UNIT 3 NEUROLOGICAL STUDIES AND CONSCIOUSNESS

Contents

3.0 OBJECTIVES

- To give general overview of neurological studies.
- To figure out the important fields of neurology.
- To see the relationship between neurology and consciousness/

3.1 INTRODUCTION

This introductory unit tries to give an over-view of neurology. We first deal with the history of neurology. Then we take up some general features of brain. Then we deal with the development of brain leading to the evolution of consciousness.

3.2 ETYMOLOGY

The word Neurology comes from the Greek word *neurologia* and deals with *disorders of the nervous system*. Specifically, it deals with the diagnosis and treatment of all categories of disease involving the *central, peripheral, and autonomic nervous systems,* including their coverings, blood vessels, and all effector tissue, such as muscle. Neurology can be defined as the medical specialty concerned with the diagnosis and treatment of disorders of the nervous system - the brain, the spinal cord, and the nerves. According to the World English Dictionary; Neurology means the study of the anatomy, physiology, and diseases of the nervous system. Similarly, a neurologist is a specially trained physician who diagnoses and treats disorders in the nervous system, whether caused by disease or injury. This includes diseases of the brain, spinal cord, nerves and

muscles. Neurologists possess a comprehensive knowledge of the neurological structures of the body, including the cerebral cortex and its division into various lobes and their individual jobs in making the body work as a whole. In short neurology can be defined the branch of medical science that deals with the nervous system.

3.3 HISTORICAL DETAILS OF NEUROLOGY

We list below some of the major discoveries that have advanced neurological research and studies. The list is only indicative and not exhaustive.

a) The First Scientific Studies of Nerve Function

All living things are built of cells. These are not just passive building blocks; they are busy active places. The first scientific studies of nerve function were done in the 18th century. However, clinical neurology had very less scope for further development and findings until the mid-19th century as a result it was very difficult to name and find out the information about the causes of epilepsy, aphasia and other problems due to brain damage. It is interesting to note that the Knowledge of the brain and nervous functions came from studies of animals and the analysis of human nerve cells under the microscope.

b) Beginning of Neurology

With the invention of the electroencephalograph (EEG) in the 1920s which was meant to record electrical brain activity, the diagnosis of neurological disease became easy and speedy. Next came the development of cerebral angiography which helped to see the blood vessels in the brain. Specific drug therapies have been introduced to treat neurological conditions. Thus the future form of neurology will be shaped by knowledge of the human genome and proteome. Electroencephalograph is particularly useful in picking up abnormal brain activity that might be associated with seizure disorders like epilepsy, head injury, brain tumours, infection and inflammation of the brain, chemical disturbances and some sleep disorders.

c) New findings in Neurology

Positron emission tomography in clinical neurology was researched by Karl Herholz MD and W.D. Heist MD from the Department of Neurology, University Cologne, and Max-Planck Institute for Neurological Research, Köln, Germany. According to them, the Positron emission tomography (PET) imaging in clinical neurology serves different purposes like differential diagnosis, especially in the early stage of neurological disorders, description of path physiologic changes that are responsible for manifestation and course of a disease, and evaluation and follow-up of treatment effects and so on. Positron emission tomography relies on a radioactive phenomenon, “positron decay”. Certain radioactive materials will release positively charged particles, called positron as they decay (Al-Chalabi, Turner, Delamont 2006).

MRI- Magnetic Resonance Imaging

It is helpful in revealing the blood vessels of the brain- angiography. An abnormal expansion of a blood vessel, an aneurysm can be made visible by injecting a dye into the blood vessels. the dye is opaque to X-rays and so outlines the aneurysm (Al-Chalabi, Turner, Delamont 2006).

Computed Axial Tomography- the CT Scan

CT was discovered independently by a British engineer named Sir Godfrey Hounsfield and Dr. Alan Cormack. It has become a mainstay for diagnosing medical diseases. For their work, Hounsfield and Cormack were jointly awarded the Nobel Prize in 1979. CT scanners first began to be installed in 1974. Further, in the late 1980s the spiral CT was invented .in this , the X- ray camera rotates spirally downwards and can encompass data from an entire organ within half a minute. this has also permitted the development of CT angiography (Al-Chalabi, Turner, Delamont 2006).

