Unit -1

THE STORY OF PSYCHOLOGY AND THINKING CRITICALLY WITH PSYCHOLOGICAL SCIENCE - I

Unit Structure :

1.0 OBJECTIVES

- The chapter here explains what psychology is all about.
- It explains the milestones in psychology's early development.
- Understanding how a behaviour is explained or analysed at three different levels.
- Understanding subfields of psychology.

1.1 WHAT IS PSYCHOLOGY?

Psychology is the scientific study of behaviour and mental processes. Behaviour includes all of our external or overt actions and reactions such as talking, walking, facial expressions, etc. Mental processes refer to all the internal or overt actions of our mind such as thinking, feeling, remembering, etc.

Psychology is considered to be scientific because psychology studies people and their behaviour in a systematic manner through careful and controlled observations. The findings of psychology can be verified and re-verified. Existing theories of psychology are modified in the light of new findings. However,

psychology is not as exact science as pure sciences such as physics and chemistry. In pure sciences such as physics, chemistry, etc. it is possible to make absolutely accurate predictions, but the subject of psychology is human behaviour. Each human being is unique and different from the other and therefore one cannot predict with hundred percent accuracy, how a person will behave in a given situation. Yet Psychology is a science since it rigorously follows scientific methods.

Psychology has four goals- It describes what is happening, explains why it is happening, predicts when will it happen again and through this prediction tries to control human behaviour, i.e., it determines how human behaviour can be changed.

1.1.1 Roots of psychology: Psychological science is born:

Psychology as a subject started when human beings asked questions like who we are? how our thoughts, feelings and actions are produced and how do we understand and manage our environment and people around us. Psychological science is born. It is human nature to be curious about ourselves and the world around us. Before 300 B.C.E the Greek naturalist and philosopher Aristotle spoke about learning memory, motivation, emotion perception and personality. Some of the ideas put forward by him were like heavy meal produces gases and it makes us sleepy. It also collects heat and surrounds heart which becomes a source of personality. Though, in modern times, we laugh at Aristotle's guesses but we have to acknowledge that at least he was asking right questions.

Philosopher's thinking about human behaviour continued till birth of psychology until December 1879 when Wilhelm Wundt started a laboratory at university of Liepzig in Germany. He developed experimental apparatus to measure reaction time. He observed that people take longer time to be aware of their awareness, e.g., his machine measured the time lag between people's hearing a ball hit a platform and their pressing a telegraph key. People responded in about one tenth of a second when asked to press the key as soon as the sound occurred and in about two tenth of a second when asked to press the key as soon as they were consciously aware of perceiving the sound. Wundt was trying to measure atoms of mind - the fastest and simple mental processes. Thus, the first psychological laboratory was staffed by Wundt and his graduate students. Soon the new science of psychology became organised into two different branches or schools of thought. These two early schools were structuralism and functionalism.

Structuralism:

Edward Bradford Titchener student of Wilhelm Wundt was interested in discovering structure of mind. He engaged people in self-reflective introspection (looking inwards) and trained them to report elements of experiences as they looked at a rose or listened to a metronome or smelled a scent or tasted a substance. He asked them to report their immediate sensations, their images and feelings while going through these experiences. He further asked them to relate these sensations to one another. But unfortunately, it was noticed that the introspection method was unreliable for two reasons –

a.) it required smart and verbal people
b.) its results differed from person to person and from experience to experience.

So, the method of introspection was not accepted for its subjective nature and structuralism did not continue to exist. Trying to understand mind's structure from simple elements was like trying to understand a car by examining its disconnected parts.

Functionalism:

Philosopher psychologist William James was influenced by evolutionary theory of Charles Darwin and thought it would be more useful to consider the evolved functions of our thoughts and feelings. For example, thinking is done by brain but the question arises why it is done. James assumed that thinking is developed because of its adaptive nature, it helped our ancestors to survive. Similarly, consciousness serves the function of helping us to remember past, adjust to present and plan for our future. William James, a functionalist, engage into the explorations of down to earth emotions, memories, will power, habits and moment to moment streams of consciousness.

William James is more known for his writing and mentoring in 1890 he admitted Mary Whiton Calkins a lady student to his graduate seminar in spite of the objections of Harvard's President these were the years when women did not have a right to vote. When Calkins joined all other male students dropped out. So, James tutored her alone. Later on, she completed all of Harvard's Ph.D. requirements, by scoring more then all male students but still she was denied a degree that she earned from Harvard university. Instead she was offered a degree from Radcliffe College, that was Harvard's undergraduate sister school for women. Calkins resisted the unequal treatment and refused the degree. Later on, she became a distinguished memory researcher and the American Psychological Associations (APA) first female President in 1905.

Later on, Margaret Floy Washburn was the first female psychologist having Ph.D. degree. She wrote an influential book titled as “The Animal Mind” and became second female APA President in 1921. But Washburn’s gender closed doors for her also. Her thesis was the first foreign study Wundt published in his journal but she could not join all male organisation of experimental psychologist founded by Titchener. This is in stark contrast to recent past from 1996 to 2012, when out of 16 elected presidents of APA,8 were women. In United States, Canada, Europe most psychology doctorates are earned by women now.

Publisher Henry Holt was impressed by writings of William James and he offered him a contract to write a textbook of the new science of psychology. James agreed and began his work in 1878 with the view of completing it in two years but actually it took him 12 years to complete *“Principles of psychology”*. This is a book that introduced psychology to educated public. More than a century later, people still marvel at the brilliance and elegance of this book.

1.1.2 Psychological Science develops

Let us see how psychology continued to develop from 1920s to till today. In the initial phase, many psychologists believed that compared to everything else in our external universe, if there is one thing about which everyone has maximum knowledge then that is about himself/herself. We have maximum knowledge about ourselves because of inside information. In conformity to this idea, Wundt and Titchener also focused on inner sensations images and feelings. William James used introspective examination for understanding elements of consciousness and emotions. So, the early psychologist define psychology as a science of mental life.

Behaviourism:

In 1920s John B. Watson and B. F. Skinner rejected the method of introspection and redefined psychology as scientific study of observable behaviour. They argued that science is based on observation. We cannot observe sensations, feelings or thoughts and therefore they cannot be studied. However, people’s behaviour as they respond to different situations can be observed and recorded, so only observable behaviour should be considered in scientific study of psychology. Many psychologists agreed that behaviourism was one of the major force in psychology right into 1960s.

Freudian Psychology:

The other major force at that time was Freudian Psychology. In 1940, Sigmund Freud spoke about the unconscious thought processes and an emotional response to childhood experiences and their influence on our behaviour. Just as in 1900s, the behaviourists had rejected prevailing definition of psychology at that

time, similarly, two other groups rejected the definition of psychology that was prevailing in 1960s.

Humanistic Psychology:

Humanistic psychologist like Carl Rogers and Abraham Maslow found that Freudian perspective and behaviourism were limited approaches to understand human behaviour. They pointed out that instead of focusing our attention on the meaning of early childhood memories (as propagated by Freud) or learning of conditioned responses (as propagated by behaviourists), it is important to pay attention to the ways that current environmental influences can nurture or limit our growth potential and satisfy our need for love and acceptance. More than early childhood experiences and learning of conditioned response, humanist felt that the current environmental conditions influence the potential of growth.

Cognitive Psychology:

The rebellion of the second group of psychologists who rebelled during 1960s is known as Cognitive Revolution. This revolution once again believed that it is important to see how mind processes and retains information. Cognitive psychology scientifically explores the way we perceive, process and remember information. Cognitive neuroscience, an interdisciplinary study, has enriched our knowledge about brain activity underlying mental activity. It has given us new ways to understand ourselves and to treat disorders such as depression.

In the light of this historical background, we can summarize psychology's concern about observable behaviour and inner thoughts and feelings by defining psychology as the science of behaviour and mental processes. Let us analyse the definition.

Behaviour: It is anything that organism does. It is any action that can observed and recorded, may be smiling, yelling, studying, talking, running etc.

Mental processes: These are internal susceptive experiences on the basis of which inferences can be drawn about the behaviour like sensations perception, dreams, thoughts, beliefs and feelings.

Science: Psychology is less a set of findings than a way of asking and answering questions.

1. 1.3 Contemporary Psychology:

Psychology as science emerged from the field of biology and philosophy. Wilhelm Wundt was a philosopher and psychologist, William James was an American Philosopher. Freud was a physician; Ivan Pavlov was a Russian Physiologist. The most

influential child observer Jean Piaget was a Swiss biologist. Morton Hunt in 1993, called them as “Magellans of the Mind” (Ferdinand Magellan (1489–1521) was a famous Portuguese navigator who made many discoveries and explored areas of the world previously unknown to his fellow Europeans. Because early psychologists made exciting discoveries and explored unknown frontiers, they were preparing the way (they were pioneers) for future psychologists and can thus be considered “Magellans of the mind.”

Thus, Morton Hunt held that psychology originated in several fields and in many countries. Even today's psychologist are the citizens of many different countries. The international Union of Psychological Science has 71 nations from Albania to Zimbabwe as its members. In China, the first department of Psychology at university level was opened in 1978 and in 2008 there were nearly 200 Departments of Psychology at university level. Apart from that, due to international publications, joined meetings, advent of internet, collaboration across the borders, Psychology is growing rapidly and globalizing. Today Psychology is not only developing at various places but the topics of interest also vary from the study of nerve cell to the study of international conflicts.

1.1.4 Psychology’s Biggest Question: Nature v/s Nurture:

The biggest and most persistent question faced by psychologists has been whether human traits develop at birth or later on through experience. Plato(428-348 B.C.E.), assumed that character and intelligence and certain ideas are inherited. Aristotle(384-322 B.C.E.) on the other hand, argued that everything that is there in our mind has come through external world through our senses. In other words, he said that whatever information, sensation, feelings are stored in our mind has come through our experiences of external world.

In 1600s, John Locke also argued that mind is a blank sheet on which experiences write. René Descartes did not agree with this suggestion and believed that some ideas are innate. Two centuries later, Descartes’ ideas got support from a naturalist, Charles Darwin.

The role of internal or innate factor was supported by Charles Darwin’s concept of natural selection. He explained the diversity in different organisms of the same species as stemming from the process of natural selection. Thus, nature selects the traits that best enable organism to survive and reproduce in a particular environment. Darwin believed that theory explained not only animal structure(such as polar bear’s white coat) but animal behaviour also(such as the emotional expressions linked to lust and rage). This theory of evolution as proposed by Charles Darwin has become an important principle for psychology in 21stcentury.

The nature and nurture issue has continued to remain a major concern of psychologist today. More and more psychologists are exploring relative contributions of biology and experience and exploring questions such as:

1. How and why we human beings are alike? Is it because of our common biology and evolutionary history?
2. How and why we human beings are diverse? Is it because of our differing environments?
3. Diversities or variations are found. Are they because of genetic factors, or variation in the environmental conditions?
4. Are gender differences caused by biological conditions or are they created by existing social environment?
5. Is children's grammar mostly innate or formed by experience?
6. Are personality and intelligence differences caused by hereditary conditions or by environmental conditions?
7. Are sexual behaviours more 'pushed' by inner biology or 'pulled' by external incentives?
8. Psychological disorders such as depression should be treated as disorders of brain or disorders of thoughts?

Contemporary science resolves this Nature and Nurture controversy by saying "Nurture works on what nature endows". In other word's nature biologically endows us with enormous capacity to learn and adapt and nurture as environment decides how this endowment will flourish or will develop. Moreover, every psychological event (every thought, every emotion) is simultaneously biological event. For example, depression can be both – a brain disorder and a thought disorder.

1.1.5 Psychology's Three Main Levels of Analysis:

Table 1.1 Psychology's Current Perspectives:- (Adopted from David Myers)

Perspectives	Focus	Sample Questions	Example of Subfields Using this Perspectives
Neuroscience	How the body and brain enable emotions, memories, and sensory experiences.	How is blood chemistry linked with moods and motives? How do pain messages travel from the hand to the brain?	Biological; Cognitive; Clinical
Evolutionary	How the natural selections of traits have promoted the survival of genes	How does evolution influence behavioural tendencies?	Biological; Developmental; Social
Behaviour genetics	How our genes and our environment influence our individual differences	To what extent are psychological traits such as intelligence, sexual orientation, vulnerability to depression products of genes? Of our environment?	Personality; Developmental
Psychodynamic	How behaviour springs from unconscious drives and conflicts	How can someone's personality traits and disorders be explained by unfulfilled wishes and childhood traumas?	Clinical; Counselling; Personality
Behavioural	How we learn observable response	How do we learn fear particular objects or situations? What is the most effective way to change our behaviour, say to lose weight or stop smoking?	Clinical; Counselling; Industrial-organizational

Cognitive	How we encode, process, store, and retrieve information	How do we use information in remembering? Reasoning? Solving problems?	Cognitive; Clinical; Counselling; industrial-organizational
Social-cultural	How behaviour and thinking vary across situations and cultures	How are we alike as members of one human family? How do we differ as products of our environment?	Developmental; social; Clinical; counselling

Biopsychosocial Approach:

Each one of us is a complex system that is part of a larger social system. At micro level, we are made up of smaller systems such as nervous system and body organs, which is made up of still smaller systems such as cells, molecules and atoms. These tiered systems suggest that different levels of analysis are complementary, because everything is related to everything else. All these levels put together are called biopsychosocial approach.

Biological influences include influences such as natural selection of adaptive traits, genetic predisposition of responding to environment, brain mechanism and hormonal influences.

Psychological influences include learned fears and expectations, emotional responses, cognitive processing and perceptual interpretations. These two contribute to behaviour or mental processes that are expressed in socio cultural conditions like presence of others, expectations of family, society and culture, influence of friends, other groups and compelling models such as media. Understanding at each level gives a perspective to human behaviour.

Each of these levels give a unique advantage to look at behaviour or mental processes. Yet each by itself is incomplete. Psychologists have variety of perspectives and ask different questions and have their own limits. For example, Let us see how different perspectives understand anger. Person studying from neuroscience perspective will focus on brain circuits that cause anger.

- Evolutionary perspective will focus on how anger has helped the survival of the organism.
- Behaviour genetics may study how heredity and experience influence an individual differences in temperament.

- Psychodynamic perspective may say that it is an expression of unconscious hostility.
- Behavioural perspective may try to see which external stimuli triggers anger.
- Cognitive perspective will explain how given situation affects our anger and how anger affects our Thinking.
- Socio cultural perspective will concern itself with how expression of anger may vary in different socio-cultural conditions.

All these perspectives do not still give a complete picture of human behaviour. The table 1.1 summarises key perspectives and their areas of concern and subfields of psychology, and perspectives.

