noise.

Hearing loss resulting from problems in the outer or middle ear is referred to as “conduction loss” Conduction loss may result from a build-

up of wax in the ear canal, infections of the middle ear and a disease known as otosclerosis.

People with conduction loss can be helped by use of a hearing aid, which acts by amplifying sound signals. Hearing loss may occur due to damage to the inner ear, the auditory pathways, or the auditory cortex. Some substances, such as quinine and antibiotics damage hair cells in sensitive individuals. Nicotine produces hearing loss by reducing blood supply to the ear [Zelman, 1973].

Post-Test

1. What do you understand by auditory perception?
2. Discuss hearing disorders?
3. What is meant by conduction Loss?

References

Schultz, D.; Schultz, E. S.; (2002). *Psychology and Work Today*. Prentice Hall New Jersey.

Bloom, F.; Nelson, C. A.; Lazerson, A. (2001). *Brain Mind and Behaviour*. Educational Broadcasting Corporation, NY.

Freeberg, L. (2006). *Discovering Biological Psychology*. Houghton Mifflin Company.

LECTURE EIGHT

The Body Senses

Introduction

The traditional five senses, which include sight, and smell, taste and touch were listed and described by Aristotle more than 2000 years ago. But science has improved overtime and today at least nine or ten senses have been identified by scientists. This lecture gives an understanding of the new discoveries of body senses.

Objectives

At the end of this lecture, you should be able to:

1. identify the body senses;
2. explain the somato-sensory system; and
3. describe the extra-sensory perception.

Pre-Test

1. List the body senses.
2. Explain the somato-sensory system.
3. Describe other senses.

Content

A collection of five or six senses that are called somasthetic senses have been added. These senses are concerned with perceiving the body and its position in space. They include kinaesthetic sense which is an awareness of where the limbs are and how they move the vestibular (sense of balance), touch, temperature, sensitivity and pain. There may be a sixth somasthetic sense called the magnetic sense. And, finally, some

researchers have argued that there is possibly an eleventh sense which is the extra-sensory perception or ESP (also sometimes called the psi)

The somato-sensory system is a system that provides information about the body senses including touch, movement, pain and temperature. It might be a blessing to be born without a sense of pain but people who have impaired pain reception typically die prematuredly due to their inability to respond to injury (Freeberg, 2006).

The vestibular system is the sensory system that provides information about the position and movement of the head. It contributes to our sense of balance. When the vestibular system is impaired by a bad cold or by motion sickness, the result is usually an unpleasant period of nausea and dizziness. The vestibular sense relies on an organ in the inner ear that contains three semi-circular canals. If these structures are disrupted, say by infection or injury or by spending too much time in weightlessness in outer space as it happen to astronauts, people have a difficult time keeping their balance.

Kinesthetic Sense

This is a sense that registers the movement and position of the limbs. Two types of specialised cells sense this information. One type is the tendons the materials that connect muscles to bones and are triggered by tension. The other is in the muscles themselves and is triggered by whether the muscles are stretched or contracted (Pinel, 1993).

Touch

Our sense of touch begins with our skin; the skin is the largest and heaviest organ of the human body. Our skin provides a boundary separating what is inside from what is outside. It prevents dehydration and protects the body from dirt and bacteria flying objects changes in temperature making crucial vitamins and triggering the release of various hormones. The skin is also a massive sensory organ. Millions of receptors in the skin produce impulses when stimulated in specific ways. It is the particular combination of receptors being stimulated that produces a specific sensation Rossenberger and Kossyln, 2006).

When viewed in cross section, the skin can be divided into the outer layer of epidermis and the inner layer of the dermis. Below the dermis we find the subcutaneous tissue, which contains connective tissue and fat.

Human skin varies dramatically in thickness across different areas of the body starting from about half a millimetre on your face to twenty times that that thickness on the bottom of your foot (Freeberg, 2006).

Temperature

The skin has separate system for registering hot and cold, indeed, there are distinct spots on your skin that register only hot or cold. These spots are about 1 millimetre across (Hensel, 1982). If a cold spot is stimulated, you will feel a sensation of cold even if the stimulus is something hot. This phenomenon is called paradoxical cold. Thermo-receptors are free nerve endings in the skin that respond to surface temperature. Different sets of thermo-receptors respond to warmth or cold and neither type's responds to mechanical stimulation (Dulclaus and Kenshalo, 1980).

Pain

The sensation of pain arises primarily when two different kinds of nerves are stimulated. These nerves have fibres that differ in size and in the speed with which they transmit impulses. Thus we can feel double pain. The first phase of sharp pain occurs at the time of injury. It is followed by a dull pain, the two kinds of pain arise from different fibres sending their messages at different speeds (Rollman,1991).

Given the anguish experienced by chronic pain patients, it would seem initially miraculous to be able to do away with this sensory modality altogether. However, research on those born without effective pain reception suggests otherwise. Patients who perceive no pain frequently die at young ages, primarily due to degeneration of joints and the spine. We need pain to remind us to stop when we are injured to assess a situation before proceeding and to give the body time to heal. Nevertheless, pain is not a perfect warning system. (e.g. cancer and paper cuts). Attitudes towards pain may also play a significant role in our perceptions of the experience. Athletes and non athletes share similar pain thresholds or levels of stimulation identified as painful. However these groups are quite different in their tolerance of pain (Scott and gijsbergs, 1981) one of the ways we deal with pain is by producing substances in our brains called endorphins that have painkilling effects. People differ in the amount of pain they can withstand.

Other Senses

Two additional senses are more controversial one of these is the magnetic sense which may exist in humans, and the other is called the extra sensory perception which may not exist at all (Kossyln and Rosenberg,2006).

Magnetic Sense

There is evidence that humans have a weak form of this sense (Baker, 1980). Many birds migrate long distances each year guided in part by the magnetic field of the earth. Tiny bits of iron found in crucial neurons of these birds apparently play a part in this sense (Gould, 1998, Kirschvink, et al, 2001). Magnetic fields have also been shown to disrupt spatial learning in mice, at least for brief periods of time. (Levine and Bluni, 1994)

Extra-Sensory Perception

The ability to perceive and know things without using ordinary senses is often referred to as extra sensory perception (ESP). It is also sometimes called anomalous cognition or PSI. Many forms of ESP have been asserted including telepathy, the ability to send and transmit thoughts directly from mind to mind; clairvoyance, the ability to know about events directly without using the ordinary senses or reading someone else's mind and pre-cognition; the ability to foretell future events.

Most psychologists are sceptical about ESP for the following reasons

The failure to replicate the effects of ESP and Psychokinesis PK: The ability to move objects directly not by manipulating them physically is difficult to repeat

Lack of brain mechanism: It is not known how the brain could possibly produce or pick up ESP signals or produce PK signals

Lack of signals: No ESP signals have been measured and it is not known what forms these signals might take

Alternative explanations: There is the spectre of alternative explanations which rely on known facts about mental processing and behaviour.

Summary

1. Some researchers have argued that there is possibly an eleventh sense which is the extra-sensory perception or ESP (also sometimes called the psi)
2. The somato-sensory system is a system that provides information about the body senses including touch, movement, pain and temperature.
3. The vestibular system is the sensory system that provides information about the position and movement of the head. It contributes to our sense of balance.
4. This is a sense that registers the movement and position of the limbs.
5. Our sense of touch begins with our skin; the skin is the largest and heaviest organ of the human body.
6. When viewed in cross section, the skin can be divided into the outer layer of epidermis and the inner layer of the dermis.
7. The skin has separate systems for registering hot and cold; indeed, there are distinct spots on your skin that register only hot or cold.
8. The sensation of pain arises primarily when two different kinds of nerves are stimulated. These nerves have fibres that differ in size and in the speed with which they transmit impulses. Thus, we can feel double pain.
9. Given the anguish experienced by chronic pain patients, it would seem initially miraculous to be able to do away with this sensory modality altogether. However, research on those born without effective pain reception suggests otherwise.
10. One of the ways we deal with pain is by producing substances in our brains called endorphins that have painkilling effects. People differ in the amount of pain they can withstand.

Post-Test

1. List the body senses.
2. Explain what is meant by thermo receptors.
3. Describe magnetic sense and extra sensory perception
4. Explain the sense of touch

References

Schultz, D.; Schultz, E. S.; (2002). *Psychology and Work Today*. Prentice Hall New Jersey

Bloom, F.; Nelson, C. A.; Lazerson, A. (2001). *Brain Mind and Behaviour*. Educational Broadcasting Corporation, NY.

Freeberg, L. (2006). *Discovering Biological Psychology*. Houghton Mifflin Company.

LECTURE NINE

Movement

Introduction

In this lecture, you will gain a greater understanding of how our nervous system commands are translated into movement. Even if we don't have the natural ability and dedication to reach the pinnacle of athletic performance, our muscles usually do a good job of getting us around and carrying out skilled movements.