Check Your Progress I

Note: Use the space provided for your answers.s.

1) What is the etymology of neurology?

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2) How did EEG help the progress in neurology?

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Developmental Dyslexia and Animal Studies

At the interface between cognition and neurology was researched by the American neurologist, Albert M. Galaburda. Recent findings in autopsy studies, neuroimaging, and neurophysiology indicate that dyslexia is accompanied by fundamental changes in brain anatomy and physiology, involving several anatomical and physiological stages in the processing stream, which can be attributed to anomalous prenatal and immediately postnatal brain development. Epidemiological evidence in dyslexic families led to the discovery of animal models with immune disease, comparable anatomical changes and learning disorders, which have contributed a lot in finding about mechanisms of injury and plasticity to indicate that substantial changes in neural networks concerned with perception and cognition are present.

Identifying a Molecular Switch That Controls Neuronal Migration in the Developing Brain

St. Jude Children's Research Hospital investigators have identified key components of a signaling pathway that controls the departure of neurons from the brain niche where they form and allows these cells to start migrating to their final destination. However the defects in this system affect the architecture of the brain and are associated with epilepsy, mental retardation and perhaps

malignant brain tumors. Thus the findings provide insight into brain development as well as clues about the mechanism that are helpful in the other developing tissues and organ systems, particularly the epithelial tissue that covers body surfaces.

Neurological Diseases Major Discovery

Researchers at the University de Montreal and the Montreal Neurological Institute, McGill University have discovered that cells which normally support nerve cell (neuron) survival also play an active and major role in the death of neurons in the eye.

New Findings on the Neurological Organization of Dreaming

Sigmund Freud is still the most widely read author on the subject of dreams.he concluded his studies of dreams by saying that "the dreams serves preponderantly to guard against pain" (Searle 2004). The fundamental neuropsychological mechanisms involved in dreaming appear to be (1) inhibitory mental control, (2) spatial thought, and (3) quasi-spatial (symbolic) operations. The essential factor in REM sleep, by contrast, is basic arousal. Dreaming is a natural mental activity. most dreams are clear, coherent, realistic and detailed accounts of a situation involving the dreamer and other people. More often than not, dreams are about very ordinary activities and preoccupations, although they can also be fantastic or ridiculous things.so dreamiong can be looked upon as a continuous stream of mental activity, which we become aware of when aroused, occurring particularly during REM and to a lesser extent during NREM sleep (Al-Chalabi, Turner, Delamont 2006).

Brain Underpinnings for Auditory and Visual Illusions and Everyday Experiences

New research indicates that the integration of senses and functions in the brain is very common. It is found that about two percent of the population has a condition called synesthesia, in which two different sensations, like color and sound, are experienced at once. Although this condition is rare, the new findings suggest the brain is wired in complex and sometimes overlapping ways to help people interpret and understand their environments. Scientists have also found the relationship between stroke and brain damage caused by the lack of oxygen. Dr Sharlin Ahmed, Research Liaison Officer at The Stroke Association says: "When a stroke strikes the brain is starved of oxygen and as a result brain cells in the affected area die. The use of stem cells to replace dead brain tissue is a promising technique which could help to reverse some of the disabling effects of stroke. Damage to the rhinal cortex of both hemispheres causes severe memory loss or amnesia. The crucial feature of the amnesic syndrome is a devastating absence of memory for events since the injury (Gellatly and Zarate1998).