1.1.6 Subfields of Psychology:

Some psychologists conduct basic research that builds psychology's knowledge base for example Biological psychologist they will explore the link between brain and mind, Developmental psychologists will study behaviour and abilities from womb to tomb, Cognitive psychologists study how we perceive think and solve problems, Personality psychologists investigate our relatively permanent traits, social psychologist study how we get impacted by others' social behaviour and how do we impact their behaviour, Counselling psychologists listen carefully to a client's troubled thoughts and emotions and A Social - cultural psychologists will be studying the variations in human values and behaviour in different cultures.

Some psychologists engage in basic research. In applied research, practical problems are tackled like industrial psychologist helping companies to select employees or develop training programs etc. However, all subfields of psychology have common goal – to describe and explain behaviour and the mind underlying it. The specific branches of psychology are given below.

Biological psychologist: They try to understand the relationship between functioning of brain and behaviour.Biopsychology studies how emotions, thoughts and behavior are affected by the brain, the nervous system and neurotransmitters in humans and animals. The field can be viewed as a combination of neuroscience and basic psychology. It focuses on how damage to specific areas of the brain affects neural function and behavior, as well as the influence of drugs and other mind altering substances on the brain and body.

Developmental psychologist: They study how behaviour, abilities change throughout our entire life span.It is the scientific study of growth, change and stability in behavior that occurs throughout

lifespan. It looks into the physical, cognitive, personality and social development. It studies the impact of heredity and environment on development, e.g. age construct, cohorts.

Cognitive psychologist: They are concerned with how we perceive, think and solve problems. It is a study of mental processes such as "attention, language use, memory, perception, problem solving, creativity, and thinking."The term Cognition refers to the mental processes. The mental processes involve gaining knowledge and comprehension. These processes include thinking, knowing, remembering, judging, and problem-solving. These are higher-level functions of the brain and cover language, imagination, perception, and planning.

Personality psychologist: They investigate how traits influence behaviour. Personality psychology is a branch of psychology that studies personality and its variation among individuals. It is a scientific study which aims to show how people are individually different due to psychological forces.

Social psychology: It is a study of how individual behaviour is influenced by people around him.It is a scientific study of how people's thoughts, feelings and behaviors are influenced by the actual, imagined or implied presence of others.

Socio-cultural psychology: It suggests that human behavior is influenced by social and cultural forces outside the individual. This perspective involves ethnicity, gender, sexual orientation, religion, social class, family traditions, culture, nationality, etc.

Industrial organisational psychology: It is a study of behavior in work settings and the application of psychological principles to change work behavior. It covers topics such as selection, training programs, performance evaluation, leadership, motivation and job satisfaction, reducing stress, consumer behavior, cultural diversity, globalization, technology, etc. It uses psychological concepts and methods to help organizations and companies to boost their morale and productivity, design products and implement systems.

Engineering psychology: It is the science of human behaviour and capability, applied to the design and operation of systems and technology. It is concerned with the adaptation of the equipment and environment to people, based upon their psychological capacities and limitations. Its objective is improving overall system performance and comfort.

Clinical Psychology: It is cconcerned with understanding, evaluating, predicting, alleviating and preventing intellectual, emotional, biological, psychological, social and behavioural

maladjustment, disability and discomfort. It is aapplied to a wide range of client population, across the life span, in varying cultures and at all socioeconomic levels. It aims to promoting human adaptation, adjustment, and personal effectiveness and satisfaction.

Psychology and helping professions: Psychology also deals with practical problems like how to have a happy marriage, how to overcome anxiety and depression or how to bring up healthy children.

Counselling psychology: Counselling psychologist help people to cope-up with challenges and crisis in academic, vocational and marital life. They help to improve personal and social functioning. The counseling psychologists deal with less serious problems compared to clinical psychologists.

Psychiatry: Psychiatrist are medical personnel, who provide medication for psychological issues like depression, anxiety.

Positive Psychology: Martin Seligman and others have focused researched or human strengths and human potentialities. Positive psychology explores positive emotions, positive character traits and enabling institutions. They are more concerned with, if psychology contribute to good life and help a person to lead a meaningful life. It is a science of positive aspects of human life, such as happiness, optimism, social connectedness, well-being and flourishing.It believes thatPeople want to lead meaningful and fulfilling lives, to cultivate what is best within themselves, to enhance their experiences of love, work, and play

Community psychology: Community psychologists work to create social and physical environment that are healthy for all. For example, if there is a problem of bullying in school, they will try to change that. Some psychologists may train students to cope with stress of transition from elementary school to middle school. Community psychologists seek to study how the school and neighbourhood give birth and encouragement to bullying.

Forensic Psychology: Forensic psychologists apply psychology's principles and methods in the criminal justice system. They may assess witness credibility, or testify in court on a defendant's state of mind and future risk. Forensic psychologistsapply psychology to the criminal justice system, assess offenders' state of mind at time of offense - Sanity evaluations, assess competency of individuals to stand trial - Competency evaluations, assess risk of re-offending, assess, witness credibility, assess malingering and deception, evaluate child custody in divorce, prepare for and provide testimony in court, assess consistency of factual information across multiple

sources, advise police on mental illness and criminal psychology, consult with attorneys on mental health issues in the court system, work with at-risk populations such as trauma survivors, design correctional programs, etc.

In summary, we can say psychology is a subject that relates to many fields, psychologist teach in medical schools, law schools, theological seminaries they work in hospitals, factories and corporate houses. They engage in interdisciplinary studies such as psychohistory (psychological analysis of historical character, psycholinguistics the study of language and thinking psycho-ceramics the study of crackpots.

Psychologist have gained insight into brain, mind dreams, memories and depression and joy. Psychology helps us to understand how we perceive, think, feel and act.

Strengths & Weaknesses of Psychology:

Psychology also influences modern culture. Learning about psychology's findings changes people. They do not judge psychological disorders as moral failings. They no longer believe that psychological disorders should be treated with as punishment and ostracism. Similarly, now they do not regard women mentally inferior to men. They no longer view and rear children as ignorant, wilful beast that need taming. Morton Hunt rightly pointed out that knowledge has modified attitudes and through them behaviour. Once we are aware of how our body is connected to our mind, how a child's mind grows, how our perceptions are formed and how our memory works, how people differ across the world, our way of thinking will change forever.

However, psychology has certain limitations. It can't answer questions such as –

Why should I live?
Why should I do anything?
Is there any purpose in life that even death cannot destroy?

Yet psychology deepens our appreciation for how we humans perceive, think and feel and act. It enriches our lives and broadens our vision.

Before closing this chapter, let me talk about one of the most important concerns among students and that is how to improve their memory power and grades in the exam.

Close -up: Improve your Retention and Grades:

Very often students are under the impression that to memorize their new learning properly, they need to keep revising

the new lesson, i.e., to keep rereading it again and again. But memory researcher Henry Roediger and Jeffrey Karpicke (2006) believe that apart from rehearsal of the material you need to repeatedly do self- testing yourselves. They called it **testing effect** or **retrieval practice** effect or **test-enhanced learning**. They demonstrated in one of their studies in 2008 that students could recall the meaning of 40 previously learned Swahili words much better if they repeatedly tested themselves, rather than if they spent the same time restudying the words.

The key is that to master new information, you must *actively process* that information. Our brain is like a muscle that grows stronger with exercise. Many studies have shown that people can learn and remember better when they put material to be learnt in their own words, rehearse it and then retrieve and review it again.

These principles are included in a method called **SQ3R study method**. SQ3R is an acronym for 5 steps – Survey, Question, Read, Retrieve and Review.

Survey refers to taking a bird's eye view of the material that needs to be learnt. You should scan the headlines and notice how the material is organized. Secondly, you need to try and answer its learning objective questions and if you try and fail to retrieve the answer, that actually helps you to learn. The reason is that those who test their understanding before reading and find out what is it that they don't know yet, will learn and remember better.

The third activity is read actively, i.e., search for the answers to the questions. At each sitting, read only that much of a chapter that you can absorb without getting tired. Read actively and critically. Ask questions, take notes, make the ideas as your own.

The fourth activity is retrieve. Retrieve the main ideas of the chapter. Test yourself. This will help you to realize what and how much you know and what you still need to master. The testing itself will help you to learn and retain information more effectively. For effective learning, test yourself repeatedly.

The fifth and final step is to review. Read over any notes that you have taken and quickly review the whole chapter. Write down what a concept is before rereading to check your understanding.

Apart from SQ3R method, some other techniques will also help in improving your learning. These are –

Distribute Your Study Time - Spaced practice helps in better retention than massed practice. It means that you will remember material better when you space your time over many study

sessions rather than trying to mug up in one session. Many students make that mistake. They try to mug up entire study material just in one day before exam and they miserably fail to retain that information. It should be memorized over several days in small portions at a time. Instead of trying to learn the entire chapter in one sitting, read just one section and then turn to something else. Interleaving your study of one subject with study of other subjects will boost long term retention and will protect you from false overconfidence that you have memorized the whole chapter.

Learn to Think Critically - Whether you are reading at home or you are learning in a class, note people's assumptions and values. Pay attention to what perspectives or biases underlies an argument and evaluate the evidence or proof given for those assumptions. Find out whether these assumptions are based on informative experiments or are just anecdotal. Evaluate their conclusions and judge whether there are alternative explanations.

Process Class Information Actively –Listen for the main ideas and sub-ideas of a lecture. Write them down. Ask questions during and after class. In class, process the information actively, that will help you to understand and retain it better. Make the information as your own by taking notes in your own words. Relate what you read to what you already know. Tell someone about it.

Overlearn –Very often people suggest that overlearning improves retention. But there are pitfalls to that. We tend to overestimate how much we know. The feeling of familiarity can be deceptively comforting. For optimum effectiveness, one should use retrieval practice more and should spend extra study time on testing his knowledge.

Memory expert Elizabeth Bjork and Robert Bjork (2011) gave following advice to improve your retention and grades:

"Spend less time on the input side and more time on the output side, such as summarizing what you have read from memory or getting together with friends and asking each other questions. Any activities that involve testing yourself- that is, activities that require you to retrieve or generate information, rather than just representing information to yourself – will make your learning both more durable and flexible".

1.2 SUMMARY

Points to remember

Aristotle before 300 B.C theorised about learning memory, motivation, emotion, perception and personality, psychology as a science was born at university of Leipzig in 1879

The first two schools of thought that emerged were structuralism and functionalism. William Wundt spoke about elements of mind or atoms of mind.

Wundt's student Edward Titchner used method of introspection to study elements of mind but the subjective nature of the method was not accepted by thinkers. Philosopher psychologist William James was more concerned with studying the functions of thoughts and feelings thus rose functionalism

Charles Darwin also spoke about adaptive functions of various human behaviours

In 1890 James mentored first lady student Mary Whiton Calkins who became a memory researcher and the first woman to be President of American Psychological Association Margaret Floy Washburn was the first woman to receive psychology Ph.D. she wrote on "Animal Behaviour"

Henry Holt offered a contract to William James for writing a textbook of new science of psychology it was completed after 12 years known as Principles of psychology

Early pioneers define psychology as a science of mental life John Watson, B F Skinner redefined psychology as scientific study of observable behaviour

Sigmund Fraud in 1940's spoke about unconscious thought processes, carl Rogers and Abraham Maslow focused on current environmental influences.

The second group of psychologists who rebelled against earlier thinking is the cognitive revolution, they emphasise mental processes. Cognitive neuroscience an interdisciplinary study is concerned with brain activity and underlying mental processes to include all these aspects today we define psychology as science of behaviour and mental processes. Contemporary psychology, Psychology is evolved from philosophy and biology. Wundt was philosopher and physiologist James was a American philosopher

Freud was physician, Ivan Pavlov was Russian psychologist. Jean Piaget was a biologist today's psychologist are citizens of many countries. International union of psychology has 71 nations as its members.

The biggest question faced by psychology today is nature or nurture controversy. Today's psychologist are more exploring relative contributions of biology and experience, nature selects the traits that best enable organism to survive and reproduce in the

given environment. This is a issue that will be discussed throughout the chapters. Psychology understands behaviour at three main levels it is a bio-psychosocial approach. Biological influences like Genetic Predispositions brain mechanism etc psychological influences like learned fears expectations, emotions etc and social influences are like influences of family, society, religion on the whole.

The subfields of psychology are connected with the current perspectives (Please refer to the table gives the subfields and the related current perspectives). Like any other field psychology also has certain strengths and weaknesses. At the end, tips are given on how to retain information in your memory and improve your grades.

1.3 QUESTIONS-IMPROVE YOUR GRADE

1. Write a note on roots of psychology
2. Explain the nature and origin of psychology
3. What is the historic or biggest question of psychology
4. Explain the different levels of analysis of human behaviour
5. Explain different sub fields of psychology and their relation to different perspectives.

1.4 REFERENCES

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Unit -2

THE STORY OF PSYCHOLOGY AND THINKING CRITICALLY WITH PSYCHOLOGICAL SCIENCE - II

Unit Structure :

2.0 OBJECTIVE

After reading this unit, you will be able to understand:

- why psychology as a science is required
- What are the errors that we make while understanding human behavior
- What are the different scientific method and how statistical reasoning is done

2.1 THE NEED FOR PSYCHOLOGICAL SCIENCE

There is common feeling that psychology explains or informs what everyone is aware of. Some pace their faith in human

intuitions. For example prince Charles (2000) said that “buried deep within each and every one of us there is an instinctive heartfelt awareness that provides- if we allow it to –the most reliable guide “. Former president of America explained his decision to launch the Iraq War by saying that he is a gut player and he depends on instincts. Today’s psychological science does study intuition but it is observed that our thinking memory and attitude operate at two levels conscious and unconscious. But still our intuitions are more likely to go wrong. The three phenomena, hindsight bias, judgmental overconfidence and even tendency to perceive patterns in random events illustrate why we cannot solely depend on intuition.

2.1.1 The Hindsight Bias: I Knew of all along Phenomenon:

Hindsight bias is defined as the tendency to believe after learning an outcome that one knew it all along and such an outcome was inevitable. Itis also known as (I knew it all along) phenomenon. A cricket team’s captain is given the credit if the match is won and captain is faulted if the match is lost. After acricket match, war or election, its outcome usually seems to be inevitable and then we say after the outcome 'See this is what I was saying or I knew this would happen.

People have tremendous capacity and willingness to explain away contradictory findings as justifiable based on common sense. For example, half the members of a group were told that psychologist have found that separation weakens romantic attraction and as the saying goes “out of site out of mind”and asked them to imagine why this might be true. Most people can and nearly all will then view this true finding as not very surprising. Members of the other half group were told that separation strengthens romantic attractions and as the saying goes “absence makes the heart grow fonder”. They were also asked to imagine why this might be true. People given this untrue result also imagined it and believed the findings. When two opposite findings look like a common sense, there is a problem. Such errors in a recollection and explanations of the events necessitate psychological research. Just asking people how and why they felt or acted in a particular manner can be misleading sometimes. This is not because common sense is usually wrong, but because common sense describes what has happened and does not tell what will happen.