Objectives

At the end of this lecture, you should be able to:

1. identify muscles;
2. list the type of muscles;
3. describe the neural control of muscles; and
4. explain the disorders of movement.

Pre-Test

1. Identify Muscles
2. List the type of Muscles
3. Describe the Neural control of Muscles
4. Explain the disorders of Movement.

CONTENT

Muscles

Muscles make up the majority of the human body tissues and are responsible for the movement of the body and the movement of materials within the body.

Types of Muscles

Muscles can be divided into smooth muscle and striated muscle, based on their appearance. Smooth muscle is found in the lining of the digestive tract within the arteries and in the reproductive system. Smooth muscles move nutrients through the digestive tract control blood pressure and mix sperm with seminal fluid among other tasks. The smooth muscles are controlled by the autonomic nervous system.

Striated muscle is named after its striped appearance. There are two types of striated muscles. One is the cardiac muscle, and the other is the skeletal muscle. The tissue of the heart cardiac muscle composes. Skeletal muscle that is attached to bones produces the majority of body movement while other skeletal muscles are responsible for moving our eyes and lungs. Skeletal muscles are made up of long, very thin cells referred to as muscle fibres. Human muscle fibbers usually extend the length of the muscle and may be up to 30cm long and from 0.05 to 0.15 mm wide. Cardiac muscles keep our heart beating. Skeletal muscles move our bones, eyes and lungs. The contraction of a single muscle fibre can occur and this is referred to as a twitch.

Exercise can build muscles. In many cases, muscle enlargement is desirable. However enlargement of the cardiac muscle often results in life threatening heart disease. There is a case of loss of muscle mass which is as a result of ageing, which begins as early as age 25 and accelerates through the remainder of the life span. By age 50, most people have lost at least 10 percent of the muscle mass they had at age 25.

The Interaction of Muscles at a Joint

Muscles can only do one thing and that is to contract. The contraction of a single muscle can either straighten or bend a joint, but not both. As a result, muscles are able to pull a bone in a single direction but are unable to push it back. Relaxing the muscle will not necessarily cause a limb to move back to its original position. Muscles are arranged at a joint in antagonistic pairs. Muscles that straighten joints are referred to as extensors and muscles that bend joints are known as flexors. To bend the knee, the flexor muscles of the thigh must contract while the flexors relax. Movement of some joints is more complicated than flexion and extension. Additional muscles are needed at joints, such as the shoulder, the hip, the wrist and the ankle, to allow for rotation and other complex movements.

Neural Control of Muscles

The contraction of skeletal muscles is directly controlled by motor neurons originating in either the spinal cord or in the nuclei of the cranial nerves. The alpha motor neurons are the spinal cord motor neurons directly responsible for signalling muscle fibres to contract. The alpha motor neurons form highly efficient connections with muscle fibers at a location called the neuromuscular junction, while the motor unit is the combination of a single alpha motor neuron and all the muscle fibers that it innervates.

Reflex Control of Movement

The spinal cord is responsible for a number of reflex movements designed to protect us from injury, to maintain posture and to co-ordinate the movement of our limbs. We have the mono synaptic and the polysynaptic reflexes. These reflexes are present throughout the human life span.

Disorders of Movement

A variety of toxic substances interfere with movement by acting on synapses within the motor system.

Muscular Dystrophy

This is not a single disease, but rather a group of inherited diseases characterised by progressive muscle degeneration.

Polio

This occurs only in human beings and is caused by a contagious virus that specifically targets and destroys spinal alpha motor neurons. The development of effective vaccines for polio in the 1950's drastically reduced the number of cases worldwide.

Accidental Spinal Cord Damage

The spinal cord may be accidentally damaged when the protective vertebrae surrounding the cord are broken and compressed or sever the cord itself. These tragic accidents generally result in permanent paralysis of the muscles served by neurons below the level of damage. If the damage occurs in the cervical area or neck region of the spinal cord, the

person will experience quadriplegia or the loss of movement in both arms and legs. If the damage occurs in the lumbar region of the lower back, the person will experience paraplegia, the loss of movement in the legs.

Amyotrophic Lateral Sclerosis (Lou Gehrigs's Disorder)

ALS is also known as Lou Gehric's disease. ALS results from the degeneration of motor neurons in the spinal cord and brainstem. The muscles serve d by these motor neurons degenerate when their input ceases. The cause of ALS is still somewhat mysterious.

Parkinson Disease

Parkinson disease is characterised by a progressive difficulty in all movements' muscular tremors in the resting hand and frozen facial expressions. These symptoms were first observed by the English physician James Parkinson in the early 1800's. Patients with Parkinson disease experience enormous difficulty such as standing up from a chair. The disease produces a characteristically stooped posture. Patients' reflexive movements are also impaired and they fall easily if they loose their balance. Treatments include surgery, medication, electrical stimulation and fatal cell implants.

Huntington's disease

Huntington's disease strikes in middle age and produces involuntary, jerky movements. As the diseases progresses, cognitive symptoms such as depression, hallucinations and delusion may occur. There is no known cure for this disease, which strikes about one person out of 1000.

Summary

1. Muscles make up the majority of the human body tissues and are responsible for the movements of the body and the movement of materials within the body.
2. Muscles can be divided into smooth muscle and striated muscle based on their appearance.
3. Smooth muscle is found in the lining of the digestive tract within the arteries and in the reproductive system. Smooth muscles move nutrients through the digestive tract control blood pressure and mix sperm with seminal fluid among other tasks. The smooth muscles are controlled by the autonomic nervous system.
4. Striated muscle is named after its striped appearance. There are two types of striated muscle. One is the cardiac muscle and the other is the skeletal muscle.
5. The tissue of the heart composes the cardiac muscle. Skeletal muscle that is attached to bones produces the majority of body movement, while other skeletal muscles are responsible for moving our eyes and lungs.
6. Skeletal muscles are made up of long, very thin cells referred to as muscle fibres. Human muscle fibers usually extend the length of the muscle and may be up to 30cm long and from 0.05 to 0.15 mm wide.
7. Cardiac muscles keep our heart beating. Skeletal muscles move our bones eyes and lungs. The contraction of a single muscle fibre can occur, and this is referred to as a twitch.
8. Muscles can only do one thing and that is to contract. The contraction of a single muscle can either straighten or bend a joint, but not both. As a result, muscles are able to pull a bone in a single direction but are unable to push it back.
9. Relaxing the muscle will not necessarily cause a limb to move back to its original position. Muscles are arranged at a joint in antagonistic pairs.
10. The muscles that straighten joints are referred to as extensors, and the muscles that bend joints are known as flexors. To bend the knee, the flexor muscles of the thigh must contract while the flexors relax. Movement of some joints is more complicated than

flexion and extension. Additional muscles are needed at joints, such as the shoulder, the hip, the wrist and the ankle, to allow for rotation and other complex movements.

11. The contraction of skeletal muscles is directly controlled by motor neurons originating from either the spinal cord or from the nuclei of the cranial nerves.
12. The alpha motor neurons are the spinal cord motor neurons directly responsible for signalling muscle fibres to contract.
13. The spinal cord is responsible for a number of reflex movements designed to protect us from injury, to maintain posture and to co-ordinate the movement of our limbs.
14. We have the mono-synaptic and the poly-synaptic reflexes. These reflexes are present throughout the human life span
15. Muscular dystrophy is not a single disease, but rather a group of inherited diseases characterised by progressive muscle degeneration.
16. Huntington's disease strikes in middle age and produces involuntary, jerky movements.

Post-Test

1. Mention the three disorders of movement
2. List the types of muscles
3. Describe the neural control of Muscles

References

Schultz, D.; Schultz, E. S.; (2002). *Psychology and Work Today*. Prentice Hall, New Jersey.

Bloom, F.; Nelson, C. A.; Lazerson, A. (2001). *Brain Mind and Behaviour*. Educational Broadcasting Corporation, NY.

Freeberg, L. (2006). *Discovering Biological Psychology*. Houghton Mifflin Company.

LECTURE TEN

Sleep and Dreaming

Introduction

In this lecture, you will be introduced to what takes place during the different stages of sleep and when usually dreams occur. Attention is paid to the physiological parts involved in the process of sleep and dream. Some reasons are advanced on the importance of sleep, some common sleep phenomenon and sleep disorders. The Circadian rhythm which is the sleep-wake pattern is part of the discussion in this lecture.

Objectives

At the end of the lecture, you should be able to:

1. explain the stage of sleep when dreams usually occur;
2. discuss the physiology of sleep and dream;
3. discuss some phenomenon associated with sleep; and
4. some sleep disorders.