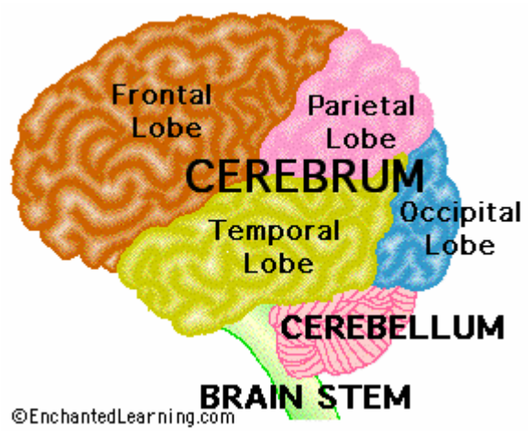
Emergence of Neuroculture

NeuroCulture is the relation between the sciences that study the functioning of the brain and culture. We normally understand culture as the knowledge, history, habits, ideas and values of the human race, and their manifestations in any form of expression: social, scientific, artistic, philosophical, moral or religious, etc. It is interesting to note that the basis of NeuroCulture is that everything a human being creates is generated in the brain, from the most primary functions which

resulted from millions of years of evolution. This lead to superior expressions, like art, religious or scientific thinking. Thus, the link that relates the biological functioning of the brain to the results of its processes creates a method of explaining how human beings respond to their environment in every possible way. Neuroscience, together with the humanistic and scientific disciplines, creates a new level of study that leads to a reassessment of some of its fields of study and, of course, the enrichment of neurological studies.

3.4 THE GENERAL STRUCTURE OF THE BRAIN

The brain is the portion of the central nervous system in vertebrates (animals with bones) that lies within the skull. In humans, the brain weighs about 3 pounds. Differences in weight and size do not correlate with differences in mental ability. The brain is the control center for movement, sleep, hunger, thirst, and virtually every other vital activity necessary to survive. The brain is a pinkish-gray mass that is composed of about 10 billion nerve cells. The nerve cells are linked to each other and together play a vital role in the control of all mental functions. Nerve fibers in the brain are covered in a near-white substance called myelin and form the white matter of the brain. Nerve cell bodies, which are not covered by myelin sheaths, form the gray matter. The brain is divided into three major parts, the hindbrain (including the cerebellum and the brain stem), the midbrain, and the forebrain (including the diencephalon and the cerebrum).



The brain has three main parts, the **cerebrum**, the **cerebellum**, and the **brain stem**. The brain is divided into regions that control specific functions (Enchantedlearning.com).

3.5 SOME SPECIFIC FUNCTIONS OF THE REGIONS OF BRAIN

The specific functions associated with the different part of the brain are given below (Enchantedlearning.com)

THE CEREBRUM:
Frontal Lobe

- Behavior
- Abstract thought processes

- Problem solving
- Attention
- Creative thought
- Some emotion
- Intellect
- Reflection
- Judgment
- Initiative
- Inhibition
- Coordination of movements
- Generalized and mass movements
- Some eye movements
- Sense of smell
- Muscle movements
- Skilled movements
- Some motor skills
- Physical reaction
- Libido (sexual urges)

Occipital Lobe

- Vision
- Reading

Parietal Lobe

- Sense of touch (tactile senstation)
- Appreciation of form through touch (stereognosis)
- Response to internal stimuli (proprioception)
- Sensory combination and comprehension
- Some language and reading functions
- Some visual functions

Temporal Lobe

- Auditory memories
- Some hearing
- Visual memories
- Some vision pathways
- Other memory
- Music
- Fear

- Some language
- Some speech
- Some behavior amd emotions
- Sense of identity

Right Hemisphere (the representational hemisphere)

- The right hemisphere controls the left side of the body
- Temporal and spatial relationships
- Analyzing nonverbal information
- Communicating emotion

Left Hemisphere (the categorical hemisphere)

- The left hemisphere controls the right side of the body
- Produce and understand language

Corpus Callosum

- Communication between the left and right side of the brain

The Cerebellum

- Balance
- Posture
- Cardiac, respiratory, and vasomotor centers

The Brain Stem

- Motor and sensory pathway to body and face
- Vital centers: cardiac, respiratory, vasomotor

Hypothalamus

- Moods and motivation
- Sexual maturation
- Temperature regulation
- Hormonal body processes

Optic Chiasm

- Vision and the optic nerve

Pituitary Gland

- Hormonal body processes
- Physical maturation
- Growth (height and form)
- Sexual maturation
- Sexual functioning