At least in 100 studies done in different countries among children and adults, hindsight bias was observed. It is observed that our intuitions are sometimes right and sometimes wrong. We are all behavior watchers. So many of findings in psychology research seems to be seen before. For example, many people believe that love leads to happiness and they seem to be right as we have a deep need to belong. But our intuitions cannot be always correct.

For example, the famous saying like familiarity breeds contempt or dreams predict future may not be always true as the outcome of an event always depends on number of environmental factors and also on factors such as brain chemical messages(brain chemical messages control our moods and memories), effect of stress on a capacity to fight disease and so on.

2.1.2 Overconfidence:

We generally have a tendency to think that we know more than we do. If someone asks us question about the certainty of our answer we tend to be more confident than correct. The best example is following anagram given by Richard Goranson (1978). He asked people to unscramble the alphabets:

WREAT – WATER
ETRYN – ENTRY
GRABE – BARGE

Now see how many seconds would you require to unscramble this alphabet. Did hindsight bias come in the way? Knowing answers make us overconfident. The solution would take only 10 seconds for us to answer while in reality, problem solver requires 3 minutes.

The question arises are we better at predicting social behaviors? Students show that this may not be always the case. Philip Turlock (1998,2005) collected more than 27000 expert prediction on world event such as future of South Africa or whether Quebec would separate from Canada. He found that these predictions which experts made with 80% confidence on average were right less than 40% of the time.

2.1.3 Perceiving Order in Random Events:

We are naturally eager to make sense of the world. Wallace Stevens called it as out “rage for order”. We are more prone to perceive patterns. For example, people tend to see a face or the divine images on the trees or vegetables or moon, or seeing virgin Mary’s image on grilled cheese sandwich. We find order even in random data because random sequences often don’t look random (FALK et al, 2009 Nickerson 2002, 2005). In actual random sequences patterns and streaks (such as repeating digits) occur more often than people expect and they don’t look random to people and they over interpret them. Such pictures we get to see on media also so many dotted lines are shown and then question is asked do you see an image. In some random events, weird seeming streaks do occur. For example, during 2010 world cup German Octopus Paul was offered two boxes each with mussels and with national flag on one side Paul selected the right box eight out of eight times in predicting the outcome of Germany’s 7

matches and Spain's victory in finals. Such happenings are extraordinary. We struggle to give ordinary chance related explanations to such events. The main thing to note is that hindsight bias, overconfidence and perceiving order in random events leads us to overestimate our intuition. But scientific enquiry helps us to differentiate reality from illusion.

2.1.4 Scientific Attitude: Curiosity, Skepticism And Humble:

Scientific attitude is marked by curiosity, skepticism and humbleness. Every science is guided by curiosity, a passion to explore and understand without misleading or without being misled. Scientific attitude is required to come close to real answers of the questions rather than the fantasy based answers. For this purpose being skepticism is more important.

Being skeptical does not only mean being analytical and durable but open for answers. So as a scientist psychologist, approach the world of behaviour with curious skepticism by asking questions like what do you mean? How do you know? The skeptical thinking allows a psychologist to select best suitable answers for explanation of human behavior. For Example, can astrologers predict anyone's future based on position of the planet on the birth chart? Is electroconvulsive therapy an effective treatment for severe depression? Such questions are put to test by psychologist. On the basis of such skeptical thinking the answer for the first question is NO and YES for the second question.

Putting a scientific attitude into practice not only requires curiosity skepticism but also humility. Humility refers to an awareness of one's own vulnerability to errors and openness to surprises and new perspectives. Historians of science tell us that these three attitudes, curiosity, skepticism and humbleness have made modern sciences more advanced. Some deeply religious people may consider science as a threat, but the leaders of scientific revolution, scientist like Isaac Newton and Copernicus were deeply religious, they were acting on the idea that "in order to love and honor God it is necessary to fully appreciate the wonders of his handiwork (Stark 2003). However scientist, like anyone else, have their egos and may cling to their preconceptions, but the ideals of curiosity, skepticism and humbleness helps to maintain objectivity of the obtained information.

2.1.5 Critical Thinking:

Critical thinking is defined as a thinking that does not blindly accept arguments and conclusions. Rather it examines assumptions discerns hidden values, evaluates evidence and assess conclusions. Whether reading a news report or listening to conversation, critical thinkers ask questions.

Scientist always ask questions like how do they know? What is this person's personal agenda? Is the conclusion based on gut feeling or is there some kind of evidence? Does the evidence justify a cause-effect conclusion? Or is there any cause and effect relationship? Are there any alternative explanations?

Critical thinking helps scientist to remain away from the biases. A single occurrence is understood from multiple perspectives. The preconceived notions will be challenged. Thus, critical thinking challenges the popular assumptions of behaviour. For example in 2010 environmentalist proposed that bitter cold in North America and East Coast snow storms are caused by global warming. Critical thinkers would ask questions like where is the evidence. Is earth actually warming? Are polar ice caps melting? Are vegetation patterns changing? They will always look at the evidence or the facts that support such inference

2.2 HOW DO PSYCHOLOGIST ASK AND ANSWER QUESTIONS

The scientific attitude of psychologist is supported by scientific method. Scientific method is a self-correcting process for evaluating ideas with observation and analysis. Hunches, the plausible sounding explanation of human behavior are tested with scientific method. This ideas or theories are tested against evidence. If evidence supports then the idea or theory is accepted, otherwise theory is revised or rejected.

2.2.1 Scientific Method:

Before beginning with scientific method, it is necessary to understand concept of Theory. In science, a theory explains with principles that organize observations and predict behaviour or events. A theory is simplified by organizing isolated facts. A theory offers summary by connecting facts with deeper principles. For example, Effects of sleep deprivation on memory. Now there are number of observations related to sleep deprivation. For example, people with poor sleeping habits cannot answer questions in the class, they tend to do badly on test. So, it can be concluded that good sleep improves memory. So, sleep retention principle summaries the facts related to effects of sleep loss.

So, it is suggested that sleep loss affects memory. Yet all theories need to be tested. A good theory produces testable predictions called as hypothesis. Hypothesis enables us to revise and predict theory. Hypothesis is a testable prediction. The finding may either confirm or reject the prediction. For example, to test our theory about the effect of sleep on memory, people's retention of

the course material after good night's sleep and after shortened sleep is tested.

Sometimes our theories can bias our observations. We may see what we expect to see. To have control on such biases psychologist usually suggest operational definition of procedures and concepts for example hunger might be defined as a hours without eating, generosity as money contributed. These operational definitions help others in replicating or repeating the original observations with different participants, materials and circumstances if they get similar results the confidence in finding the reliability grows. Definitions are carefully worded statements, so that if becomes possible for others to repeat original observations with different participants.

Finally, it can be said that theory is useful
(1.) to organize range ofself-reports and observations.
(2.) Theory implies predictions that anyone can use to check theory or derive practical application for example if people sleep more will their retention improve?

A research may lead to a revised theory, that better organizes and predicts what we know. research may be replicated and supported by similar findings

In psychology hypothesis can be tested and theories can be revised by using descriptive methods such as a case study method, naturalistic observation method, survey methods to observe and describe behavior and why it is important to have random sampling.

2.2.2 Description:

Psychologist used case studies, naturalistic observations, surveys to observe and describebehaviour. Professional psychologist describe behavior objectively and systematically by using methods said above.

a) The Case Study Method:

It is one of the oldest method. It examines one individual in depth in the hope that individual will reveal true things about himself. The early knowledge about brain and areas of brain is based on in depth case studies which showed impairment after and some kind of brain damage.

Studies of only few chimpanzees have shown their capacity for understanding and language. Jean Piaget's theory of Cognitive development is based on case studies of his own children. In depth case studies show what can happen and they give direction for further study.

However, case study method has limitations. For example, individual cases may mislead us and we may draw false conclusions, if the individual is atypical. Dramatic stories and personal experiences attract our attention. But stories can mislead. A case study cannot be used for drawing any general inference or general principle that apply to all. Individual cases can suggest fruitful ideas, but to find the general truth that covers individual cases, we must answer questions with other research methods.

b) Naturalistic Observations:

It is observing and recording behavior in naturally occurring situations without trying to manipulate, and control the situations. Naturalistic Observations does not explain behavior. It only describes behavior. Such description of behavior can be more revealing and interesting. For example, it was believed that only human beings use tools but it is observed that even chimpanzees sometimes insert stick in termite mound and withdraw it, eating the stick's load of termites. This is unobtrusive naturalistic observation. This was the observation without any interference or intervention. Such unobtrusive naturalistic observations have led to later studies of animal thinking, language and emotion. It was due to such observation studies, we know now that chimpanzees and baboons use deception. Similarly, there are some interesting findings based on naturalistic observations about human beings. For example,

human beings laugh 30 times more often in social situation then in a solitary situation as we laugh 17 muscles contort our mouth and squeeze our eyes and we emit series of 75milliseconds vowel like sounds spaced about $1/5^{th}$ of a second.

Another interesting example was a study done by Mat this Mehl and James Pennebaker (2003). They studied 52 students from university of Texas to find out what this introductory psychology students say and do in their everyday life. They were made to wear a belt which had electronically activated recorder they wore it for 4 days. This recorder captured 30seconds of students waking hours of every 12.5mins .Thus they had information of more than 10000 half minute life slices by the end of the study. The result showed that the percentage of slices when students were talking to someone was 28% and percentage of the time they were at the keyboard of the computer was 9%.

Another study was done at university of Niveda Las Vegas to find out what was there on the minds of the students. This was done by giving them beepers. A beeper interrupted their daily activities, signaling them to record their inner experiences at that moment. The result showed that there were five types of inner experiences such as inner speech, inner seeing unsymbolized thinking, feeling and sensory awareness.

Naturalistic observation enabled Robert Levin and Ara Norenzayan to compare pace of life in 31 countries. Pace of life included walking speed, accuracy of public clock, and speed with which postal clerk completed a request. It was observed that life is fastest in Japan and western Europe whereas life is slower in economically less developed countries. People in colder climates tend to live at a faster pace and are more prone to die from heart disease. However, naturalistic observation merely describes the events but does not tell us why they take place.

C)The Survey Method:

Compared to case history method and naturalistic observation method, the survey method looks at many cases but in less depth. A survey asks people to report their behaviours and opinions. Questions about everything from sexual practices to political opinion are asked in survey. Some of the recent surveys are-

- Half of all Americans reported experiencing more happiness and enjoyment than worry and stress on the previous day (Gallop , 2010)
- Online Canadians reported using new forms of electronic communication and thus receiving 35% fewer emails in 2010 than 2008
- One in 5 people across 22 countries believe that aliens beings have come to earth and now walk among us as disguise humans
- 68% of all humans say that religion is important in their daily lives.

  But asking questions in survey can be very tricky answers always depend on the way questions are worded and the type of respondents selected.

Wording Effect: Even subtle changes in order of wording of questions can have major effects. For example, people are more approving if instead of using the word "taxes" we can the word ‘revenue enhancers’ and instead of using the word "welfare" we use the word “aid of needy”. Such wording can change the opinion of the respondents.

For example in 2009three in four Americans in one national survey approved of giving people a choice of public or private health insurance ,yet in another survey most Americans were not in favour of public health care plan administered by federal government that would compete directly with private health insurance companies . It is here the wording brings about the total change of opinions

Random sampling: Survey method requires a sample that fairly represents populations under study. It isnot always possible to survey everyone in the group. Every member of the population must get an equal and fair chance of being selected as a part of sample. This is called as random sampling. Insampling, there is always a temptation to ignore sampling bias and draw conclusion on the basis of vivid but unrepresentative cases. But the best way is to have representative sampling. Representative sampling can be achieved with the help of random sampling where every student from the total population has fair chance of being selected as a part of population under study. Large representative samples are better than small ones.

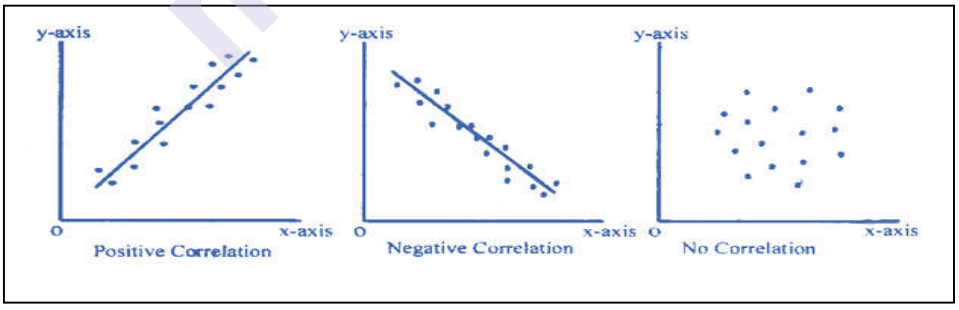
The point to remember is while considering the finding of the survey think critically and look at the size of the sample. For survey method, it is always good to have larger representative sample than larger sample that is not representative.

2.2.3 Correlation:

Naturalistic observation shows that one behavior is related to other. We say that they correlate. A statistical measure correlation coefficient helpsus to understand how two variables are closely related. For example, intelligence and school grades are closely related.

The correlation coefficient can be graphically represented in the form of scatter diagram. The following are scatter diagram representing different correlation. Each dot is the scatter plot represents the values of two variables.

Fig. 2.1 Positive, Negative and Zero Correlation



Perfect positive correlation: Perfect positivecorrelation is a rare phenomenon indicating increase in one variable accompaniedby simultaneous increase in anothervariable. But generally, height and weight are positively correlated.

Zero correlations: Zero correlations are found between the two variables when they are not related. For exampleheight and intelligence.

Perfect negative correlation: Increase in one is accompanied by simultaneous decrease to another variable. For example intelligence and failures in the school.

Correlation & Causation:

Correlations only help us to predict, they explain the nature of relationship. The major limitation of method of correlation is they do not explain or specify whether one is the cause of other.

Correlation helps us to make predictions for example high self esteem is negatively correlated with depression but it cannot be said that it is the exact cause of depression. People with lower self esteem are at the high risk of depression whatever may be the strength of the relationship it cannot be said that one is the cause of other. For example length of marriage correlates with hair loss in men. But it does not mean that marriage causes men to lose their hair or balding men become better husbands. To summarize association does not prove causation.