Pre-Test

1. At what stage of sleep do we dream?
2. How does our body relate to sleep and dream?
3. Mention some sleep disorders that you know?

CONTENT

Sleep is a complex combination of states, which involve some level of conscious awareness and unconsciousness. Usually, we gently slip from wakefulness into sleep. Several stages of conscious awareness are part of the sleep process. In this process of sleep, we pass from waking

consciousness into a semi wakeful state. Within the sleep cycle, there are four stages. All these stages contain little or no conscious awareness, then into dream sleep. These stages are examined below.

Hypnagogic state: This is the state at which we dream for a while, before we pass on into a "twilight" state that is neither day-dreaming nor dreaming. (Mavromatis, 1987). We begin to loose voluntary control over our body movement; our sensitivity to outside stimuli diminishes; thought patterns are less bound by reality. For most people, it is an enjoyable state and more relaxed.

The four levels of sleep are defined on the basis of electroencephalogram (EEG) which measures electrical brain activities. The depth of sleep alternates upward and downwards many times during the night.

Rem Sleep and Dream

The Rapid Eye Movement (REM) sleep is characterised by movement of the eyes under the eye lid during the sleeping process. This stage of sleep is often accomplished with dreams. Under observation, most people if awakened at this stage could reflect that they have dreamt.

Autonomic storms

Wilse Webb (1968) likened dream sleep to an autonomic storm. It is noted that it is not only the eyeballs that are busy during dream; the autonomic nervous system and other parts of the peripheral nervous system are also active during dream causing noticeable changes in many parts of the body; blood flow to the brain increases; the heartbeat becomes irregular; the muscles of the face and fingers twitch, and breathing becomes irregular. The voluntary control of the large body muscles is largely lost during REM sleep; perhaps, to keep us from acting out our dreams.

The time spent dreaming is about 90 percent of the REM sleep (Starch and Meier, 1996)). The length of REM dreams varies, but the longest REM dream may be about an hour, and it usually occurs during the last part of the sleep cycle. (Hobson 1989; Web, 1982). It is also estimated that we spend about 2 hours each night in the conscious state of REM dreams. However, REM sleep is not the only part of the sleep cycle that contains dreams.

Non-REM Sleep and Dreams

Apart from the REM sleep which was initially believed to be the only part of the sleeping process characterised with dream, the Non-REM sleep has periods when dreaming is reported. However, the nature of non-REM dreams is quite different from that of REM dreams. Non-REM dreams are often brief, fragmentary impressions that are less emotional and less likely to involve visual images than are REM sleep dreams. The REM dreams are like watching or participating in a play; non-REM dreams resemble the ordinary process of thinking briefly about something during the daytime. It is so much like day time thoughts that individuals awakened during a non-REM dream often deny that they had been asleep at all. The non-REM dreams are often not thought of as dreams at all and are less likely to be spontaneously recalled after waking than are REM dreams. (Foulkes, 1989; Hobson, 1989; Stauch and Meier, 1996).

When both REM dreams which are estimated to be about 2 hours all through the night, and the Non-REM dreams which are said to occur about half of the other 4-6 hours of sleep in the night are compared, one can see that a surprising amount of time is spent in states of consciousness during sleep. It is assumed that we are consciously aware during sleep much more than we would have suspected.

Why We Sleep

Sleep researchers have not yet reached an agreement as to the reason why we sleep. Nonetheless, there are some bits of evidence that sleep plays a role in the restoration of the body. It is clear that we need sleep in the sense that we apparently create a "sleep debt" that needs to be made up if we miss sleep. In Florida, some university students participated in a sleep experiment. They were limited to 2 hours of sleep for one night. The next day, they were irritable, fatigued and inefficient and the next night they fell asleep more quickly and slept longer than usual (Webb & Bonnet, 1979). Allan Hobson (1989) proposed a specific theory that sleep plays a restorative role. His theory is based on the existence of a centre in the brain storm that is active when we are awake (sleep-inhibiting system) and two other centres in the brain stem that are activated when we are sleeping (sleep – promoting systems). Hobson suggested that we need to sleep and dream to give the sleep-inhibiting system chance to rest and replenish itself.

However, Wiles Webb (1975) proposed a very different view of why we sleep. He suggested that sleep serves as a protective rather than a restorative role. Webb was not convinced that humans have much of a physiological need for sleep. He hypothesized that we fall asleep to keep us from moving around in the dark of night. It keeps us from wasting our energy, falling off cliffs and promotes having better night visions.

Sleep Phenomena

1. **Nightmares**: These are dreams that occur during REM sleep and whose content is exceptionally frightening, sad, provoking or in some other ways uncomfortable. They are upsetting enough to wake us up during the dream. This means that we can vividly remember such dreams; even though, they account for only a small proportion of the dreams most people have.
2. **Night terrors**: These are less common dreams but they could even be more upsetting dream experiences. The individual becomes awake suddenly in a state of panic. Sometimes, he may be screaming and usually with no clear recollection of an accompanying dream. A sense of calm usually returns after a few minutes. Unlike nightmares, they do not occur during REM sleep but occur during the deepest phase of non- REM sleeps. They are most common in pre-school age children. However, sometimes, some adults could experience them.
3. **Sleepwalking**: This phenomenon also occurs during the deepest part of non- REM sleeps. Sleep-walkers rise from the bed and carry on complicated tasks, such as walking from one room to another; even though, they are sound asleep. It is mostly common among children before the age of puberty but some adults also manifest this phenomenon. In adults, it appears only during periods of stress. Except for the danger of accidents while wandering, it is not an abnormal behaviour.
4. **Sleep talking**: This phenomenon can occur during any stage of the sleep cycle. Here, the individual who is sound asleep says words, sometimes making fairly incoherent statements for a brief period of time. It is common in young adults but could occur at all ages.

Sleep Disorders

These are troublesome but highly treatable disorders.

1. **Insomnia**: This refers to a variety of difficulties in which individuals report that they sleep less than they wish. There are two types of insomnia:
   i. **sleep onset insomnia**: individuals have difficulty falling asleep at the hour they would like, but sleep is normal after it begins.
   ii. **Early waking insomnia**: this involves waking earlier than desired, either several times in the middle of the night or early in the morning. Both are common in individuals undergoing periods of stress anxiety or depression.
2. **Narcolepsy**: This is a rare sleep disorder that very few people experiment but its impact can be quite serious. The narcoleptic individuals often fall unexpectedly into a slumber in the middle of work or even during conversation with others, especially, when upset or stressed. The individual experiences loss of muscle tone and shows a lack of body movement, as if she or he has suddenly fallen into a dream sleep. Studies have shown that it is not REM sleep that causes narcolepsy. It causes serious difficulties with the use of dangerous machines and other job-related activities.
3. **Sleep apnea**: This is a sudden, temporary interruption of breathing during sleep. This phenomenon is common with older adults particularly those who snore. It is caused either by too much relaxation of the muscles of the throat or by a temporary cessation of brain signals for breathing. The individual experiences a few of apneas each night. This is not problematic. Many apneas in the night it result into loss of oxygen to the brain and the individual becomes exhausted the next day. Many may even develop a condition such as narcolepsy.

Circadian Rhythm

This is the cycle of waking and sleeping that regulates our pattern of sleep. The pineal gland appears to be its primary interval clock and the hormone melatonin is a key factor that regulates sleepfulness. A hormone of the pituitary, the growth hormone (for body growth and repair) is secreted mostly during the first 2 hours of sleep with little secreted during the day.

This reflects the roles that sleep plays in normal growth and health maintenance. Body temperature also follows the circadian rhythm. Body temperature falls just as you are beginning to feel sleepy and continues to fall until the middle of the sleep period.

The adrenal stress hormone (cortisol) also follows the circadian rhythm. Cortisol secretion begins to rise shortly after you fall asleep and continues to rise through the night. The peak of cortisol is just before awakening.

Summary

1. Sleep is a complex combination of states, which involve some level of conscious awareness and unconsciousness.
2. The four levels of sleep are defined on the basis of electroencephalogram (EEG), which measures electrical brain activities.
3. The Rapid Eye Movement (REM) sleep is often accomplished with dreams.
4. The autonomic nervous system and other parts of the peripheral nervous system are active during dream causing noticeable changes in many parts of the body.
5. The Non-REM sleep has periods when dreaming is also reported but the nature of non-REM dreams is quite different from that of REM dreams.

Post-Test

1. Give a vivid explanation of the different stages of sleep.
2. Explain the physiological reactions that involve the REM and the Non-REM sleep processes.
3. Briefly explain sleep disorders and their causes.

References

Foulkes, D. (1989). Understanding Our Dreams. *Natural Sciences*. Pp.296-301.

Hobson, J. A. (1989). *Sleep*. New York, Scientific American Library

Lahey, B.B., (2001). *Psychology: An Introduction* McGraw-Hill Inc.