Spinal Cord

- Conduit and source of sensation and movement

Ventricles and Cerebral Aqueduct

- Contains the cerebrospinal fluid that bathes the brain and spinal cord

3.6 THE EVOLUTION AND DEVELOPMENT OF THE HUMAN BRAIN

The evolution of the brain acquired a process of continuous change and selection in all aspects of life on earth, including the human brain. The scientists have discovered that billions of years ago, life existed only in the form of single celled organisms. These organisms were continued through their own chemical processes until they gradually evolved into the multi-celled beings that first appeared approximately 680 million years ago. Thus the more complex animals, including man, afterward evolved from these multi-celled beings. The evolution of the human brain followed a similar course; moving from the simple to the complex over an extended period of time. The billions of cells that work together to make the brain and body function harmoniously have numerous critical functions. The brain is after all a far more multi-functional organ by nature than other, less complex organs such as the heart or the liver.

It is a fact that as man evolved, certain mutations took place within the nervous system that forced it to evolve in time with the body. For example, just as external physical changes were selected as either worthy or unworthy by the environment, mutations in the nervous system were also forced to prove their might against environmental challenges. The brain of an embryo starts off as a simple tube of tissue. It then develops three enlargements that will become the forebrain later divides into the two cerebral hemispheres, which grow outwards to cover much of the lower brain regions. (Angus Gellatly Oscar Zarate 1998)

Configuration of the Brain

The adult human brain weighs on average about 3 (1.5 kg) with a size (volume) of around 1130 cubic centimeters (cm^3) in women and 1260 cm^3 in men, although there is substantial individual variation. Men with the same body height and body surface area as women have on average 100g heavier brains, although these differences do not correlate in any simple way with gray matter neuron counts or with overall measures of cognitive performance. At the age of 20, a man has around 176,000 km and a woman about 149,000 km of militated axons in their brains. The two cerebral hemispheres are the largest and most obvious features of human and other primate brains. Their surface grey matter is the cortex, sometimes called neo-cortex to distinguish it from the cortex found in lower, and more ancient, brain structures (Al-Chalabi, Turner and Delamont 2006).

Functions of the Brain

From an organismic perspective, the primary function of a brain is to control the actions of an animal. To do this, it extracts enough relevant information from sense organs to refine actions. Sensory signals may stimulate an immediate response as when the olfactory system of a deer detects the odor of a wolf; they may modulate an ongoing pattern of activity as in the effect of light-dark cycles

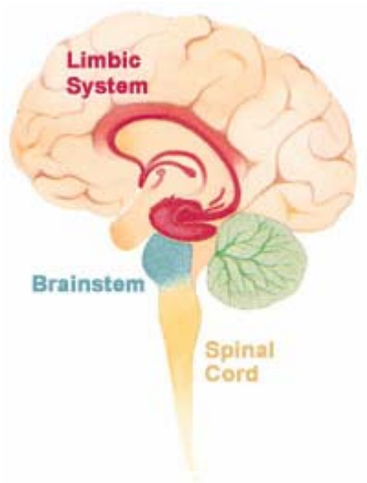
on an organism's sleep-wake behavior; or their information may be stored in case of future relevance.

Functional subsystems. One of the most important of these is on the basis of the chemical neurotransmitters used by neurons to communicate with each other. Another is in terms of the way a brain area contributes to information processing: sensory areas bring information into the brain and reformat it; motor signals send information out of the brain to control muscles and glands; arousal systems modulate the activity of the brain according to time of day and other factors .In the first signs of a nervous system, the notochord develops and causes the elctoderm above to become tissue, which in turn sinks down to become a tube of nervous tissue- the future spinal cord and brain (Al-Chalabi, Turner and Delamont 2006).

As per the Neurotransmitter systems, with few exceptions, each neuron in the brain consistently releases the same chemical neurotransmitter, or combination of neurotransmitters, at all of the synaptic connections it makes with other neurons.Thus, a neuron can be characterized by the neurotransmitters it releases.

Sensory Systems

Like animals, humans learn about the world through their senses. traditionally, there are five senses. taste and smell are closely associated with the limbic system. One of the primary functions of a brain is to extract biologically relevant information from sensory inputs. Even in the human brain, sensory processes go well beyond the classical five senses of sight, sound, taste, touch, and smell: our brains are provided with information about temperature, balance, limb position, and the chemical composition of the bloodstream, among other things. All of these modalities are detected by specialized sensors that project signals into the brain (Gellatly and Zarate 1998).