2.2.4 Experimentation:

Researchers have found that children who were breast feed as infants have somewhat higher intelligent scores then children who were bottle fed with cow's milk. There are three different studies to compare breast fed children and bottle-fed children and they say that breast fed children are the best. Now the question is whether nutrients in mother's milk contribute to brain development. To find answers for such questions, to **isolate cause and effect relationship, researchers perform experiments.** Experiments help researchers in isolating effect of one or more factors by

1. Manipulating the factors of interest and
2. Holding constant (controlling the other factors).

They often create **experimental group** in which people receive treatment and **control group** that does not receive treatment. To minimize the effect of the other differences between the two groups researchers randomly assign people to two conditions. Random assignment equalizes two groups so age, attitude, characteristics, etc. and their effects can be minimized. For example, in a study on effects of feeding, one bottle fed group was compared with the breast-fed group children by effectively controlling all other factors except nutrition. This supported conclusion that breast feed is best for development of intelligence.

Experimental method is different than survey method. In survey naturally occurring relationships are uncovered whereas in experiment we manipulate the factors to determine the effects of the variables.

Experimenters often use blind (uninformed) technique about what treatment each group is receiving. The study uses **double blind procedure** where neither participants or researchers are aware of which group is receiving the treatment. This is done to avoid **placebo effect** where results are caused by the expectations alone.

Independent Variable:

Experiment is a research method in which an investigator manipulates one or more factor to observe effect on some behavior or mental process. Experiments enable researchers to isolate or manipulate effect of one factor on other. This is an independent variable. Independent because experimenter can vary it independently of other factors. It is a variable as it is increased or decreased by the experimenter.

Dependent Variable:

Dependent variable is a consequence of an independent variable. Dependent valuable can be discussed as an effect of an independent valuable. Both variables, independent and dependent, are given precise operational definitions which specify the procedures that manipulate the independent variable or measure the dependent variable. These definitions answer the question, "what do you mean?". The answer to this question with a level of precision enables others to replicate the study.

Confounding Variables:

The other factors which can potentially influence the results of the independent variable are called as confounding variables. The random assignment of the group can control the potential influence of confounding variables.

In short, we can say a variable is anything that can vary (infant's nutrition, intelligence or anything- anything within the limits of what is possible and ethical). Experiments aim to manipulate an independent variable, measure the dependent variable and allow random assignment to control all other confounding variables. Experiments can be helpful in the evaluation of social programs eg: if early childhood education programmed can help in boosting impoverished children chances of academic success.

2.2.5 Statistical Reasoning in Everyday Life:

Statistics are the tools that help us to see and interpret what unaided eye might miss. For example, researchers Michel Norton and Dan Ariely invited 5522 to estimate the percent of wealth possessed by richest 20 % in the country and their average guess was 58% (dramatically underestimated) but in reality, 20% possessed 84% wealth of the nation. Statistics helps everyone. One need not be deceived by such offhand estimates.

Describing Data:

Once the researchers collect the data, they need to organize and summarize it in some measurable way to make that data more meaningful.

Measures of Central Tendency:

One of the simplest way is to convert it into bar graphs. The other method is to summaries data by using measures of central tendency. They give you single score that represents a set of scores. Measures of central tendency can be given as follows.

1. **Mean:** An arithmetic average. It is a total sum of scores divided by total number of scores.
2. **Median**: median is a midpoint, 5oth percentile. if all scores are arranged from highest to lowest, half scores will be above the median and half scores will be below the median.
3. **Mode**: It is the most frequently occurring score in the distribution.

Measures of central tendency summaries the data but if distribution is lopsided or skewed by a few way-out or extreme scores, where scores are either more on the higher side or lower side then the measures of central tendency do not give you real picture, because mean is influenced by extreme scores. For example, if you are looking for the mean of the marks scored by 50 students in class and in this group if there are 5 students scoring 100 on 100 it will change sum total of score and it may inflate the average score obtained by the students. So, in this case a few atypical cases will distort the average

Median also does not give you complete picture for e.g. it is said that 78% of the people in India live life below poverty line if we use median here can we say anything conclusive about the people's income in the 50% above and 50% below range in reality top 22% of the people have maximum share in the income of the nation. Once again, few atypical cases distort this score.

Measures of variation

As shown above, in central tendency, a single number leaves out lot of information. So it helps to know how much variation is there in the data. They tell you how similar or diverse scores are. Averages derived from scores with low variability are more reliable than averages derived from scores with high variability.

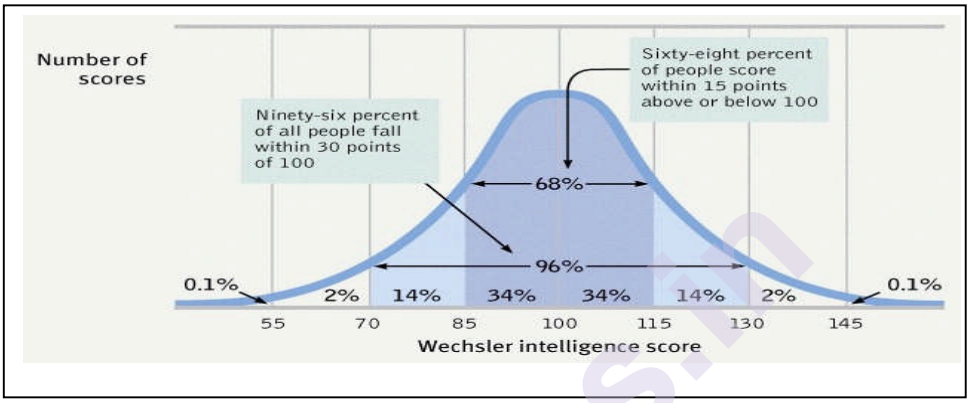
The measures of variability are:

1. **Range** – It is the gap between the lowest score and the highest score. It provides crude estimate of variation. Couple of extreme

scores once again can increase the gap between highest and lowest score

2. **Standard deviation**: it is another measure of finding out how scores deviate from one another. This measure tells you whether scores are packed together or dispersed. The computation tells you how much each scores differs from the mean

Fig. 2.2 Standard deviation



The meaning of standard deviation can be understood better if you know how much scores differ or tend to be away from average. For example, large number of people show variations in height weight intelligence scores, grades. These scores form a symmetrical bell-shaped distribution where most cases fall near the mean and few fall near the either extremes of the curve. **This curve is also known as bell shaped curve.**

The above figure 2.2 shows that nearly 68% of the cases fall within one standard deviation on either side of the mean. It means 68% of the people taking intelligence test will score near plus or minus 15 points of 100. About 95% will score within plus or minus 30 points.

2.2.6 Significant differences

How do we know that whether observed differences can be generalized to other population? The average score in one group (for e.g. breast-fed babies) could be considerably different from the average score in another group (bottle fed babies) not because of real differences but because of chance fluctuations in the people selected as a sample. The question is how confidently can we say that observed differences are not cause by chance factors and for this purpose we can ask how reliable and significant differences are. When is the observed difference reliable? It is when we have to decide that whether it is safe to generalize from a sample under study. At this time, the following three principles should be kept in mind

a. **Representative samples are better than bias samples.**
Generalizations can be based on representative samples rather than on exceptional cases. It is always not possible to have random sample of whole population under study, so it is important to keep in mind what population a study has sampled.

b. **Less variable observations are more reliable than more variable observations.**
Observations with less variability can be more dependable as more variability means possibility of other factors interfering with the results

c. **More number of case are better than fewer number of cases.**
Averages based on many cases are more reliable than less number of cases. To summarize generalizations based on few unrepresentative cases are unreliable.

When the Difference Is Significant-Significance of observed differences can be established by statistical testing. When averages of two sample are each reliable, measures of their respective population (that is , if they are based on large number of representative sample, with less variability) then their differences are also likely to be reliable, for e.g. we study gender differences and aggression we select two homogeneous group of men and women (group with less variability) and hear there is a sample average score with a large difference then we can have confidence that there is a real difference between the two. Thus when sample averages are reliable and the difference between them is large then we say difference is statistically significant, means observed difference is not caused by chance factors.

In judging significance level of the observed difference psychologist are very conservative. The conclusions cannot be stretched beyond what observation suggest. Statistical significance only says that there is a likelihood that results occur not by chance factors but it does not say anything about importance of the results

2.3 FREQUENTLY ASKED QUESTIONS ABOUT PSYCHOLOGY

The frequently asked questions about psychology are as follows:

Can laboratory experiments eliminate everyday life?

The experimenter intends to turn laboratory experiment into a simplified reality, one that simulates and controls important features of everyday life. Here experimenter recreates psychological forces under controlled conditions.

The purpose of experimenter is not to create real life situations but to test theoretical principles (Mook 1983) For example. In aggression studies, deciding whether to push a button that delivers a shock may not be same as slapping someone but the underlying principle is the same. It is the resulting principle and not the specific finding that help to explain every day behavior

When psychologists apply laboratory research on aggression to actual violence they apply theoretical principles of aggressive behavior. These are the principles refined on the basis of laboratory research. Many such findings are based on laboratory research it has to be remembered that psychological science focuses less on particular behavior but more on seeking general principles that help to explain many behaviours.

Does behavior depend on one's culture and gender?

Joseph Henrich Seteven Heine, and Norenzayan (2010) studied Western Educated, Industrialized, Rich, and Democratic cultures (WEIRD cultures). Most of them form only 12% of humanity. Do such studies tell about people in general? Culture refers to shared ideas and behaviours that one generation passes onto the next generation. It influences our standards of promptness and frankness attitude towards premarital sex and varying body shapes, tendency to be formal or informal, willingness to maintain eye contact, distance maintained in conversation and so on.

With these differences in mind is it possible to say what is true for one group or community is true for others also. Our biological heritage says that we all are human beings and are one but we grow up in a different social cultural environmental setup. Some findings are common but not all for example people diagnose with dyslexia, a reading disorder exhibit same malfunction of brain irrespective of culture they belong to. Variation in language interferes with communication across the cultures. Yet all languages share deep principles of grammar.

People in different cultures vary in feelings of loneliness. We all are alike in certain aspects but we are different in many other aspects

Why do psychologist study animals and what ethical guideline safeguard human and animal research participants?

Psychologist study animals for many reasons. Some are as follows:

a. They find animals fascinating. They want to find out how different species learn, think and behave
b. We share some common biology with animals. It can be used for understanding treatment for human diseases

c. The processes by which learning takes place are similar in human beings and in animals especially in rats and monkeys. The neural mechanism of learning can be understood by performing experiments on animals

Roger Ulrich (1991) said that similarities between animals and human beings does not defend our use of animals for the purpose of research.

Is it right to place well being of human being above that of animals?

Is it right to expose monkeys to HIV like virus in search of treatment of AIDS. Is our use of animals as natural as the behavior of carnivorous animals? The answers for these questions depend on culture?

If human life is given first priority what safe guards should protect wellbeing of animals. Different governments have given different guidelines. British psychological society guidelines call for housing of animals under reasonably natural living conditions with companions for social animals(Lea 2000).

American Psychological Association guidelines state that researchers must ensure

"the comfort, health and humane treatment" of animals and minimize infections, illness and pain (APA 2002).

European parliament also now mandates standards for animal's care and housing (Vogel 2000). Animal studies have benefited animals also Ohio team of researchers have identified stress hormones in dogs. They have devised handling and stroking methods to reduce stress in dogs. Other studies have helped in improving care and management of animals. By revealing our behavioral kinship with animals and the remarkable intelligence of chimpanzees, gorillas and other animals, experiments have led to increased empathy and protection for them.

The Guidelines for Performing Experiments on Human Beings:
The American Psychological Association Ethics code urges researchers to obtain

1. Informed consent of potential participants
2. Protect them from harm and discomfort
3. Keep information confidential about each participant
4. Use deception or stress them temporarily only when it is absolutely necessary and justifiable, e.g., some experiments

won't work if participants know everything beforehand and participants might try to confirm the researcher's predictions.

5. Fully debrief people or explain the research afterwards most universities have their committees for ethics.

Is Psychology free of value judgments?

Psychology is not free of value judgments. Values do influence what we study and how we study. There are questions like Productivity or work morale. Should gender differences or sex discrimination be studied? Should we study conformity or independence? It has been observed that values do color the facts

Psychologist may have preconceptions that can bias observations. Even the words used for describing something reflect values. For example, one person may describe a behavior as rigid other may call it consistent. One person may speak about faith other may term it as fanaticism. Professional judgments of how to raise children, how to live life, how to have self-fulfillment in life are the value based advices.

Psychology cannot address all questions, but it Studies how learning can be enhanced. It looks into how problems like war, overpopulation crime and family crisis can be dealt with.This involves attitude and behavior. Psychology cannot speak about all of life's great questions but it addresses important questions.

2.4 SUMMARY

We often feel that our gut feeling is more important than anything ales. It is the intuition that we use for understanding human behavior. Intuition has its own limitations. Three phenomena like hindsight bias, over confidence and tendency to perceive an order in random events suggest that we cannot solely depend on intuition.

Hindsight bias refers to I knew of all along phenomena. It is an error in recollection. Overconfidence in a thinking that we know mere than what me actually know we tend is be more confident than correct.

Perceiving order in random events is our natural tendency to make sense of our world the events are perceived is be together giving same kind of meaning.

The scientific attitude includes curiosity, skepticism and humbleness. These are the three main components of scientific attitude curiosity in asking questions, if it is a passion to explore and understand whether misleading on being misled being skeptical refers to offering the most plausible explanation that

makes the facts. Putting Scientific attitude requires curiosity, skepticism and humility. Humility is awareness of own vulnerability to errors and opens to surprises. Scientific attitude prepares a person to think smarter.

In critical thinking assumptions are examined hidden values are judged and evidence is evaluated. Psychologist ask and answer questions by scientific method. It is a self-correcting process of evaluating ideas with observation and analysis

Scientific Method has three important components: Theory, hypothesis and Operational definition of words. Theory explains principles that organizes observation and behavior. Theory simplifies by organizing isolated facts. A good theory produces testable predictions called as hypothesis. They enable us to reject or revise a theory. They specify what results would support a theory and what results would disconfirm of our theories can bias our observation. To check their biases psychologists, report their research with precise operational definitions so that some studies can be replicated.

A theory is useful if it organizes range of self report observations Implies predictions that anyone can use to check theory or derive practical application. Theories and hypothesis can be refined by using description method. Psychologist use description for explaining behavior and observation. It is done in a systematic manner through observation

The case study examines an individual in depth with the hope of revealing things true of himself. Intensive case studies are sometimes revealing but no generalization can be made on the basis of observation of one person

Naturalistic observations is a method that records behavior in natural settings Naturalistic observation does not explain behavior. It may provide snapshots of everyday life. Researcher does not have control over condition.

Survey method looks at many cases in less depth. A survey asks people to report their behavior or opinion. The answers obtain for questions depend upon the wording effect even subtle changes in the order of wording questions can have major effects.

Random sampling in everyday thinking we tend to generalize from the sample we observes especially vivid cases. But it has to be remembered that the best cases for generalizing is from a representative sample. It is not possible to study everyone in the population under study; therefore representative sample is used for drawing inference.