Mavromatis A. (1987). *Hypnogogia*. London: London Routledge.

Webb W.B. (1968). *Sleep: An Experimental Approach*. New York. Macmillian

Web W.B. (1982). Sleep and biological rhythms. In W.B. Webb (Ed) *Biological Rhythms, Sleep and Performance* (87-110) New York Riley.

Webb W. B. & Bonnet M.H.1979). Sleep and Dreams. In M.E. Meyer (Ed.) *Foundations of Contemporary Psychology*. New York Oxford University Press.

LECTURE ELEVEN

Sexual Behaviour

Introduction

Human beings have sexual motives as much as they have motives for hunger and thirst. Without these sexual motives, humans and animals that depend on them would soon go into extinction. The sexual motives are driven by a series of stimuli, such as the hypothalamus control, External stimuli, learning and emotions. The hormones also play some role in sexual behaviour. In this lecture, we shall examine sexual behaviour as well as come forms of unusual and abnormal sexual behaviour.

Objectives

At the end of this lecture, you should be able to:

1. explain the importance of sexual motives to the sustenance of the human and animal species;
2. show the similarities and the dissimilarities between the sexual motives and other motives like thirst and hunger; and
3. discuss the different atypical and abnormal forms of sexual behaviour.

Pre-Test

1. What are the distinctive characteristics between sexual motives and other motives like hunger?
2. Discss the importance of hormones in sexual behaviour.
3. Mention some forms of abnormal sexual behaviour.

CONTENT

Human beings have sexual motives as much as they have motives or hunger and thirst. Without these sexual motives humans and animals that depend on them would soon go into extinction. Whereas hunger and thirst and other primary motives which are necessary for survival of the individual, sexual motivation are a primary motive essential to the survival of the species.

Sexual motivation is similar to other primary motives like hunger, thirst and others in a number of ways;

1. **Hypothalamic Control**: Just like hunger and thirst, sexual motives are controlled by the hypothalamus. When the hypothalamus is surgically destroyed, sexual behaviour will not be initiated even in the presence of provocative sexual stimuli. A section of the hypothalamus inhibits sexual behaviour. If the inhibiting system is destroyed in laboratory animals, they engage in unusual and unrestrained amount of sexual behaviour. The hypothalamus also indirectly influences female sexuality through its control of the menstrual circle.
2. **External Stimuli**: just as the sight and aroma of food can stimulate hunger, so highly sensitive is also sexual motivation to external stimuli. The person who is initially not sexually aroused, whether male or female will often be aroused by a seductive partner or romantic fantasies. One aspect of the role of external stimuli has been termed the **Coolidge effect**. Following intercourse, males of many animals' species will have intercourse again with the same receptive female sometime after the refractory period has elapsed.
3. **The Role of Learning**: Sexual motivation is influenced by learning. The enormous variety in the sexual behaviour of the members of any society at any point in history strongly points to the role of learning in sexuality. Differences in sexuality between cultures also portray the influence of learning experience on sexual motivation.
4. **Role of Emotions**: Sexual motivation is influenced to a great extent by our emotions, stress, anxiety and depression. These are accompanied by increased sympathetic autonomic arousal and because sexual arousal is mediated by parasympathetic arousal, which is in opposition to the sympathetic activity. These emotions generally result in a decrease in sexual motivation. Anxiety and depression sometimes result in an increase in sexual motivation.

Hormones and Sexual Behaviour

In animals, hormones from the endocrine system play a major role in regulating sexual motivation. Cats, female dogs, rats are more receptive to sexual stimulation only when they are ovulating (heat period). Males are less influenced by the hormones than females. Sexuality and hormones are related. Brecher and Brecher (1979) found that when men were sexually aroused by viewing erotic films, their blood level of testosterone rose significantly.

Unusual (atypical) and Abnormal or Deviant Sexual Behaviour

To a large extent, human beings differ in their sexual preferences and practices. Some of these practices are considered as abnormal only if the individuals who engage in the sexual practices consider them abnormal for themselves.

Transvestism: This is the practice of dressing in the clothes of the opposite sex. Transvestites often state that they cross-dress because it is sexually stimulating; some say they cross-dress to free themselves from confining sexual stereotypes.

Transexualism: This is a condition in which the individual feels trapped in a body of the wrong sex. Example is a male who is anatomically male, but feels he is actually a woman given the wrong body. Trans sexual occasionally or permanently dress in clothes of the opposite anatomical sex. To them cross dressing has nothing to do with sexual arousal, but thought they may feel that they are dressing in the clothes of their true sex. In some instances, these individuals undergo hormone injection and plastic surgery to change their sex.

Fetishism: This refers to the act whereby individuals are primarily or exclusively aroused by specific objects or materials e.g. underwear (panties), shoes, etc. A fetishist may be a male who is sexually aroused by the act of stealing such articles from an unsuspecting woman.

Sexual Sadism and Masochism

Sexual sadism is the practice of receiving sexual pleasure from inflicting pain on others. While sexual masochism is the condition in which receiving pain is sexually exciting. These practices are carried out with consenting partners who enjoy the practice; though they do not usually

inflict severe pain or medically dangerous pains. However, in some cases, it could involve intense pain like whipping, burning and kicking.

Voyeurism

Voyeurism is the practice of obtaining sexual pleasure by watching others undress or engage in sexual activities. Voyeurs generally derive these pleasures only if the individuals they are watching are unaware of their presence and when there is an element of danger involved. They become very excited peeping through windows. Because they often frighten the person they are watching and because it is illegal, voyeurism is considered abnormal. They are usually heterosexual males who have difficulties establishing a normal sexual relationship.

Exhibitionism

This is a practice in which a person obtains sexual pleasure from exposing his/her genitals to others. They may be males who are shy and have inhibited sex lives. Exhibitionists want to shock their victims but are rarely dangerous.

Forced Sexual Behaviour

These are forms of deviant sexual behaviour that involve actual, threatened or implied force to the victim. These include rape, sexual abuse of children, incest and sexual harassment.

Rape: This is an incident in which an individual forces another person to engage in a sexual act with him/her. In most cases, the rapist is a male and the victim a female. Sometimes there may be a female rapist. The aftermath of rape often leaves the victim with a feeling that their entire life has been altered due to the assault. Such feelings like intense anxiety, depression as well as disturbance in sleep, relationships and daily functioning usually occur.

Sexual Abuse of Children (pedophilia)

This is a situation where children are sexually assaulted or exploited. When the sexual contact is by a family member, the sexual abuse is termed incest. When the sexual act involves some force or threat of force, the assault is child rape. However, when there are no force, it is child

molestation. Children who have been sexually abused manifest difficult emotional or behavioural reactions. The children often tend to be traumatized and suffer traumatic reactions. Sometimes, the child might feel a sense of personal betrayal by the person who violated them and feel stigmatised because they have been assaulted.

The adults who engage in sexual activities with children experience sexual pleasure through sexual contact with the children. They usually first gain the trust and acceptance of their victims before engaging in sexual behaviour with them. The child molesters are usually neighbours, family members or someone who knows the child.

Sexual Harassment

This is unwanted sexual advances, requests for sexual favours and unwanted touching of parts of the body (breasts, buttocks, sexual suggestive) of the victim. It usually occurs between persons with different levels of power in a school or workplace. It could also be the case of physical strength on the part of the harassing party. Most incidents of harassment are not reported to authorities due to power imbalance. Every victim of sexual harassment suffers in the sense of becoming less comfortable and relaxed at school or work. Sexual harassment can provoke a serious level of anxiety and depression.

Sexually Transmitted Diseases (STDs)

Theses are diseases caused by microrganisms that spread through sexual contacts. Today, different STDs threaten the health of millions of people each year. Some are easily treated and cured if detected early. Others are incurable and may eventually lead to death. When untreated and unattended to STDs can cause infertility and they also pose serious health threats to pregnant women and their offspring. All STDs require immediate medical attention. The likelihood of contacting STDs increases sharply with the frequency of unsafe sex. Some of the common STDs are Syphilis, Gonorrhea, Chlamydia, Genital herps, Genital warts, and Acquired Immuno deficiency Virus (AIDS) caused by Human Immunodeficiency Virus (HIV).

Summary

1. Whereas hunger and thirst and other primary motives are necessary for survival of the individual, sexual motivation are primary motives essential to the survival of the species.
2. Sexual motivation is similar to other primary motives like hunger, thirst and others in a number of ways.
3. In animals, hormones from the endocrine system play a major role in regulating sexual motivation.
4. Human beings differ in their sexual preferences and practices. Some of these practices are considered as abnormal only if the individuals who engage in the sexual practices consider them abnormal for themselves.
5. Sexually Transmitted Diseases (STD) are diseases caused by microrganisms that spread through sexual contacts. Some are easily treated and cured if detected early. Others are incurable and may eventually lead to death.