Motor Systems

Motor systems are areas of the brain that are more or less directly involved in producing body movements, that is, in activating muscles. With the exception of the muscles that control the eye, all of the voluntary muscle in the body are directly innervated by motor neurons in the spinal cord, which therefore are the final common path for the movement-generating system. People who suffer damage to the hippocampus become bad at finding their way about. Some, if

they remain in their home, can cope with the familiar environment (Gellatly and Zarate 1998).

Arousal Systems

A key component of the arousal system is the suprachiasmatic nucleus (SCN), a tiny part of the hypothalamus located directly above the point at which the optic nerves from the two eyes cross. The SCN projects to a set of areas in the hypothalamus, brainstem, and midbrain that are involved in implementing sleep-wake cycles. An important component of the system is the so-called reticular formation, a group of neuron-clusters scattered diffusely through the core of the lower brain. Reticular neurons send signals to the thalamus, which in turn sends activity-level-controlling signals to every part of the cortex. Damage to the reticular formation can produce a permanent state of coma.

Brain: The Amazing Organ

Every animal we can think of — mammals, birds, reptiles, fish, and amphibians — has a brain. But the human brain is unique. It gives us the power to think, plan, speak, imagine... It is truly an amazing organ.

- It controls body temperature, blood pressure, heart rate and breathing.
- It accepts a flood of information about the world around you from your various senses (seeing, hearing, smelling, tasting, touching, etc).
- It handles physical motion when walking, talking, standing or sitting.
- It lets you think, dream, reason and experience emotions.

It is interesting to note that all of these tasks are coordinated, controlled andregulated by an organ that is about the size of a small head of cauliflower.

Some Interesting Facts about the Brain

- The brain uses 20% of your body's energy, but it makes up only 2% of your body's weight.
- The average human brain weighs around three pounds or 1.4 kilos.
- Your brain is about 1300-1400 cubic centimeters in volume, about the size of a cantaloupe and wrinkled like a walnut.
- In 1874, Carl Wernicke discovered that damage to an area of the temporal lobe, close to tissue involved in hearing resulted in anoathaer type of language disorder (Gellatly and Zarate 1998).
- A brain generates 25 watts of power while you're awake enough to illuminate a light bulb.
- A newborn baby's brain grows almost 3 times in course of first year
- Humans have the most complex brain of any animal on earth.

The brain is divided into two sides. The left side of your brain controls the right side of your body; and, the right side of your brain controls the left side of your body.

Check Your Progress II

Note: Use the space provided for your answers.s.

1) When did neurology originate?

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2) What is NeuroCulture and its significance for neurological studies?

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3.7 DISEASES AND CONDITIONS OF THE BRAIN

There are many diseases connected with the brain. Advances in neurological studies, it is hoped, will be able to find remedy for at least most of these conditions.

- Stroke, meningitis, multiple sclerosis, coma, paralytic polio, Parkinson's disease, Leu Gehrig's Disease, Cerebral Palsy, and migraine headaches are all diseases and conditions that affect the brain.
- A stroke is damage to the brain due either to blockage in blood flow or to loss of blood from blood vessels in the brain.
- Coma is an extended period of unconsciousness from which a person cannot be aroused even with the most painful stimuli.
- Damage in the cerebellum has a variety of consequences .defects include loss of the ability to learn new movements, disruption of posture, jerkiness of movements inability to make rhythmic movements, and impaired sequencing of movements.
- People with Parkinson's disease, characterized by tremor and an inability to initiate movements, have a shortage of dopamine in the BG (Gellatly and Zarate 1998).