Correlation Is a statistical measure showing how things vary together thus they tell us how well one predicts another. The correlation coefficient can be graphically represented by drawing scatter plots. They are used for depicting nature of correlation. There can be three types of relationships that exist between two variables: Perfect positive correlation, Zero correlation and Perfect negative correlation. A correlation is positive if two sets of scores rise and fall together. Correlation is negative if sets of scores relate inversely one set of scores goes up and other goes down. A correlation coefficient helps us to see world more clearly by revealing the extent to which two things correlate.

Correlation and causation helps us to make predictions. It just tells us how two variables are associated. It has to remembered that association does not prove causation correlation indicates the possibility of cause and effect relationship but does not prove the cause and effect relationship

In an experiment researcher isolate cause and effect relationship. They isolate cause and effect relationship by manipulating factors of interest and by holding other factors constant. This is often done by creating experimental and control group. Experimental group that receives the treatment and control group is a group that is tested under normal circumstances. An experiment is not complete without independent and dependant variable. Independent variable is one that varies independently to other factors Dependant variable are that varies depending on what happens during the experiment. Confounding variables are variable that can potentially influence the results of the experiment.

Statistical reasoning is used for describing the date. Data can be discussed by using measures of central tendency and measures of variability.

Measures of central tendency are mean, median and mode. Mean is an average. It is inferred by exceptional scores. Mode is 50% percentile a point where 50% cases are above and below the median

The measures of variation is the measure that tells you about the amount of variation in the data. How similar or diverse the scores are. Averages derived from the scores of low variability are more reliable than averages derived from the scores of high variability

Range is the gap between lowest and highest score. The more useful measure for understanding how one score deviates from one another is standard variation. It tells you whether scores are packed or dispersed. The meaning of standard deviation can be

understood with the help of normal deviation curve. It is graphic representation of traits. Traits like height weight and intelligence fall in normal distribution curve The observed differences are considered as reliable when selected sample is representative in nature, observation are less variable and when there are more number of cases.

The difference is significant if the observed difference is not because of chance factors The frequently asked questions about psychology are Can laboratory experiment illustrate everyday life, secondly does behavior depends on one's culture or gender

Why do psychologist study animals? Are there ethical guidelines for conducting research and animals? The answer for this question are explained at the length in the notes but it can be remembered that American Psychological Association gives guidelines for protecting the welfare of human participants.

2.5 QUESTIONS

1. What it intuition and explain the errors that we make while going by gut feeling
2. Explain what is scientific attitude
3. What are the characteristics of experimental method?
4. Why statistical reasoning is required in everyday life?
5. Write notes on
   a. Scientific method
   b. Case study method
   c. Survey method
   d. Method of correlation
   e. Write notes on
   f. Measures of central tendency
   g. Measures of variability
   h. Behavior culture and gender
   i. Ethical guidelines for conducting research on humans and animals.

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Unit -3

THE BIOLOGY OF MIND - I

Unit Structure :

3.0 OBJECTIVES:

After reading this unit, you will be able to understand –

- Why it is important to understand the biological functioning of our body
- The structure and functions of neurons
- The Central and Peripheral Nervous System

3.1 INTRODUCTION:

There is a famous saying by Descartes, a French philosopher, that "I think, therefore I am". But, the fact remains that we cannot claim to exist, think or behave without our bodies. Our entire behavior, thinking, emotion and even urges are biological functions. We cannot laugh, love, study, aggress, compete, study, explore without our bodies. Without our genes, our brain, our appearance, reflexes, we are nobody.

Many ancient philosophers tried to identify where exactly is our mind in our body. Pluto rightfully mentioned mind is in the head, that means in brain. Aristotle on the other hand believed the mind to be in heart. Modern science has proved that it is your brain and not your heart that falls in love. In early 1800s, Franz Gall gave the concept of phrenology, study of bumps on the skull. He believed that bumps on the skull can indicate the mental abilities and character traits of a person. However, research proved phrenology is nothing but a gimmick and one cannot judge abilities or personality of a person from the bumps on the skull. But it can't be denied that brain does have control over different aspects of

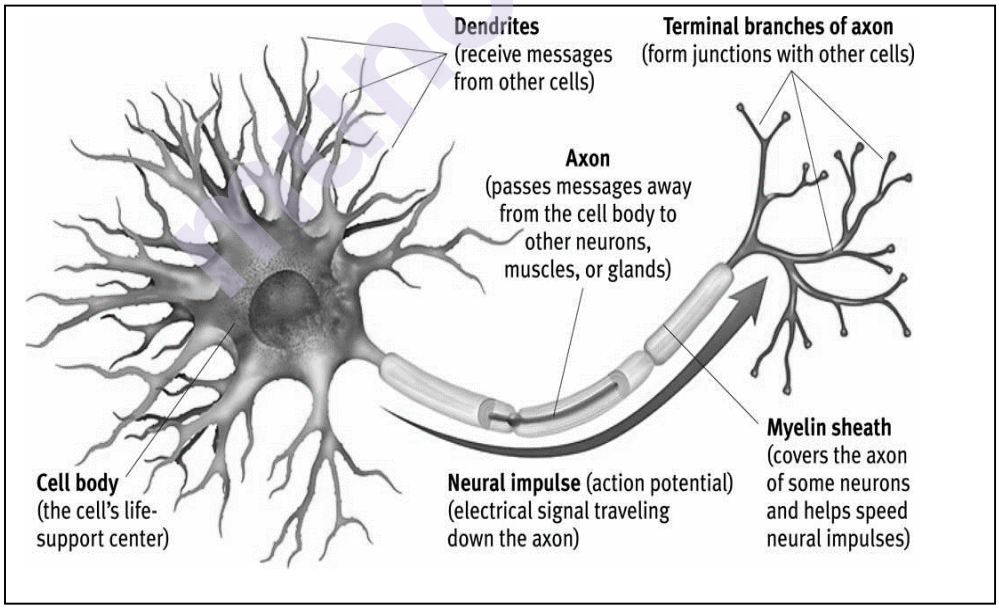
behavior. Phrenology was beneficial because it did bring researchers' attention to the fact that different brain regions are responsible for particular functions. This triggered the research to find the link between biology and psychological events and have discovered a strong interplay between our biology and our behavior and mind. For instance, it has been discovered that we are each a system composed of subsystems that are in turn composed of even smaller subsystems. Tiny cells organize to form body organs. These organs form large system for digestion, circulation and information processing. These systems are part of larger system- the individual who in turn is part of family and society. So, we are biopsychosocial systems. To understand our behavior, we need to study how these biological, social and psychological systems work and interact.

3.2 NEURAL COMMUNICATION:

Neural communication is any type of signaling that takes place between neurons throughout the nervous system. So, let us first see what are neurons and how do they transmit the information.

3.2.1 Neuron:

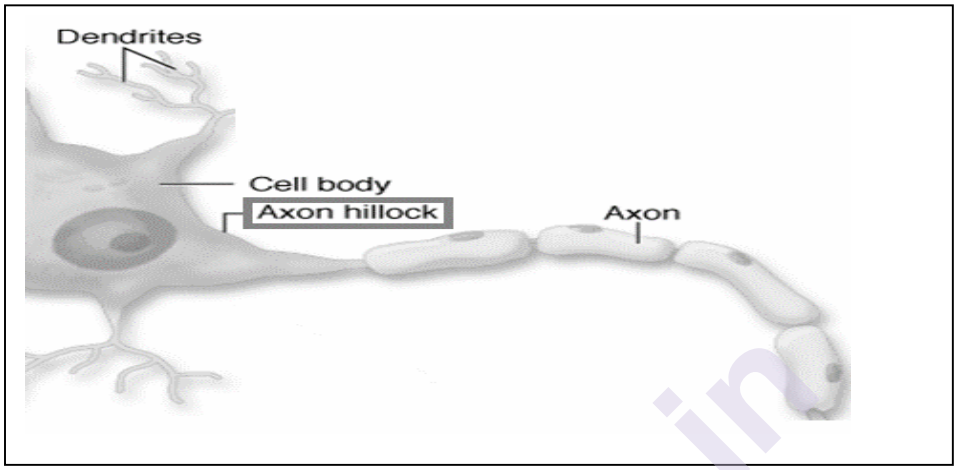
Fig.3.1



The neuron (nerve cell) is the fundamental unit of the nervous system. Neurons have many different shapes and sizes. However, a typical neuron consists of a cell body, dendrites, an axon and synaptic terminals. As you can see in figure 3.1 dendrites are like fibers branching out from cell body. Dendrites are thin structures that arise from the cell body, often extending for

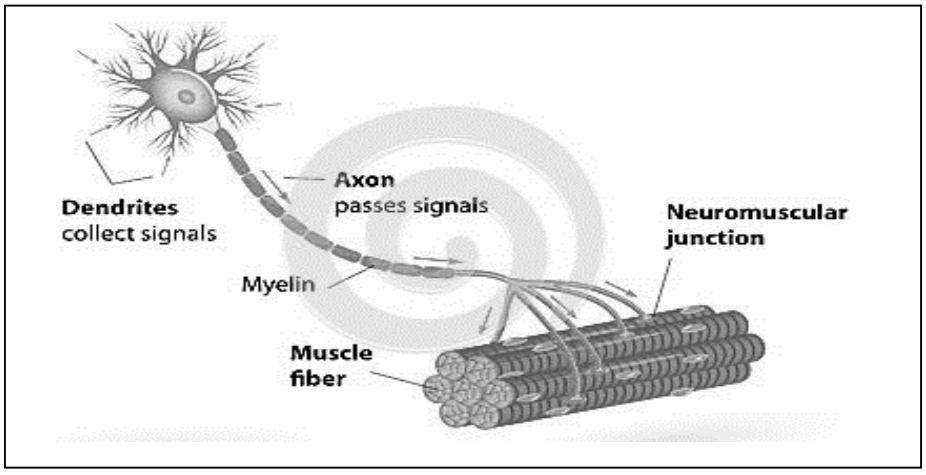
hundreds of micrometers and branching multiple times, giving rise to a complex "dendritic tree". The dendrites receive information and pass it on to cell body. On the other side of cell body, an axon arises from the cell body at a site called the axon hillock and travels for a long distance. See Fig.3.2.

Fig.3.2



Compare to dendrites, axons may be very long projecting several feet through the body.Axons are covered in a myelin sheath, a layer of fatty tissues that insulates axons and that increases the speed of impulses passed through those axons. This is similar to electric wires used at home. They are insulated with plastic cover so that electric impulse passing through wire does not get lost and speed does not come down. The myelin sheath is laid down up to the age of 25 approximately. As myelin sheath keeps covering neurons, our neural efficiency, judgement and self-control grows. If the myelin sheath degenerates, multiple sclerosis takes place and the communication to muscles slows down and eventually loss of muscle control takes place.

Fig.3.3



Many neurons have only one axon, but this axon undergoes extensive branching, enabling communication with many target cells. Axon passes the message through axon terminal branches to other neurons or to muscles or glands. Axon terminal transmit signals to other neuron dendrites or tissues (like a radio transmitter)So, we can say dendrites listen and axons speak. See Fig.3.3.

When neuron's dendrites receive information from our senses or from neighboring neurons, in the form of electrical or chemical signals, they transmit these signals through an impulse called the action potential, which is a brief electrical charge that travels down its axon. Researchers measure brain activities in milliseconds and computer activities in nanoseconds. So, even though our brain is much more complex than a computer, it slower than computer in executing simple responses.

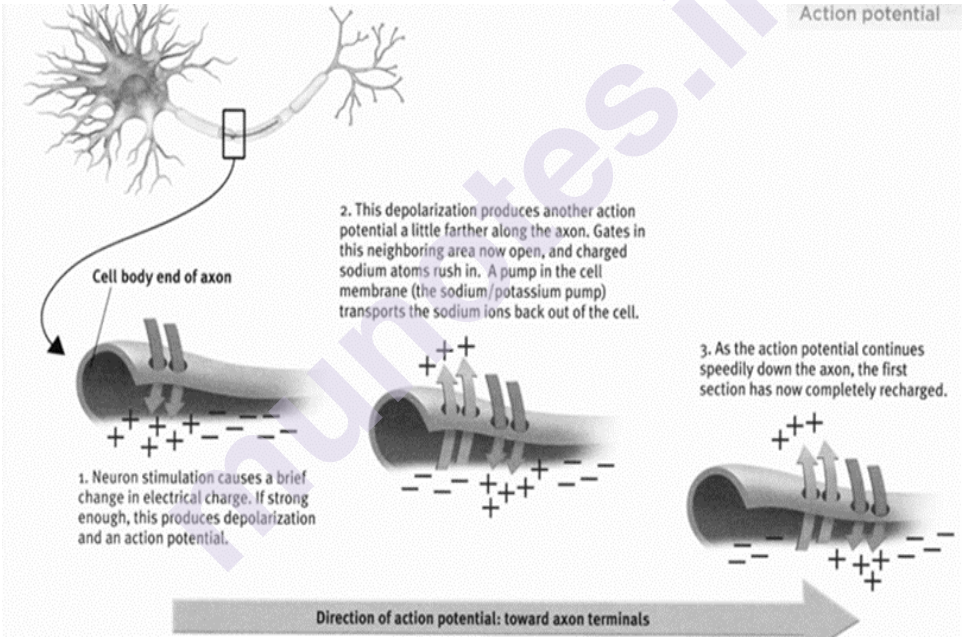
A neuron that is at rest, that is not currently firing a neural impulse is actually electrically charged. The inside of the cell is actually a semiliquid solution in which there are electrically charged particles called **ions.**There is semiliquid solution surrounding the outside of the cell also. This outside semiliquid also contains sodium ions. The ions inside the cell are negatively charged while the ions outside the cell are positively charged. This difference in charges is an electrical potential. The cell wall itself is permeable (porous), so, some substance that is outside the cell can enter through this porous cell wall and some substance with in the cell can come out of the cell through this porous wall. Positively charged sodium ions are too big to enter the cell membrane when the cell is at rest because even though the cell membrane is permeable, the openings are too small at resting state. When the cell is resting, that state is called resting potential. As the outside ions are positively charged and ions inside the cell are negatively charged, these opposite electrical charges attract each other. The sodium ions cluster around the cell wall.