Post-Test

1. State the similarities between sexual behaviour and other primary motives like hunger, thirst and others.
2. Give a vivid explanation of five forms of unusual sexual behaviour.
3. Mention some forms of abnormal sexual behaviour. When does a sexual behaviour become abnormal?

References

Brecher E, M. and Brecher J (1979). Sex is good for your health. *Playboy*. Pp. 125ff.

Lahey, B.B., (2001) *Psychology: An Introduction.* McGraw-Hill Inc.

LECTURE TWELVE

Emotional Behaviour

Introduction

In this lecture, you will be exposed to both physiological and characteristic reactions to emotions. Social role of emotion that develops at an early age is in the development of partnerships to achieve joint goals. Physiological changes associated with emotional changes reveal bodily changes accompanied by various facial expressions like fear, anger, sadness, happiness, surprise and disgust. Furthermore, we shall examine some methods in understanding the relationship between psychological functioning (emotion) and the functions of the brain.

Objectives

At the end of this lecture, you should be able to:

1. explain the relationship between the brain and emotional reactions;
2. discuss biological aspects of emotions; and
3. describe/explain the cognitive process and emotion.

Pre-Test

1. Outline the four stages in the development of emotional process.
2. What are the three main methods psychologists apply in understanding the relationship between emotion and brain functioning?
3. Enumerate the three functional types of neurochemicals involved in emotion.

CONTENT

Emotions are the experiences that give colour, meaning and intensity to our lives. According to Watson and Tellepen (1985), all of the varied human emotions can be thought as different combinations of only two basic elements – positive and negative emotions. These are generally reactive to stimuli that are accompanied by physiological arousal and characteristic behaviour. For instance, when we are afraid, we experience an acutely unpleasant feeling. The sympathetic part of the autonomous nervous system is aroused and fear shows in our behaviour. The emotion of passion, on the other hand, is a combination of different feelings, biological changes and behaviour.

Social Aspects of Emotional Development

Even in young infants, emotions play an important social communicative role between infants and their caregivers. Caregivers regulate the infants' emotional arousal by reading the infants' signals, keeping in time with them and adjusting the environment in order to maintain the optimal level of stimulation for the child. Field (1994) calls this "attunement". He says that without it, the child's behaviour will become disorganised and chaotic.

Another important social role of emotion that develops at an early age is in the development of partnerships to achieve joint goals. Hoffman (1984) outlined four stages in the development of this process:

1. **Global Empathy**: Children merely pick up signs of distress from others through emotional contagion and feel distressed themselves.
2. **Egocentric Empathy**: Children know the other is in distress, but they can react only if they themselves are in distress.
3. In the third stage, the child begins to develop an understanding that the other person's feelings are different from his or her distress.
4. In the fourth stage, the final stage true empathy for another person's experience is developed. It is this ability to gradually appreciate the emotional perspective of other people that allows a developing person to cooperate more and more with his or her peers in the achievement of joint goals.

Biological Aspects of Emotion

Some prototype experiments carried out in the area of physiological changes associated with emotional changes revealed that bodily changes are accompanied by various facial expressions like fear, anger, sadness, happiness, surprise and disgust. In the experiments, the facial expressions were video recorded and a number of physiological measures were taken (heart rate, skin conductance, hand temperature and forearm muscle tension). The result of the experiment by Ekman et al, (1983), Levenson *et al*, (1990) showed that each posed expression matched specific physiological pattern. Low heart rate was associated with happiness, disgust and surprise, while high heart rate is associated with sadness, anger and fear. Anger was characterised with high skin temperature, relative to fear and sadness, which were characterised by low skin temperature.

Emotions and the Brain

Psychologists apply three main methods in understanding the relationship between psychological functioning (emotion) and the functions of the brain these methods are:

1. **Lesion method**: This is damage to the brain, which may be accidentally or deliberately inflicted through surgery in experiments on animals.
2. **Chemical or electrical stimulation**: In this method, the brain area is chemically or electrically stimulated, and there is consequent observation of the behavioural changes that such stimulation induces.
3. **Sophisticated imaging techniques**: These have been used to examine differential activation of different brain regions as a function of changes in emotional experiences or behaviour.

The hypothalamus (region below the thalamus) has a particular role in monitoring interval physiological states (e.g. water, temperature, hormones) and organising appropriate behaviour. The hypothalamus and septum process emotional and motivational information and contribute to the organisation of appropriate behaviour. The aspect of the hypothalamus more involved in emotional processing is the amygdala. The amygdala is regarded as the central emotional computer for the brain. It receives inputs

from the region of the cortex concerned with visual recognition and auditory recognition and sensory information directly from the thalamus (LeDoux, 1993, 1996).

Neurochemical and the Brain

Brain communication relies on various chemicals known as neurochemical for communication from one region to another. There are three functional types.

These are:

1. **Transmitter substances**: These are released into the synapse of nerve cells.
2. **Hormones**: Chemicals carried around the body by the blood to affect organs that are sensitive to them.
3. **Neuromodulators**: Many of these are peptides. They modulate the pain system and many of them resemble addictive drugs like opium and heroine.

Emotion on Cognitive Processes

This section is to examine the effect of emotion on cognitive processing. This involves the interaction of current emotion with subsequent appraisal. Some research focused on how basic cognitive processes such as perception, attention and memory are affected by emotional states. For instance, some research has shown that anxious individuals seem especially vigilant for danger or threat, whereas sad or depressed individuals selectively remember negative materials from the past, which may bear on their current loss. Some studies provide support for an involuntary attentional vigilance for threat in individuals who are anxious.

Another study by Clark and Teasdale (1982) indicates that bias towards the recall of negative material is associated with increased depressed mood. In their study, they noted that during the most depressed part of the day, subjects recalled more unhappy memories, whereas during at the least depressed part of the day, they recalled more happy memories. This effect is known as mood congruent memory.

Summary

1. In young infants, emotions play an important social communicative role between infants and their caregivers.
2. Hoffman outlined four stages in the development of the social role of emotion.
3. The hypothalamus has a particular role in monitoring internal physiological states and organising appropriate behaviour.
4. Brain communication relies on various chemicals known as neurochemicals for communication from one region to another.
5. Some basic cognitive processes, such as perception, attention and memory are affected by emotional states.

Post-Test

1. What are the neurochemicals necessary for communication within the brain?
2. Explain the major responsibilities of the hypothalamus and the septum process in emotion and motivational information.
3. Explain the social aspects of emotional development.

Reference

Ekman P, Levenson R.W. & Friessen W.V (1983) Autonomic Nervous System Activity Distinguished among Emotions. *Science* 231, 108-1210.

LeDoux, J (1996). *The Emotional Brain*. New York: Simon & Schuster.

Levenson, R.W. Ekman, P & Friessen, W.V (1990). Voluntary facial action generates emotion specific autonomic nervous system activity. *Psychophysiology* 27, 363-84.

Watsons, D and Tellepen, A. (1985). Towards a Consensual Structure of Mood. *Psychological Bulletin*. 98, 219-235.

LECTURE THIRTEEN

Learning and Memory I

Introduction

In this lecture, the importance of learning experiences will be considered. If you behave in a way that leads to something positive, you will probably behave that way more often in the future. This knowledge is given to you through experience. We shall also examine organised and disorganised learning. Organised learning will lead to better long- term memory than is learning which is disorganised. In this lecture, the level of processing, theory is also considered. This theory assumes that long-term memory depends to a large extent on the type of processing, which occurs at the time of learning. Two types of memory, episodic and semantic memory would be considered in this lecture.

Objectives

At the end of this lecture, you should be able to:

1. explain the differences between organised and disorganised learning in relation to long term memory;
2. make a distinction between elaborate rehearsals and maintenance rehearsals; and
3. discuss the various types of memories and retention.

Pre-Test

1. State the differences between organised and disorganised learning.
2. Explain the various types of memory rehearsals that you know.
3. Briefly explain the following: episodic and semantic memory; explicit and implicit memory

CONTENT

In psychology, learning is any permanent change in behaviour brought about through experience involving interaction with the environment. Learning experiences are very important in shaping human behaviour. Sometimes, learning results from the consequence of your behaviour. If you behave in a way that leads to something positive, you will probably behave that way more often in the future. Also, the processes occurring at the time of learning have an important effect on subsequent long time memory.

It is assumed that learning which is organised will lead to better long-term memory than will learning, which is disorganised. The use of imagery can enhance memory. Craik and Lockhart (1972) argued that memory depends on the attention and perceptual processes occurring at the time of learning. They claimed that there are different levels of processing of physical characteristics of stimuli, such as deciding if words are written in capital or "small" letters. At the highest level, there is deep processing which includes meaning or interpretation of a stimulus. While "depth" is in term of the meaningfulness derived from the stimulus.