3.8 BRAIN DEATH AND THE LOSS OF PERSONHOOD

It is obvious that the sense of self or personhood (identity) is connected to the brain. And brain death is connected to the loss of personhood. There are two theories with regard to the death of a person from the neurobiological perspective; i) the whole-brain death definition and ii) the higher-brain death definition (Jones 2004). The whole-brain death is considered as the traditional definition of

neurobiological death which states that death occurs due to the cessation of the functioning of the whole brain. This is considered a biological concept of death since it takes account of the irreversible cessation of the functioning of the whole brain and the whole body. In this definition of brain death there is no difference between the death of any other organism and that of a human being. Gareth Jones writes, "This (whole-brain death) entails the cessation of functioning of a biological unit, in the sense that there is no difference between the deaths of any biological life, be it a dog, rat or human being" (Jones 2004).

As opposed to the whole-brain death, higher-brain death defines death as the higher capacities of a human being ceasing irreversibly due to the irreparable cerebral cessation. This is known as the personalist conception of death, as a person is considered dead when his higher functions which are considered essentially human cease to function or stop working in an irrecoverable way. This definition of death accords the human being personhood which states that he is more than a biological organism.

This higher-brain definition stresses the irreversible loss of functions regarded as characteristic of human existence and of our meaning as human persons: our individual personalities, conscious life, and uniqueness, and the capacity for remembering, judging, reasoning, acting, enjoying and worrying. Such a personalistic concept focuses attention onto our humanness and onto the responsibilities lying at the core of human community." (Jones 2004) Whether we accept either of the definitions of death, the important point in this regard is that both are related to the cessation of the functioning of proper or total termination of the brain processes.

3.9 NEUROLOGY AND CONSCIOUSNESS

The problem of consciousness has been away from the scientific arena for a long time since many scientists considered it as a philosophical problem. But with the emergence of neuroscience as a well-established discipline and with the technological advancements by developing new methods of brain mapping neuroscientists also find it plausible to delve into this 'hard problem'. Francis Crick and Christof Koch write in a review of *the Astonishing Hypothesis*, "We have taken exactly the opposite point of view. We think that most of the philosophical aspects of the problem should, for the moment, be left on one side, and that the time to start the scientific attack is now" (Crick and Koch 2004).

a) Francis Crick's Theory

Consciousness, as many hold, is a multi-dimensional phenomenon. This is one of the problems that makes the explanation of consciousness a hard one, be it for scientists or for philosophers. However scientists like Francis Crick and the Paul Churchland firmly believe that this is the opportune time to begin the scientific attack on consciousness. Crick's astonishing hypothesis is that "it's all done by neurons" (Crick 1994). Francis Crick tried to crack the hard problem of consciousness through the explanation of the any single aspect of consciousness - visual consciousness. Here Francis Crick writes: In approaching the problem, we made the tentative assumption that all the different aspects of consciousness (for example, pain, visual awareness, self-consciousness, and so on) employ a basic common mechanism or perhaps a few such mechanisms. If one could

understand the mechanism for one aspect, then, we hope, we will have gone most of the way towards understanding without further discussion" (Crick and Koch 2004). Francis Crick, thus, tries to solve the problem of consciousness by providing a solution to 'visual consciousness'.

For Francis Crick, the whole brain is not the part of the generation of consciousness. His whole attempt is to find the 'Neural Correlate of Consciousness'. His finding is that only specific types of neurons are conscious. These neurons should project themselves to the centres of the brain which control the motor activity and planning)Crick and Koch 2004) Francis Crick hopes to solve the problem of visual consciousness by the 'Frontal Lobe Hypothesis' where we may find the neural correlate of visual consciousness (Crick 1994). He solves the binding problem of perceptual unity by yet another neuron doctrine – mainly by the conjoining simultaneity and the speed of the firing of the neurons which may be involved in a particular act of perception, say, seeing an angry face. Crick writes: "The simplest idea would be that awareness occurs when some special set of neurons fire at very high rate (e.g., at about 400 or 500 Hertz), or that the firing is sustained for a reasonably long time. Thus "binding" would correspond to a relatively small fraction of cortical neurons, in several distinct cortical areas, firing very fast at the same time (or a long period)" (Crick 1994).