3.2.2 Action Potential:

When the cell receives a strong enough stimulation from another cell (that is when dendrites of the cell get activated), the cell membrane opens up special gates, one after the other, all down its surface that allows the sodium ions to rush into the cell. This causes the inside of the cell to become positive and outside of the cell becomes negative. This electrical charge reversal starts at the axon hillock where axon is closest to cell body, where the first gate opens and then proceeds down the axon in a kind of chain reaction. This electrical charge reversal is known as **action potential** because the electrical potential is now in action rather than at rest. In other words, action potential means that the cell is now positive inside and negative outside at the point where the

gate opened. Each action potential sequence takes about one-thousandth of a second.Depending upon the type of fiber in a neuron, some neural impulse travels at speeds ranging from 2 miles per hour (slowest) to 270 miles per hour (fastest). After the action potential passes, the cell membrane pumps the positive sodium ions back outside the cell and shuts the gates one by one until the next action potential opens the gates again. The cell becomes negative inside and positive outside once again, restoring the cell to its resting potential. Resting pause is also known as refractory period.In short, we can say that when the cell is stimulated, the first gate opens and the electrical charge at that gate only is reversed. Then the next gate opens and charge at that gate only is reversed. In the meantime, the first gate closes and the charge returns to its original state, i.e., negative inside and positive outside the cell. The action potential is the sequence of gates opening all the way down to the length of the cell.

Fig.3.4



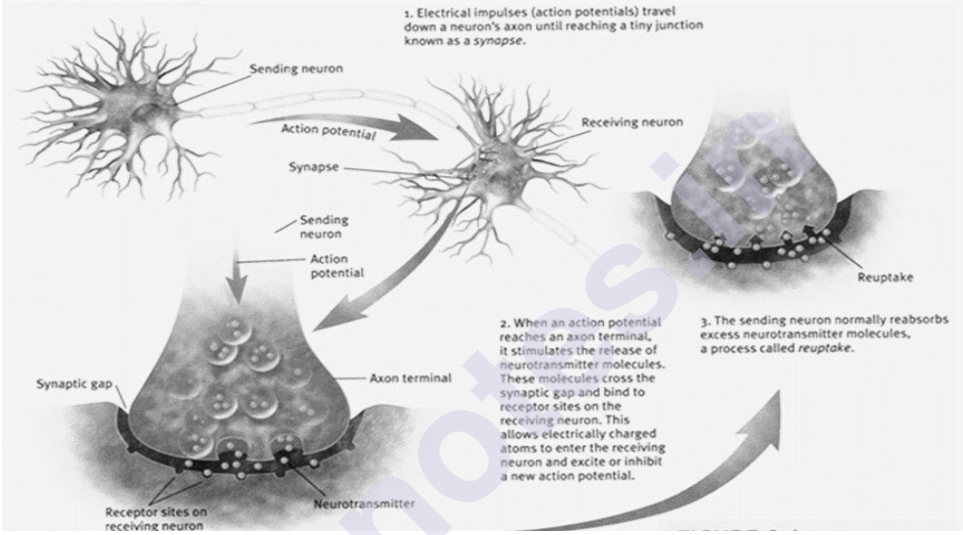
Each neuron is itself a miniature decision making device performing complex calculations as it receives signals from hundreds or even thousands of other neurons. Most signals are excitatory that is like pushing a neuron's accelerator, some are inhibitory, that is like pressing the break. If excitatory signals minus the inhibitory signals exceed a minimum intensity or threshold, the combined signals trigger an action potential. It is similar to saying, majority wins. If excitatory signals are more than inhibitory signals then action potential takes place. When a neuron does fire, it fires in an all-or-none fashion. Neurons are either firing at full strength or not firing at all. Increasing the level of stimulation above the threshold does not increase the neural impulse's intensity. However, a strong stimulus can trigger more neurons to fire and to

fire more often and more quickly. But it does not affect the action potential's strength or speed. See Fig. 3.4.

3.2.3 How Neurons Communicate:

Now let us see how do neurons communicate with each other and with the body. If you see fig. 3.1, you will see that at the end point, axon has many branches that are called axon terminals. Dendrites of receiving neuron and axon terminals of message sending neuron don't touch each other. The axon terminal of one neuron is separated from the receiving neuron by a synaptic gap /synaptic cleft which is less than a millionth of an inch wide. So how do the neurons send message across the tiny synaptic gap.

Fig.3.5



The answer is that the tip of each axon terminal has a little knob on it. These knobs are called synaptic knob or terminal buttons. The synaptic knob has a number of little saclike structures in it that are called synaptic vesicles. These synaptic vesicles are filled with fluid and a chemical substance called neurotransmitters. When an action potential reaches the synaptic knob/terminal button at the axon's end, it triggers release of chemical messengers called neurotransmitters. Within 1/10,000th of a second, the neurotransmitter molecules cross the synaptic gap and bind to the receptor sites on the receiving neuron. The dendrites of a receiving neuron contain special little locks called receptor sites. These locks have a special shape that allows only a particular molecule of neurotransmitter to fit into it, just as a key fit into a lock. The neurotransmitter unlocks tiny channels at the receiving site and electrically charged atoms flow in, exciting or inhibiting the receiving neuron's readiness to fire. Then in a process called **reuptake**, the sending neuron reabsorbs the excess neurotransmitters. See Fig 3.5.

3.2.4 How Neurotransmitters influence us:

Research studies have shown that neurotransmitters influence our hunger, thinking, depression and euphoria, addiction and therapy and many other functions. However, right now we will see the influence of neurotransmitters on our motions and emotions. Particular neurotransmitters affect specific behaviors and emotions. However, neurotransmitter systems don't operate in isolation, they interact and their effects vary with the receptors that they stimulate. For example, a neurotransmitter called Acetylcholine plays a role in learning and memory. It is also the messenger at every junction between motor neurons (which carry information from the brain and spinal cord to the body) and skeletal muscles. When ACh is released to our muscle cell receptors, the muscle contracts. If ACh transmission is blocked as happens during some kinds of anesthesia, the muscle cannot contract and we are paralyzed.

Our body releases several types of neurotransmitter molecules similar to morphine in response to pain and vigorous exercise. These **endorphins** explain why people have good feeling as "runner's high", the painkilling effect of acupuncture, and the indifference to pain in some severely injured people. So, endorphins lessen pain and boosts good mood.

3.2.5 Impact of Drugs and Other Chemicals on Neurotransmitters:

When the brain is flooded with opiate drugs such as heroin and morphine, the brain may stop producing its own natural opiates. When the drug is withdrawn, the brain may then be deprived of any form of opiate, causing intense discomfort. For suppressing the body's own neurotransmitter production, nature charges a price. Drugs and other chemicals affect brain chemistry at synapses, often by either exciting or inhibiting neuron's firing.

Agonist molecules may be similar enough to a neurotransmitter to bind its receptor and mimic its effects. Some opiate drugs are agonists and produce a temporary "High" by amplifying normal sensation of arousal and pleasure.

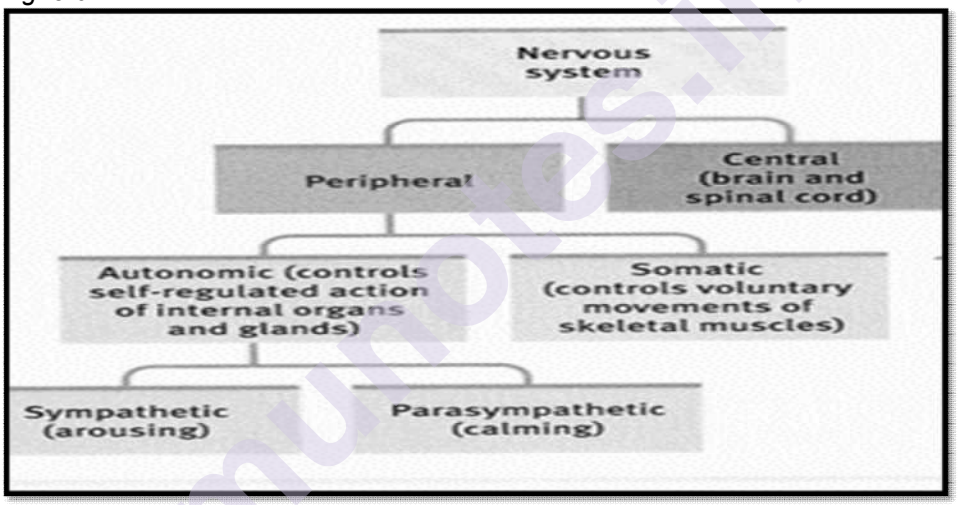
Antagonists also bind to receptors but their effect is instead to block a neurotransmitter's functioning. **Botulin**, a poison that can form in improperly tinned food, causes paralysis by blocking ACh release. Small injections of botulin- Botox- smooth wrinkles by paralyzing the underlying facial muscles. These antagonists are enough like the natural neurotransmitters to occupy its receptor sites and block its effects. But they are not similar enough to stimulate the receptor. It is like having a foreign coin which is identical to size and shape of Indian coin that fits into wending machine slot but won't operate the machine. **Curare,** a poison that

hunters apply to arrow's tips occupies and blocks ACh receptor sites on muscles, so that animal struck with arrow gets paralyzed.

3.3 THE NERVOUS SYSTEM

The essence of living is to take in information from the world and the body's tissues, to make decisions and to send back information and orders to the body's tissues. All this happens due to our body's nervous system. So, let us see how our nervous system works. The nervous system is the body's speedy, electrochemical communication network, consisting of all the nerve cells of the peripheral and central nervous system.Nerves are like electric wires. These nerves are formed by bundles of axons and link the CNS with the body's sensory receptors, muscles and glands. Our nervous is broadly divided into two parts- (see Fig.3.6& Fig.3.7)

Fig. 3.6

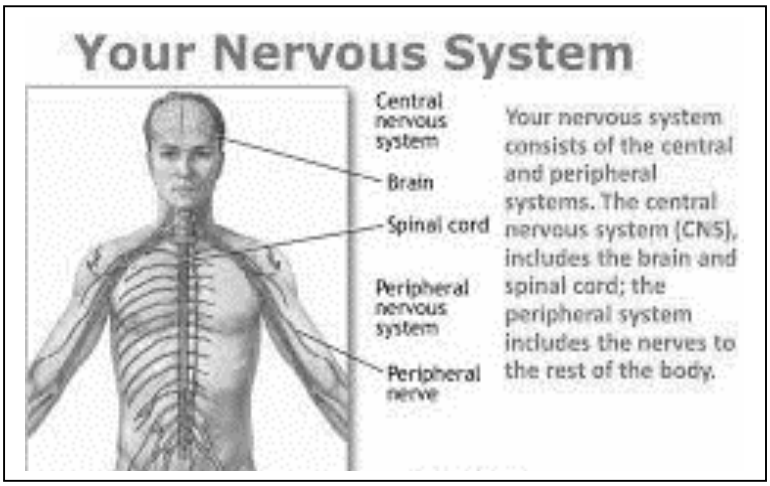


3.3.1 The Central Nervous System (CNS)

It consists of the brain and spinal cord. It is the body's decision maker. Both the brain and the spinal cord are composed of neurons that control the life sustaining functions as well as all thoughts, emotions and behavior.

The Brain: The brain enables our humanity – our thinking, feeling and acting. It consists of approximately 40 billion neurons, each connecting with roughly 10,000 other neurons. The brain's neurons cluster into work groups called **neural networks.** Just as people tend to network with their neighbors, similarly, neurons network with nearby neuronswith which they can have short, fast connections. Neurons that fire together wire together. For instance, learning to play violin, speaking a foreign language, solving a math problem takes place as feedback strengthens connections.

Fig.3.7



The Spinal Cord: It is a two-way information highway connecting the peripheral nervous system and the brain. The inner part of spinal cord appears to be grey while outer part appears to be white. The inner part of spinal cord is mainly composed of cell bodies of neuron and outer part of spinal cord consists of axons and nerves. The outer section of spinal cord is merely a message pipeline, bringing messages from the body up to the brain and messages or decisions from the brain down to the body.

There are three types of neurons- sensory neurons that carry messages from the senses to spinal cord, motor neurons that carry messages from the spinal cord to the muscles and glands and interneurons that connect the sensory neurons to the motor neurons and make up the inside of the spinal cord and the brain itself.

The Reflex: Our reflexes are our automatic responses to stimuli and are an example of how our spinal cord works. The inner part of spinal cord which is made up of cell bodies is actually a primitive sort of brain. This part of the spinal cord is responsible for certain reflexes which are very fast, lifesaving reflexes. A simple spinal reflex pathway is composed of a single sensory neuron and a single motor neuron and these often communicate through interneuron. For example, knee-jerk response, even a headless warm body can do it.

Another such pathway enables the **pain reflex.** When our finger touches a flame, neural activity (excited by the heat) travels via sensory neuron to interneurons in our spinal cord. These interneurons respond by activating motor neurons leading to the muscles in our arm. Since the simple pain reflex pathway runs through the spinal cord and right back out, our hand jerks away from the flame before the brain receives and responds to the information that caused us to feel the pain. This is the reason why it appears that our hand jerks away not by our choice but on its own.

The question comes to mind that if information travels to and from the brain through the spinal cord, what will happen if the top of spinal cord is severely damaged. Then there will be no connection between brain and spinal cord. Logically then, with your brain literally out of touch with your body, you would lose all sensation and voluntary movement in body regions with sensory and motor connections to the spinal cord below its point of injury. The research shows that we are capable of giving a response even when certain brain centers are damaged. For instance, Goldstein(2000) reported that when the brain center controlling the erection is damaged, men paralyzed below the waist were capable of having an erection(a simple reflex) when their genitals were stimulated.

3.3.2 The Peripheral Nervous System (PNS):

It is responsible for collecting information and for transmitting central nervous system's decisions to other parts of the body. The peripheral nervous system has two parts – Somatic and autonomic nervous system.

Somatic nervous system:

Itenables voluntary control of our skeletal muscles. It is made up of all the nerves carrying messages from the senses to the CNS and all of the nerves carrying messages from the CNS to the muscles of the body- especially the skeletal muscles, that is, muscles connected to the bones of our body. This allows people to move their bodies. For example, when people are walking, raising their hands in class, smelling a flower or seeing a pretty picture, they are using somatic nervous system.

Autonomic nervous system:

While the somatic part of the peripheral nervous system controls the senses and voluntary muscles, the autonomic part of the peripheral nervous system controls everything else in the body such as organs, the glands and the involuntary muscles of our internal organs and influences activities such as heartbeat, digestion and glandular activity. Usually this system operates on its own, that is why it is called autonomic nervous system.

Autonomic nervous system also consists of two parts-

- the sympathetic nervous system and
- parasympathetic nervous system.

The sympathetic nervous system:

It is located in the middle of the spinal cord column, running from near the top of the ribcage to the waist area**. It** arouses and expends energy. If something alarms or challenges us (e.g. coming across a snake) our sympathetic nervous system will increase the heartbeat, raise our blood pressure, slow our digestion, raise blood

sugar and cool us with perspiration. This makes us alert and ready for action. The heart draws blood away from nonessential organs such as skin (so at first the person may appear pale), and sometimes draws blood from even the brain itself (so the person might actually faint). Blood needs lot of oxygen before it goes to the muscles, so the lungs work overtime too (the person may begin to breath faster). While dealing with a stressful situation, digestion of food and elimination of waste are not necessary functions, so these systems tend to be shut down. Saliva dries up, the urge to go to the bathroom will be suppressed but if the person is really scared, the bladder or bowls may actually empty.