Craik and Lockhart (1972) observed that deep processing of information produces more elaborate, longer lasting and stronger memory traces than shallow processing. The level of processing theory assumes that long-term memory depends, to a large extent, on the type of processing which occurs at the time of learning. Long term memory also depends on the relationship between the information stored at the time of learning and the nature of the retention test. It was also observed that we remember stored information only when that information is relevant to subsequent memory test.

Craik and Lockhart (1972) distinguished two forms of rehearsals: **maintenance** rehearsal, which involves repeating analyses which have already been carried out and **elaborate** rehearsal which involves deeper analyses of the stimulus. The researchers observed that elaborate rehearsal is necessary for improved long term memory.

When words are processed in terms of their sounds or rhymes, this is shallow processing. However, when words are processed in terms of their meaning this is deep processing.

Long Term Memory

There are basically two types of memory, according to Tulvin (1972). These are Episodic and Semantic memory. **Episodic** is autobiographical in nature, containing personal experiences associated with a particular time and place. For example it might be the memory of a wedding ceremony you attended recently. **Semantic** memories are concerned with our knowledge of the world or issues that may not directly concern us personally. Semantic memories are organised knowledge of a person about words, their verbal symbols, meaning and referents, about relations among them and about rules, formulas, symbols, concepts and so on. Semantic memories are organised, which is reflected in our ability to retrieve information from our semantic memory very rapidly. For instance, you can think of the capital of Lagos within a second and at the same time can decide that a goat is a four-footed animal. Both episodic and semantic memories are interdependent in their functioning rather than separate.

Explicit memory is revealed when performance on a task requires conscious recollection of previous experiences, for instance, driving a car, construction of a chair and so on. However, implicit memory is revealed when performance on a task does not require the conscious recollection of previous experiences. An example of implicit memory is the fixing of a jigsaw puzzle.

Implicit memories are more or less data- driven processes, whereas explicit memory is regarded as conceptually driven processes. The implicit memories are entirely determined by external stimuli, whereas the explicit memories which are conceptually driven are started by the individual.

Summary

1. The processes occurring at the time of learning have an important effect on subsequent long time memory.
2. Learning which is organised will lead to better long- term memory than is learning which is disorganised.
3. Maintenance rehearsal involves repeating analyses which have already been carried out.
4. Elaborate rehearsal involves deeper analysis of the stimulus.
5. Episodic is autobiographical in nature, containing personal experiences associated with a particular time and place.
6. Semantic memories are concerned with our knowledge of the world or issues that may not directly concern us personally.

Post-Test

1. Give a vivid explanation between organised and disorganised memories
2. What are the distinguishing features of maintenance and elaborate rehearsals.
3. Explain explicit and implicit memory.

Reference

Craik, F.I.M., and Lockhart R.S. (1972). Levels of Processing. A Framework for memory Research. *Journal of Verbal Learning and Verbal Behaviour*, 11,671-684.

Tulving E. (1972). Episodic and Semantic Memory. In E. Tulving & W. Donaldson. (eds) *Organisation and Memory*. New York. Academic Press.

LECTURE FOURTEEN

Learning and Memory II

Introduction

In this lecture, you will be exposed to stages in formation and retrieval of memory. We shall examine brain areas involved in learning and memory, such as the hippocampus, the amygdala, the striatum, or the mammillary bodies. Disorder such as amnesia, Alzheimer's disease, Hyperthymesia, and Korsakoff's syndrome. Also from part of our discussion here. Though not a disorder, a common *temporary* failure of word retrieval from memory is the tip-of-the-tongue phenomenon.

Objectives

At the end of the lecture, you should be able to:

1. explain the stages in the formation and retrieval of memory;
2. expose the brain area involved in learning and memory; and
3. highlight and examine disorders involved in memory loss or brain damage.

Pre-Test

1. State the three stages involved in the formation and retrieval of memory.
2. Explain the brain area implicated in memory and learning.
3. What are the common disorders associated with memory

CONTENT

In psychology, memory is an organism's mental ability to store, retain and recall information. From information processing perspective there are three main stages in the formation and retrieval of memory these are:

1. Encoding or registration (receiving, processing and combining of received information)
2. Storage (creation of a permanent record of the encoded information)
3. Retrieval or recall (calling back the stored information in response to some cue for use in a process or activity)

Sensory memory

An example of sensory memory is the ability to look at an item, and remember what it looked like with just a second of observation, or memorisation,

The first experiments exploring this form of sensory memory were conducted by George Sperling (1960), using the "partial report paradigm." Subjects were presented with a grid of 12 letters, arranged into three rows of 4. After a brief presentation, subjects were then played either a high, medium or low tone, cuing them which of the rows to report. Based on these partial report experiments, Sperling (1960) was able to show that the capacity of sensory memory was approximately 12 items, but that it degraded very quickly (within a few hundred milliseconds). Because this form of memory degrades so quickly, participants would see the display, but be unable to report all of the items (12 in the "whole report" procedure) before they decayed. This type of memory cannot be prolonged via rehearsal.

Brain areas such as the hippocampus, the amygdala, the striatum, or the mammillary bodies are thought to be involved in specific types of memory. The hippocampus is believed to be involved in spatial learning and declarative learning, while the amygdala is thought to be involved in emotional memory. Damage to certain areas in patients and animal models and subsequent memory deficits are a primary source of information. However, rather than implicating a specific area, it could be that damage to adjacent areas, or to a pathway traveling through the area is actually responsible for the observed deficit. Further, it is not sufficient to describe memory, and its counterpart, learning, as solely dependent on specific

brain regions. Learning and memory are attributed to changes in neuronal synapses, thought to be mediated by long-term potentiation and long-term depression

Patients with amygdalar damage are no more likely to remember emotionally charged words than non emotionally charged ones. The hippocampus is important for explicit memory. The hippocampus is also important for memory consolidation. The hippocampus receives input from different parts of the cortex and sends its output out to different parts of the brain also. The input comes from secondary and tertiary sensory areas that have processed the information a lot already. Hippocampal damage may also cause memory loss and problems with memory storage.

Disorders

Much of the current knowledge of memory has come from studying memory disorders. Loss of memory is known as **amnesia**. There are many sorts of amnesia, and by studying their different forms, it has become possible to observe apparent defects in individual sub-systems of the brain's memory systems, and thus hypothesize their function in the normally working brain. Other neurological disorders such as **Alzheimer's** disease can also affect memory and cognition. Other disorders includes: **Hyperthymesia**, or **hyperthymesic** syndrome, which is a disorder that affects an individual's autobiographical memory. This essentially means that they cannot forget small details that otherwise would not be stored. Another disorder is **Korsakoff's** syndrome, also known as **Korsakoff's psychosis**, amnesic-confabulatory syndrome, is an organic brain disease that adversely affects memory.

While not a disorder, a common temporary failure of word retrieval from memory is the **tip-of-the-tongue phenomenon.** Sufferers of Nominal Aphasia (also called Anomia), however, do experience the tip-of-the-tongue phenomenon on an ongoing basis due to damage to the frontal and parietal lobes of the brain.

Summary

1. Sensory memory is the ability to look at an item, and remember what it looked like with just a second of observation, or memorisation.
2. Brain areas such as the hippocampus, the amygdala, the striatum, or the mammillary bodies are involved in specific types of memory.
3. Loss of memory is known as amnesia.
4. Other neurological disorders such as Alzheimer's disease can also affect memory and cognition.
5. Tip-of-the-tongue phenomenon is not a disorder, but a common temporary failure of word retrieval from memory.

Post-Test

1. Give a vivid explanation of the different parts of the brain involved in learning and memory.
2. Mention some of the disorders associated with learning and memory.
3. What does the term "tip-of-the-tongue" mean in relation to memory?

References

Anderson, J.R. (1976). *Language, Memory and Thought*. Mahwah, NJ: Erlbaum.

Baddeley, A.D. (2000). The Episodic Buffer: A New Component of Working Memory? *Trends in Cognitive Science*, 4, 417-23.

Kalat, J. W. (2001). *Biological Psychology (7th ed.)*. Belmont, CA: Wadsworth Publishing.

LECTURE FIFTEEN

Psychological Disorders- Schizophrenia

Introduction

This lecture focuses on mental disorders. Psychological disorders fall into three broad categories; biological, psychological and social. Biological account is regarded as the medical model which emphasizes the importance of parts of the body, particularly the brain, in mental disorders such as depression, anxiety and schizophrenia. These are seen as physical abnormality or dysfunction. They are commonly thought of as inherited (genetic) or insult to the brain – brain damage.