b) Qualia: The Opponent Pathway Hypothesis

The problem of qualia has been a thorn in the flesh of the philosophers and scientists who claim to explain all the aspects of human conscious experience. Among the *qualia* colour has attracted the attention of the philosophers and scientists. Neuroscientists try to solve the problem of *qualia* of colour through 'the opponent pathway hypothesis'. The opponent process account is one of the popular theories in neuroscience which explains how does the brain code sensory qualities. The scientists and philosophers who hold this view of processing sensory *qualia* by the brain generally hold the view that photoreceptor present in the human retina are in the opponent path ways like, red-green, black-white etc. (PN 2008). The colour that strike the retina of the human eye then activate the three dimensional vector space, production activity in each of the isolated pathways. In this understanding, the representation of colour *qualia* is due to the activation of the vector space in the colour opponent pathway. Each dimension in that three-dimensional space will represent the average frequency of action potentials in the axons of one class of ganglion cells projecting out of the retina.

The process of the representation of the colour, according to the opponent pathway hypothesis, is as follows. Each colour perceivable by humans will be in a region of a particular vector space in which opponent colours are present. For example, an orange stimulus produces a relatively low level of activity in both the red-green and yellow-blue opponent pathways and middle-range activity in the black-white opponent pathway. Pink stimuli, on the other hand, produce low activity in the red-green opponent pathway, middle-range activity in the yellow-blue opponent pathway, and high activity in the black-white opponent pathway (PN 2008). Location and geometrical proximity between regions reflect the structural similarities between the perceived colours.

c) Backward Referral Hypothesis

The backward referral hypothesis of consciousness has been proposed by the neuroscientist-philosopher Benjamin Libet, following an experiment he

conducted to know whether conscious awareness precedes or follows an event (Libet, Sinnott-Armstrong and Nadel2011). Libet found out that the neural event happens in a delayed 500 milli-second time after the onset of the stimulating of the event (Gazzaniga, Ivry and Mangun 1998). According to him conscious awareness of an event actually follows the event, though we often think that we are aware of the event from its very onset. Rodeny Cotterill following the hypothesis of Libet, proposed a neural circuit called "vital triangle" (fig:2.1), for the cause of the delay in the conscious awareness of an event. This neural circuit includes, sensory cortex, frontal cortex and various thalamic nuclei. The delay in conscious awareness of an event, according to Rodeny Cotterill, is because these regions are not singly responsible for the consciousness awareness but it is the feedback–feed forward connections among these three partners that enable consciousness (Gazzaniga, Ivry and Mangun 1998).

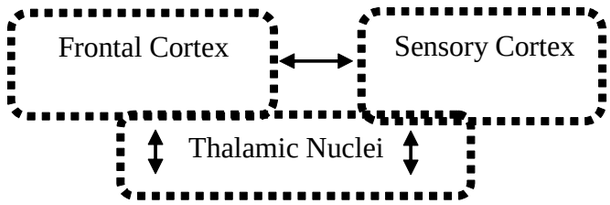

Fig: 2.1 Schematic of the Vital Triangle

There are some of the ways consciousness is being understood and explained by neuroscience. There is definitely a long way to go.

Check Your Progress III

Note: Use the space provided for your answers.s.

1) How is brain death related to the loss of personhood or identty?

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2) What is "Backward referral hypothesis"?

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3.10 LET US SUM UP

In this unit we tried to have an overall view of neurological studies and brain functions, with special focus on the emergence of human consciousness.

3.11 KEY WORDS

Aphasia: Inability to use or understand language (spoken or written) because of a brain lesion

Dyslexia: A general term for disorders that involve difficulty in learning to read or interpret words, letters, and other symbols, but that do not affect general intelligence

Hypothalamus: a region of the brain, between the thalamus and the midbrain, that functions as the main control center for the autonomic nervous system by regulating sleep cycles, body temperature, appetite, mood, etc., and that acts as an endocrine gland by producing hormones, including the releasing factors that control the hormonal secretions of the pituitary gland.

NeuroCulture: NeuroCulture is the relation between the sciences that study the functioning of the brain and culture.

Qualia: Qualia is the term used for the description of the sensory quality one subject experiences which is thought to be subjective and private.

3.12 FURTHER READINGS AND REFERENCES

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