In fact, the sympathetic nervous system is known as “fight-or-flight system” because it allows people and animals to deal with all kinds of stressful events. The sympathetic division’s job is to get the body ready to deal with the stress. It is also said that the sympathetic division is in sympathy with one’s emotions. These emotions may be anger, extreme joy, or extreme excitement. Even extreme emotions can be stressful and it deals with them.

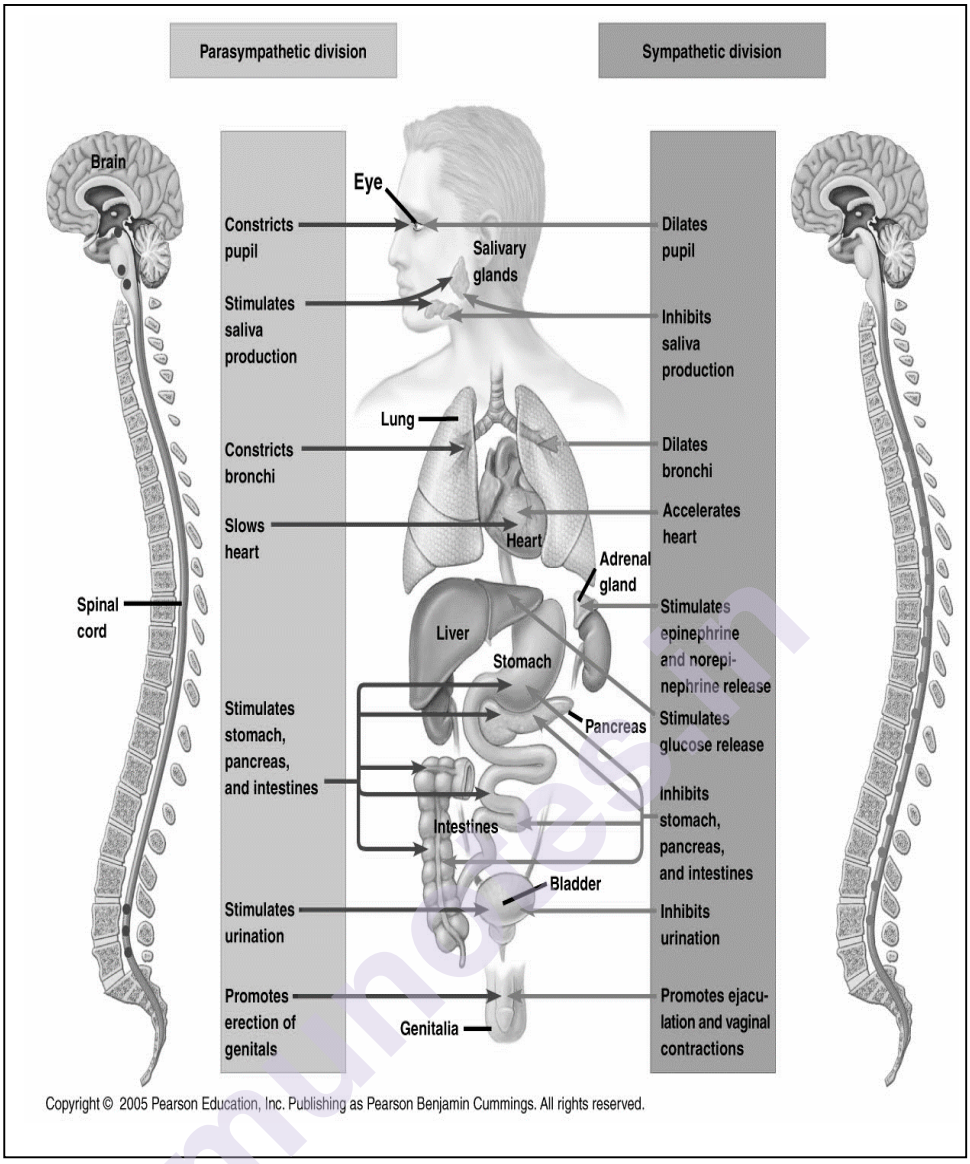
The parasympathetic nervous system:

It gets activated once the danger is over and it will produce opposite effects. It will conserve our energy by decreasing our heart beat, lowering blood sugar, constricts the pupils, reactivates digestion and excretion, etc.

In everyday situations, the sympathetic and parasympathetic nervous systems work together to keep us in a steady internal state. In other words, its job is to restore the body to normal functioning after a stressful situation ends.

If the sympathetic division can be called the fight-or-flight system, the parasympathetic division can be called “the-eat-drink-and-rest system”. The neurons of this division are located at the top and bottom of the spinal column or either side of the sympathetic division of neurons. The parasympathetic division does more than just react to the activity of the sympathetic division. It is responsible for most of the ordinary, day to day bodily functioning. It keeps the heart beating regularly, breathing normal, and digestion going. People spend most part of the day in eating, sleeping, digesting and excreting. So, it is the parasympathetic division that is normally active.

Fig 3.8



See Fig 3.8 to see the summary of difference between sympathetic and parasympathetic division.

3.4 CHECK YOUR PROGRESS:

Write short notes on

a.) Importance of studying human biology
b.) Structure of neuron
c.) Action potential
d.) Influence of neurotransmitters
e.) Impact of drugs and other chemicals on neurotransmitters
f.) The peripheral nervous system
g.) The central nervous system
h.) Sympathetic division of the autonomic nervous system
i.) Parasympathetic division of the autonomic nervous system

3.5 SUMMARY:

In this unit, we began with why it is necessary for us to understand the biological part of human body. We said our cognitive part is intertwined with our biological part. While talking about the biological part we have concentrated on nervous system. The smallest unit of nervous system is neuron. So we discussed the structure and functioning of neuron. We also discussed how communication takes place among neurons, how neurotransmitters influence our actions, motions and emotions, and how neurotransmitters get influenced by certain drugs and chemicals. Then we discussed the nervous system in broader terms, where we said that nervous system is divided into two parts- central nervous system (that consists of brain and spinal cord) and peripheral nervous system (that consists of nerves reaching out to each and every part of the body. The peripheral nervous system can be further divided into somatic and autonomic nervous system and autonomic nervous system can be further divided into the sympathetic and parasympathetic nervous system. The sympathetic nervous system gets activated when we are faced with extremely stressful situation and it readies body to face that challenging situation. On the other hand, the parasympathetic division of autonomic nervous system helps us to cool down after the stressful situation is over and it is involved in our daily activities.

3.6 QUESTIONS:

1. With the help of a diagram, explain the structure and functioning of a neuron.
2. Write a detailed note on neural communication.
3. How neurons communicate and how neurotransmitters influence us?
4. Explain in detail action potential and how neurons communicate.
5. What are the functions of the nervous system's main divisions?

3.7 REFERENCE:

1) Myers, D. G. (2013).Psychology.10th edition; International edition. New York: Worth Palgrave Macmillan, Indian reprint 2013

2) Ciccarelli, S. K. & Meyer, G. E. (2008). Psychology.(Indian sub-continent adaptation). New Delhi: Dorling Kindersley (India) pvt ltd.

Unit -4

THE BIOLOGY OF MIND - II

Unit Structure :

4.0 OBJECTIVES:

After reading this unit you will be able –

- To understand the role of various glands in influencing our body functions and behavior
- Understand the structure of brain and functions of various parts of brain

4.1 INTRODUCTION:

In previous unit, we studied about the neurons. In present unit, we will look at endocrine system –a set of glands that are interconnected with our nervous system and play a significant role in the growth and functioning of the body. We had also mentioned before a famous saying by Descartes, a French philosopher, that “I think, therefore I am”. We exist as vibrant, full of life human beings, because we have a very complex organ in our body called brain. Our brain differentiates us from other species of animal kingdom and frees us from instincts. It is because of our brain that we are not merely responding to the environment and merely surviving, we are also thinking, storing memories, knowledge and we are creating. Our brain enables us to have foresight, imagine and plan and it is due to our brain that we are able to develop technology that has helped us to conquer not only the other species who are bodily much stronger to us, but also to travel beyond our planet. So, let us see, how our endocrine system and brain functions.

4.2 THE ENDOCRINE SYSTEM:

The endocrine system is a second communication system interconnected with our nervous system. The endocrine system is the collection of glands that produce hormones that regulate metabolism, growth and development, tissue function, sexual function, reproduction, sleep, and mood, among other things.

The endocrine system is made up of the pituitary gland, thyroid gland, parathyroid glands, adrenal glands, pineal gland, pancreas, ovaries (in females) and testicles (in males). The endocrine system affects almost every organ and cell in the body. The glands secrete a form of chemical messengers that is called hormones. These hormones travel through the blood stream and affect other tissues, including the brain. When hormones act on the brain, they influence our interest in sex, food and aggression. Some hormones are chemically identical to neurotransmitters. So we can say that endocrine system and nervous system are close relatives. Like relatives, they are similar to each other yet there are subtle differences between them. For instance, in nervous system the message travels at a fraction of a second while in endocrine message through bloodstream takes several seconds or more to travel from gland to the target issue. It is similar to saying that nervous system messages are like text messages while endocrine messages are like posting a letter.

However, endocrine messages have long lasting effects than neural messages. That is why, when we get upset, it takes time for us to cool down. When we face any danger, the adrenal gland which is situated on top of the kidney releases epinephrine and norepinephrine (or what we call adrenaline and noradrenaline). These hormones increase heart rates, blood pressure and blood sugar, enabling us to have a surge of energy to deal with the emergency. But when the emergency passes away, the hormones and the feelings of excitement lingers for some time before fading.

Another endocrine gland that is most influential is pituitary gland. It is a pea sized gland situated in the core of the brain, where it is controlled by an adjacent brain area- the hypothalamus. The pituitary gland releases certain hormones such as growth hormone that stimulates physical development and oxytocin hormone. Oxytocin hormone enables uterine contractions associated with birthing, milk flow during nursing and organism. Oxytocin also promotes pair bonding, group cohesion and social trust. In an experiment, it was found that those who were given a nasal spray of oxytocin were more likely to trust strangers with their money than those who were not given spray of this hormone (Kosfeld et.al., 2005)

Pituitary secretions also influence the release of hormones by other endocrine glands. Thus, we can say, pituitary gland is like a master gland which is controlled by hypothalamus. For example, a stressful event triggers hypothalamus, hypothalamus instructs pituitary gland to release a hormone that causes adrenal glands to release cortisol, a stress hormone that increases blood sugar.

Fig.4.1

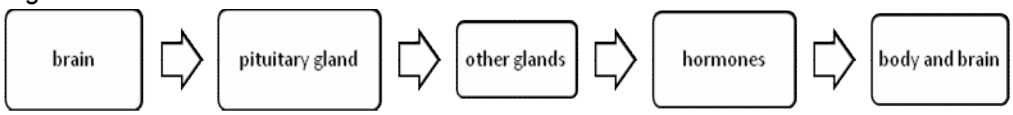


Figure 4.1 reveals the intimate connection of the nervous and endocrine systems.

The Pineal gland: The Pineal gland is also located in the brain, nearer to the back. It secretes melatonin hormone that controls circadian rhythm, induction of drowsiness and lowering of the core body temperature. In other words, it regulates the sleep-wake cycle.

The Thyroid Gland: The thyroid gland is a butterfly-shaped gland located at the base of the neck. It releases hormones to regulate metabolic rate of our body by stimulating body oxygen and energy consumption. It also plays a role in bone growth and development of the brain and nervous system in children. Thyroid hormones also help maintain normal blood pressure, heart rate, digestion, muscle tone, and reproductive functions.

Parathyroid Gland: It regulates calcium levels in the blood and bone metabolism.

Pancreas: The pancreas has digestive and hormonal functions. One part of the pancreas, the exocrine pancreas, secretes digestive enzymes. The other part of the pancreas, the endocrine pancreas, secretes hormones called insulin and glucagon. These hormones regulate the level of glucose in the blood.

4.3 THE BRAIN - THE TOOLS OF DISCOVERY:

In ancient times, scientists had no tools to study a living human brain. They used to dissect the brains of dead humans and animals to understand how brain worked. But it was impossible to tell the functioning of various parts of brain from the dead brain.

Early clinical observations by doctors and psychologists revealed that there is some connection between brain and mind. For example, it was found that damage to one side of the brain often caused numbness or paralysis on the body's opposite side.

This suggested that body's right side is wired to the left side of the brain and left side of the body is wired to right side of the brain. It was also observed that our vision or ability to see clearly was impacted with the damage to the back portion of the brain and a person will have speech difficulties if the left-front part of the brain is damaged.

However, now many new techniques have been developed to study living brain. Some of them are –

Deep Lesioning and Electrical Stimulation:

One way to study the functioning of various areas of the brain is by damaging those areas selectively and deliberately, and then studying its impact on animals or humans' abilities. Another way is that instead of destroying the part of brain, scientists may just stimulate electrically some particular area of the brain and watch the results. Both destroying and stimulation of specific areas of brain is done by same method. A thin wire insulated everywhere except the very tip is surgically inserted into the brain of the test animal. If brain tissue is to be destroyed then a strong electric current is passed through the tip of the wire to destroy the neurons. This is called deep lesioning. We obviously need to do studies using this method only with animals for ethical reasons.

In the laboratory, studies have shown that damage to one area of hypothalamus in a rat's brain reduces eating to the point of starvation, whereas damage to another area of brain produces overeating.

If researchers want to only stimulate a particular area of the brain, then a mild current is passed through the tip of the wire, causing the neuron to react as if they have received a message. This is called electrical stimulation of the brain. Now days, neuroscientists can also chemically or magnetically stimulate parts of brain.

Laboratory studies using this stimulation method have shown that depending on the stimulated part of the brain people may giggle, hear voices, turn their head, feel themselves falling or they may have out – of - body experience.

Scientists, now days can also study the messages of individual neurons. For example, modern microelectrodes (very small tip of the wire) can detect, exactly where the information goes in a cat's brain when someone strokes its whiskers. Researchers can also listen the chatter of billions of neurons and can see color representations of the brain's energy consuming activity.

The EEG:

Our mental activities emit electrical, metabolic and magnetic signals that help scientists to study the brain at work. This is a very safe way to study the activity of the living brain. Electrical activity in the brain's billions of neurons creates regular waves across its surface. Scientists study these electrical activities by using a method called electroencephalogram (EEG). EEG is an amplified read-out of these electrical waves. Researchers record the brain waves through a shower cap like hat that is filled with electrodes that are covered with a conducting gel. Electrodes are small metal disks that are placed directly on the skin of the skull. These microelectrodes are attached to wires and the wires are attached to pens that rest on the moving graph paper. These microelectrodes can detect electrical activity which causes pens to move and create short irregular curvy lines or waves that indicate many things, such as stages of sleep, seizures, presence of tumors, etc. The EEG can also be used to identify which areas of the brain are active during tasks such as reading, writing, and speaking.