Social account emphasizes the role of people's experiences in their environment in explaining the cause of mental disorder. On this view, someone might become psychologically disturbed through suffering an unusual amount of bad experiences or through lack of support from friends and relations to help them through difficult times or neglect at an early age. However, psychological account explains through faulty thinking or mental disorders. It is also maintained that mental disorder might result from an interaction of these three factors, social, psychological and biological.

Objectives

At the end of this lecture, you should be able to:

1. explain the different types and classification of schizophrenia;
2. discuss the causes and factors responsible schizophrenia; and
3. explain the brain structure of schizophrenia

Pre-Test

1. Give a vivid explanation of schizophrenia.
2. Explain the various types of schizophrenia and highlight their basic differences.

CONTENT

Schizophrenia is a psychological disorder involving cognitive disturbance (delusions and hallucinations), disorganised thinking, emotions, and behaviour, and reduced enjoyment and interests. It is a broad type of psychotic disorders that has three major subtypes as given by the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-iv). They are Paranoid, disorganised and catatonic schizophrenia. A forth category is the indifference schizophrenia. These are individuals who do not fit into the three categories.

Paranoid Schizophrenia: A person with paranoid schizophrenia holds false beliefs or disillusions that seriously distort reality. Often these are beliefs in the exceptional importance of oneself. Leading to delusion of grandeur such as being the next president, ability to stop wars etc. Another example is the belief that because of one's importance, others are "out to get me" in their attempts to thwart the individual's important mission. This is known as delusion of persecution or paranoia. Many individuals with this disorder also experience false perceptions or hallucinations. They may hear, see or feel things that are not there.

Disorganised schizophrenia: This looks like paranoid schizophrenia because of the presence of delusions and hallucinations but the cognitive processes of the disorganised schizophrenic are so disorganised and fragmented that the hallucinations have little recognisable meaning. The main feature is that the individual withdraws from normal human contacts; they act in childlike ways, react inappropriately to both happy and sad events and generally present a highly bizarre picture of others.

Catatonic schizophrenia: In appearance, it is quite different from others. Though, the sufferers sometimes experience delusions and hallucinations, their most obvious abnormalities are however, in social interaction, posture and body movements. There have long periods of stupor, statute-like state in which the individuals seem locked into a posture. They allow themselves to be placed in a posture and they maintain it. They often cease

to talk, appear not to hear what is spoken to him or her, no longer eat without been fed etc. The stupor may be broken by periods of agitations.

Biological factors (Genetics): It has long been observed that schizophrenia runs in families, though families also share the same environment. A major weakness of the genetic argument has been the failure to find a genetic basis for schizophrenia. Some claimed to have found the gene or group of genes responsible but these have not been replicated either by other researchers or even by the same researchers making such claims.

Brain structure: Examination of brain directly depends on technology. Research which has used static brain imaging techniques such as CT scans, have sometimes observed enlarged ventricles (cerebrospinal fluids) in the brains of schizophrenia sufferers. Some studies have also found reduced size in limbic structures. Other imaging technique is Positron Emission Topography (PET). It has been developed to take pictures of the brain, showing activity over a period of time.

Summary

1. Schizophrenia is a psychological disorder involving cognitive disturbance, disorganised thinking, emotions and behaviour reduced enjoyment, and interests.
2. There are three major subtypes of schizophrenia as given by the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-iv). They are Paranoid, disorganised and catatonic schizophrenia. A forth category is the indifference schizophrenia; these are individuals who do not fit into the other three categories.
3. CT scans have sometimes observed enlarged ventricles (cerebrospinal fluids) in the brains of schizophrenia sufferers.

Post-Test

1. Highlight the distinctive features of the three main classification of Schizophrenia.
2. Explain the biological factors responsible for schizophrenia and the weakness of such explanation.

LECTURE SIXTEEN

Psychological Disorders – Affective Disorders

Introduction

An affective disorder is usually characterised by two primary forms of mood disorders; depression and mania. When Depression occurs alone, it is a condition known as major depression. However, mania seems to always alternate with periods of depression (bipolar affective disorder). However, both conditions produce great misery for the individual.

Objectives

At the end of this lecture, you should be able to:

1. distinguish between major depression and bipolar affective disorders; and
2. explain the factors that predispose an individual to depression.

Pre-Test

1. What are the distinguishing features of a depressed person?
2. What are the factors that promote depression in people?
3. Mention the main characteristics involved in Bipolar Affective Disorder?

CONTENT

Major Depression

Major depression is a condition where an individual, is deeply unhappy, with little pleasure in life. To the individual the future is bleak and such person holds a negative opinion of the self and others and often sees no

reason to live. This condition is accompanied by the following; decrease or increase in sleep, increase or decrease in appetite, loss of interest in sex, loss of energy or excessive energy, difficulty in concentrating feeling impelled to commit suicide.

Major depressions are episodic disorders. They occur for only a period of time after which the individual recovers, and returns to normal state. In many cases, persons with major depressions recover within 12 to 20 weeks from the beginning of the depressive episode (Easton et al, 1997; Solomon *et al*, 1997, 2000).

In some cases, it re-occurs at periodic times which may last for several weeks to many months. These periods are followed by periods of normal moods.

The probability that an individual will develop major depression for the first time is very low until puberty. This probability rises until it reaches a pick between 45 and 55 years of age and then declines in old age. Averagely, the risk for major depression is twice as high for women than man, particularly during middle age (Eaton et al, 1997).

Major depression is often relatively mild. People with mild depression are very uncomfortable but they can cope with demands of everyday living. Severe major depression is less common, but is more disabling. This is often accompanied with distorted or bizarre psychotic distortion of reality.

The risk for major depression is significantly more in persons experiencing high levels of stress. There is evidence that some people are more vulnerable than others to depression due to genetic reasons (Kendler & Prescott, 1999).

Cognitive Factors in Depression

People sometimes develop depression when they hold negative views of themselves, the world in which they live, and the future. Studies by Alloy, Abrahamson & Francis (1999) showed that people who believe that they fall far short of being the people they would like to be are more likely to experience depression. The reason that depressed persons often fall short of their ideal is that their beliefs are perfectionist. Hewitt and Flett (1993) found that people who believe that they should be perfect in their work are likely to develop depression if they fail even slightly in their work. It could also be that people who hold perfectionist view in their social

relationships could become depressed if their personal relationships are not going well. Contrarily, people who do not expect perfection of themselves do not become depressed when things do not go well. It is not bad things happening to us that are upsetting; it is our interpretation of such situation that makes all the difference. Having a positive opinion of yourself makes depression less likely following stressful life events.

When people become depressed, their cognition changes; they become more pessimistic, more critical of themselves, more likely to blame themselves for everything bad that happens. When the period of depression goes, they return to a more positive state.

Bipolar Affective Disorder

In bipolar affective disorder, periods of mania alternate irregularly with periods of severe depression. Mania is a period when the individual experiences a remarkably "high" mood. The sensory pleasures are heightened. The self esteem is very high, little sleep, unrealistic optimism prevails. Grandiose and financially damaging schemes and buying sprees are common at this period. Quitting jobs, getting a divorce, engaging in sexual promiscuity and a psychotic distortion of reality are also common at this period. This disturbing mood can be quite enjoyable to the individuals in the short run, but it is usually very damaging to both the person and to others in the long run.

Mania may occur only once, but it returns in multiple times. When it re-occurs, it alternates irregularly with episodes of severe depression. This alternating disorder is known as bipolar affective disorder. Bipolar affective disorder is an uncommon disorder. It is equally common among women and men. It can be treated effectively with medications.

Summary

1. Major depression is a condition where an individual is deeply unhappy, with little pleasure in life.
2. Major depressions are episodic disorders, which occur for only a period of time and then the individual recovers.
3. The risk for major depression is significantly more in persons experiencing high levels of stress.
4. The reason that depressed persons often fall short of their ideal is that their beliefs are perfectionist.
5. It is not bad things happening to us that are upsetting; it is our interpretation of such situation that makes all the difference.
6. In bipolar affective disorder, periods of mania alternate irregularly with periods of severe depression.

Post-Test

1. Give a vivid explanation of major depression.
2. What are the basic cognitive factors involved in depression.
3. What are the distinguishing features of bipolar affective disorder?

References

Alloy, L.B. Abrahamson, L.Y. & Francis, E.L (1999). Do Negative Cognitive Styles Confer Vulnerability to Depression? Current Directions in *Psychological Sciences*. 8,128-132.

Eaton, W.W., Anthony J.C., Gallo, J., Cai. G., Tien, A, Romanoski. A., Lyketsos, C., &Chen. L (1997). Natural History of Diagnostic Interview Schedule /DSM-IV Major Depression. *Archieves of General Psychiatry*. 54, 993-999.

Solomon, D.A. Keller M.B.Leon. A.C. Mueller T I., Shea. M.T., Warshaw M. Maser. J.D. Coryell W. & Endicott, J.(1997)Recovery from major Depression. *Archieves of General Psychiatry*. 54, 1001-1006.

Solomon, D.A. Keller M.B.Leon. A.C. Mueller. T I., Lavori, P.W., Shea. M.T., Warshaw M. Turvey, C., Maser. J.D. Coryell W. & Endicott, J. (2000). Multiple Recurrences of Major Depressive Disorders. *American Journal of Psychiatry*, 157, 229-233.

Hewitt, P.L., and Flett G.L., (1993). Dimensions of Perfectionism, Daily Stress, and Depression: A Test of Specific Vulnerability Hypothesis. *Journal of Abnormal Psychology*. 102, 58-65.

LECTURE SEVENTEEN

Intelligence

Introduction

Intelligence refers to the cognitive abilities of an individual to learn from experience, to reason well and to cope with demands of daily living. Intelligence is a single general factor that provides the basis for the more specific abilities that each of us possesses. Fluid intelligence is the ability to learn or invent new strategies for solving new kinds of problems, while crystallised intelligence is the ability to use previously learnt skills, to solve familiar problems. The first person to develop a useful measure of intelligence is Alfred Binet in 1903. This was improved by Lewis Terman of Stanford University, and it became the Stanford-Binet Intelligence scale. Test of tacit intelligence is specific to given areas, and they are useful in predicting who will perform well in that domain.

Objectives

At the end of this lecture, you should be able to:

1. explain the basic cognitive steps involved in reasoning and problem solving;
2. explain the different types of intelligence; and
3. discuss how to intelligence.

Pre-Test

1. Give a broad definition of intelligence.
2. Mention 7 independent types of intelligence.
3. What are the basic differences between fluid and crystallised intelligence?

CONTENT

Intelligence refers to the cognitive abilities of an individual to learn from experience, to reason well and to cope with demands of daily living. It relates with how an individual is coping with the world around him/her. Sir Francis Galton popularized the concept of intelligence in the late 1800's. Galton believed that intelligent ability was inherited.

According to Galton, intelligence is a single general factor that provides the basis for the more specific abilities that each of us possesses. In this concept, if we are generally intelligent, we are more likely to develop strong mechanical, musical, artistic and other types of abilities. Other psychologists argued that intelligence is not a single general factor but a collection of many separate specific abilities. These psychologists believe most of us are much better in some cognitive abilities than others, rather than being generally good in everything. Among the many researchers on intelligence, Thornstone (1938) developed an alternative to tests of general intelligence, called the **primary mental abilities tests** that measures seven intellectual abilities.

Gailford (1982) suggested that some 150 abilities make up what is regarded as intelligence. Gardner (1983) argued that there are different types of intelligence; he suggested that different types of intelligence are mediated by different parts of the brain. He suggested that there are seven independent types of intelligence:

1. Linguistic (Verbal),
2. logical – mathematical,
3. musical
4. artistic (spatial)
5. kinesthetic (athletic)
6. Interpersonal (social skills)
7. Intrapersonal (personal adjustment).

This definition of intelligence by Gardner is much broader than the traditional one. According to Gardner, great skills in music and emotional adjustment should reflect intelligence just as much as mathematical skills. Most test of intelligence focuses only on verbal and logical – mathematical aspects of intelligence.

People with higher than average intelligence show more high and very low in specific facets of their intelligence than people with below average intelligence. It is common practice when measuring the intelligence of individuals to provide estimates of both general and more specific facets of intelligence.

Sternberg (1979) proposes a tentative theory of intelligence, which specifies the cognitive steps that a person must use in reasoning and problem solving (the cognitive components of intelligence). To solve problems, Sternberg (1979) believes that we must go through a number of cognitive steps such as;

1. **Encode:** These are information stored in the brain in a usable form. These are all relevant information about the problem.
2. **Infer:** The nature of the relationships between the terms in the problem.
3. **Identify** (Map) common characteristics in relevant pairs of elements.
4. Apply the relationship identified
5. Compare the alternative answers
6. Respond with an answer.

Sternberg (1979) suggests that this way of looking at intelligence gives us a framework for discovering which components are most important in determining whether one person is more intelligent than another. Better reasoners take more time to complete the encoding components than poor reasoners but they are faster at all the other stages.

Fluid and Crystallised intelligence

Fluid intelligence is the ability to learn or invent new strategies for solving new kinds of problems, while crystallised intelligence is the ability to use previously learnt skills, to solve familiar problems. This talks of intellect changes in relation to age. The ability to learn new skills for new problems (fluid intelligence) declines from middle age.

Measuring intelligence: the IQ tests:

The first person to develop a useful measure of intelligence is Alfred Binet in 1903. This was improved by Lewis Terman of Stanford University and

it became the Stanford-Binet Intelligence scale. David Wechsler also developed the Wechsler Intelligence scale for children or WISC – III and the Wechsler Adult Intelligence scale.

The score obtained on Binet's intelligence tests is equal to the number of items answered correctly. This is expressed in terms of the age of the children for which that score is the average. For example, if a child correctly answers 18 items and the average number of items answered by children 8 years 6 months in age is 18, then the score on the test would be expressed as 8 years 6 months. Binet called this score the mental age (MA). If your mental age is higher than your actual age (chronological Age, CA) then you are considered bright because you answered the average number of items for older children. If your mental age is lower than your chronological age then you are considered below average intelligence because you could answer only the average number of questions answered by younger children.

Intelligence Quotient (IQ)

The intelligence quotient is obtained by dividing the mental age (MA) by the chronological age (CA) so that children of different chronological ages can be compared. To remove the decimal point, the result is multiplied by 100. Therefore, IQ = MA/CA X 100. for example, if a child's MA is 6 years 6 months and his chronological age is also 6 years 6months then his IQ is 100. IQ that is over 100 indicates that the person is more intelligent than average. If the MA is 10 CA is only 8 years then IQ =10/8 x 100 =125. Conversely, if IQ is less than 100 it indicates that the individual is less intelligent than average. A child with CA of 10 years and an MA of 7 years. IQ = 7/10 x 100 = 70.

Tacit (Everyday) Intelligence

The general intelligent tests by Stanford – Binet or the Weschler scale are limited in what they predict. They are mainly useful in predicting academic performance and complex occupations. They are not useful in predicting performance in specific areas not taught in schools. For example, fishing, photography, vulcanizing, etc. Some researchers have referred to these competencies as "everyday intelligence or tacit intelligence" This is because different areas of employment pose different kinds of problems. Tests of tacit intelligence specific to given areas, and

they are useful in predicting who will perform well in that domain (Stemberg & Wagner, (1993).

Contributing factor to intelligence

There are bodies of researches that have shown that both heredity and our experiences combine to determine our level of intelligence. For instance, the IQ scores of genetically identical monozygotic (identical) twins are considerably more similar than the scores of diazygotic twins, even though both twins are raised in essentially the same intellectual environment.

Further studies like adoption studies indicated that heredity is one of the most important factors in determining IQ. Studies showed that adopted children IQ are more similar to those of their biological parents with who they never lived with than those of their adoptive parents who raised them. Both twin and adoption studies have considerably shown the importance of heredity in intelligence development.

Coupled with these evidences is the exposure that children have to the world of adult intelligence through interaction with their caregivers. This also is essential for intellectual development. Intelligence can also be enhanced by enriching young children's intellectual environment.

Summary

1. Intelligence refers to the cognitive abilities of an individual to learn from experience, to reason well and to cope with demands of daily living.
2. Intelligence is a single general factor that provides the basis for the more specific abilities that each of us possesses.
3. An alternative to tests of general intelligence, called the **primary mental abilities tests** measure seven intellectual abilities.
4. Gardner (1983) suggested that there are seven independent types of intelligence:
5. To solve problems Sternberg believes that we must go through a number of cognitive steps.
6. The intelligence quotient is obtained by dividing the mental age (MA) by the chronological age (CA).
7. Both heredity and our experiences combine to determine our level of intelligence.

Post-Test

1. In reasoning and problem solving, explain the various cognitive steps humans go through?
2. What is the intelligent quotient of a child whose MA is 14 and the CA is 12?
3. Explain vividly the term tacit 'intelligence'.

References

Gardner H. (1983). *Frames of Mind: The Theory of Multiple Intelligence*. New York. Basic Books.

Sternberg, R.J. & Wagner, R.K. (1993).The Egocentric View of Intelligence and Job Performance is wrong. *Current Directions in Psychological Sciences*. 2, 1-5.

Sternberg, S. (1969) Memory Scanning: Mental Processes revealed by Reaction Time Experiments. *Acta Psychological*, 30,276-315.

Thornstone, L.L. (1938) Primary Mental Abilities. *Psychometric Monographs* (1).