PET (Positron emission tomography):

PET is a neuroimaging technique that allows us to see inside the living brain. It shows the picture of brain activity by showing each brain area's consumption of its chemical fuel, the sugar glucose. The person, whose brain the scientist wants to study, is injected with a radioactive glucose. The computer detects the activity of the brain cells by looking at which cells are using up the radioactive glucose and projecting the image of that activity onto a monitor. Active neurons are glucose hogs and after a person receives temporarily radioactive glucose, the PET scan can track the gamma rays released by this "food for thought" as the person performs the given task. The computer uses colors to indicate different levels of activity. Areas that are very active usually show up as white or very light and the areas that are inactive show up as dark blue. With this method, researchers can actually have the person perform different tasks while the computer shows what his brain is doing during the task. PET scan can show which brain areas are most active when the person is doing mathematics calculations, looks at images of faces, or daydreams.

MRI (Magnetic Resonance Imaging):

The person's head is put in a strong magnetic field, which aligns the spinning atoms of brain molecules. Then a radio wave pulse momentarily disorients the atoms. When the atoms return to their normal spin, they give out signals that provide a detailed picture of soft tissues, including the brain.

Since many images are taken milliseconds apart, it shows how the brain responds to different stimuli, enabling researchers to study both the functional and structural brain abnormalities in

psychological disorders. MRI scans have revealed a larger than average neural area in the left hemisphere of musicians who display perfect pitch. They have also revealed enlarged ventricles, that is fluid filled areas, in some patients of schizophrenia.

fMRI (Functional MRI):

fMRI can reveal the brain's functioning and its structure. Blood goes to the parts of brain that are active. By comparing MRI scans taken less than a second apart, researchers can watch as specific brain areas are activated and oxygen-laden bloodflow increases. For example, when a person looks at a picture, the fMRI machine detects blood rushing to the back of the brain because that area processes visual information. Such pictures of the brain's changing activity give us a new insight into how brain divides its work. For instance, a fMRI study suggested which part of the brain is most active when people feel pain or rejection, listen to angry voices, think about scary things, feel happy or become sexually excited. In another study, 129 people were given eight different tasks to perform such as reading, gambling or rhyming and their brains were studied through fMRI. It was found that neuroscientists were able to predict with 80% accuracy what mental activity was being done by the participant.

All these techniques to study brain have helped psychologists in the same way as microscope helped the biology and telescope helped in astronomy.

4.3.1 Older Brain Structures:

The capacities of human beings and animals come from their brain structures. In primitive animals, brain structure is very simple and regulates basic survival functions. In lower mammals, a more complex brain structure enables emotions and greater memory apart from survival functions. In advanced mammals such as human beings, a more advanced brain structure processes more information and enables increased foresight apart from all other functions performed by less advanced brain structures.

The increased complexity of human's brain comes from new brain system that is built on top of the old brain system. Just as in case of earth, if we dig deeper, we can see the original rocks on which new landscapes have come up, similarly, if we dig deep down, we can see the fossil remnants of the past that is brainstem components performing the same tasks that they did for our ancestors.

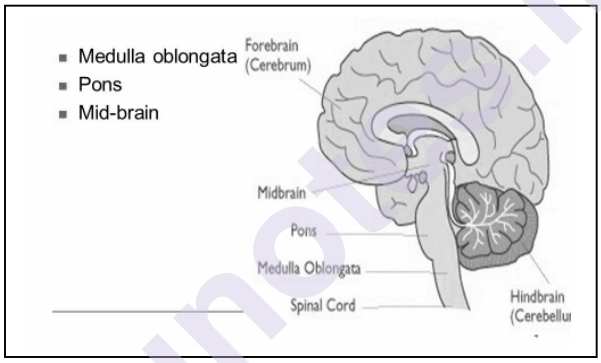
So, let us start with the base of the brain and then study the top portion of the brain or the newer systems of the brain.

The Brainstem:

The brain stem is the oldest and innermost part of the brain. The brainstem consists of the medulla oblongata, pons, and midbrain.

The medulla oblongata: The medulla oblongata is the lower half of the brainstem continuous with the spinal cord. Its upper part is continuous with the pons. It begins where the spinal cord swells slightly after entering the skull. This slight swelling is called medulla. (See Fig. 4.2) The medulla contains the cardiac, respiratory, vomiting and vasomotor centres dealing with heart rate, breathing and blood pressure. We don't need higher brain or conscious mind to regulate our heart's rate and breathing. The brainstem takes care of those tasks. It is in the medulla that the nerves coming from and going to the left and right side of the body cross over, so that the left side of the brain controls the right side of the body and vice versa.

Fig.4.2



The Pons: The Pons lies between the medulla oblongata and the midbrain. The pons is the larger swelling just above the medulla.The term pons in Latin means bridge and the pons is actually a bridge between the lower and upper part of the brain.It influences sleep and dreaming, helps in coordinating the movements of right and left sides of the body and arousal.

The midbrain: The midbrain is a small region of the brain that serves as a relay center for visual, auditory, and motor system information. It is front part of the brainstem, and any disruption to this area can cause irreversible damage and impairment. Illnesses most commonly associated with this region of the brain are stroke, schizophrenia, and Parkinson's disease.

The Thalamus:

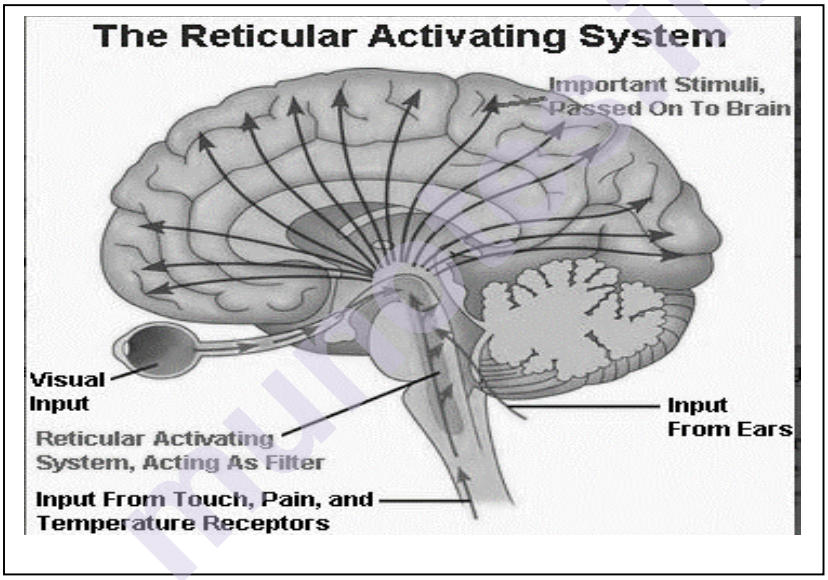
Just above the brain stem is the thalamus. It is a pair of egg shaped structures. The thalamus receives information from all the senses except smell and relays this information to the higher brain regions which deal with seeing, hearing, tasting and touching,

where it can be processed. If this part of the brain is damaged, all sensory information would not be processed and sensory confusion will take place.

The Reticular Formation:

Inside the brainstem, between your ears, the reticular formation extends through the central core of the medulla, pons, and stops in the midbrain. It is an intricate system composed of finger shaped network of neurons that extends from the spinal cord through thalamus.(See Fig. 4.3) It regulates arousal, attention, sleep and awaking cycle. It filters incoming stimuli to discriminate irrelevant background stimuli. Basically, it allows people to ignore constant unchanging information (such as the noise of a fan) and become alert to changes in the information (for example, if the noise of the fan stops).

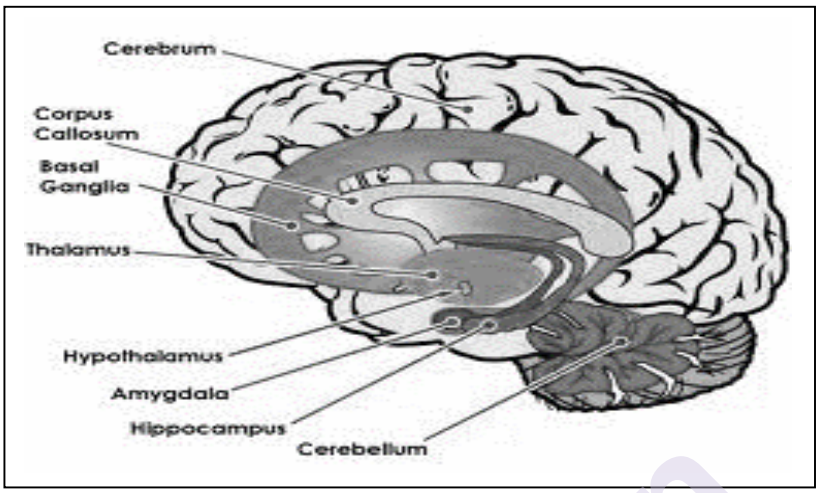
Fig.4.3



It is essential for governing some of the basic functions of higher organisms and is one of the oldest part of the brain. Damage to the reticular formation can lead to coma or death. In less severe cases, a damaged reticular formation can cause fatigue, changes in sexual arousal and disrupted sleep patterns.

The cerebellum:

Fig.4.4



Cerebellum is placed at the base of the skull just behind the pons and below the main part of the brain. It looks like a small brain. Cerebellum means little brain. The cerebellum is part of the lower brain. The cerebellum is not unique to humans. Evolutionarily speaking, it is an older portion of the brain. It is present in animals that scientists believe existed before humans. The cerebellum makes up approximately 10% of the brain's total size but it accounts for more than 50% of the total number of neurons located in the entire brain. In adults, it weighs around 150 gm.

Functions of Cerebellum: It helps -

- to judge time, modulate our emotions and
- to discriminate sounds and textures.
- to coordinates voluntary movements (especially those movements that have to happen in rapid succession such as walking, diving, skating, dancing, typing, playing musical instrument and even the movement of speech) – It controls the timing and pattern of muscle activation during movement.
- To maintain balance and equilibrium- people can sit upright because the cerebellum controls all the little muscles needed to keep them from falling out of their chair.Because of cerebellum, people don't have to consciously think about their posture, muscle tone and balance.
- It enables nonverbal learning and memory.
- Learned reflexes, skills and habits are also stored here which allows them to become more or less automatic.
- It also contributes to emotional responses.

If a person's cerebellum is damaged, he will have difficulty in walking, standing, keeping his balance or shaking hands. He can't even get a spoon to his mouth. The movements will be jerky and exaggerated. He won't be able to dance or play any musical instruments such as guitar. Alcohol influences cerebellum and that is why a drunk person cannot walk properly, or drive properly. People with damaged cerebellum may also suffer from tremors, cannot judge distance and when to stop, are unable to perform rapid alternating movements. They have slurred speech and abnormal eye movements.

The Limbic System:

Brain stem is the oldest part of the brain and the cerebral hemisphere is the highest and newest region of the brain. Between the oldest and newest brain areas lies the limbic system. It derives its name from a Latin word Limbus which means border. In this case, forming a border around the brain stem. The Limbic system contains three parts – the amygdala, the hypothalamus, and the hippocampus. (See Fig.4.4)

The Amygdala:

Amygdale is almond shaped mass of nuclei located near the hippocampus. It is involved in emotional responses, hormonal secretions, and episodic-autobiographical memory. Research has linked amygdala to aggression and fear. Information from the senses goes to the amygdala before the upper part of the brain is even involved, so that people can respond to danger quickly, sometimes before they are consciously aware of what is happening.

Research has shown that damage to amygdala causes loss of the aggressive behavior, and fear (Kluver & Bucy 1939). Another research showed that electrical stimulation of one part of an amygdala makes a docile pet cat aggressive while electrical stimulation of another part of amygdala makes it fearful.

The Hypothalamus:

The hypothalamus is a very small (size of an almond) but very powerful part of the brain that is located just below the thalamus and is part of the limbic system. 'Hypo' means 'just below', since it is just below the thalamus, it is called hypothalamus. It links the nervous system to the endocrine system via the pituitary gland. It sits right above the pituitary gland and controls the pituitary gland by either stimulating or inhibiting the secretion of pituitary hormones. Pituitary gland is called 'master gland' because it controls the functions of all other endocrine glands, so the ultimate regulation of hormones lies with the hypothalamus.

Functions of the hypothalamus: It regulates –

- Body temperature,
- Thirst,
- Hunger and weight control,
- Fatigue,
- Sleep cycles
- Sexual activity,
- Emotions,
- Important aspects of parenting and attachmentbehaviors.
- Childbirth
- Blood pressure and heart rate
- Production of digestive juices
- Balancing bodily fluids

As signals are sent to the brain from different areas of the body, they let the hypothalamus know if balance is not being achieved. The hypothalamus then responds by releasing the right hormones into the bloodstream to balance the body back out.

One example of this is the body's ability to maintain an internal temperature of 98.6°F. If the hypothalamus receives the signal that the body's internal temperature is too hot, it will tell the body to sweat. If it receives the signal that the temperature is too cold, the body will create its own heat by shivering.

Olds and Milner (1954) accidently made a remarkable discovery about the hypothalamus. They were trying to implant an electrode in a rat's reticular formation but inadvertently placed it in hypothalamus. They observed that the rat kept returning to the location where it had been stimulated by this misplaced electrode. Thus, they discovered a brain center that gives pleasure rewards. In a series of experiments later on, they went on to discover other 'pleasure centers' in hypothalamus. Other scientists called these pleasure centers as reward centers. It was observed that when rats with implanted electrodes were allowed to press pedals to trigger their own stimulation in these areas, rats kept pressing the pedals at a very high speed – sometimes up to 7000 times an hour – till they dropped from fatigue. Not only that, to get this stimulation, they would even cross an electrified floor, that normally a starving rat would not do to reach food.

In fact, research with animals have shown that both a general dopamine related reward system and specific centers associated with pleasures of eating, drinking and sex are activated by the stimulation of different parts of hypothalamus. The question arises can we generalize this research to human beings also? The answer is yes. Research has shown that human beings also have limbic centers for pleasure. In one study, a neurosurgeon implanted

an electrode in such areas to calm a violent patient. Stimulated patient reported mild pleasure, though he did not show the same intensity as the stimulated rat showed in Old's experiment. Other experiments have shown the effects of a dopamine related reward system also.

Researchers believe that addictive disorders such as alcoholism, drug abuse, binge eating may be originating from malfunctioning in natural brain systems for pleasure and wellbeing. People who are genetically predisposed to reward deficiency syndrome may crave for whatever gives that missing pleasure or relieves negative feelings.

The Hippocampus:

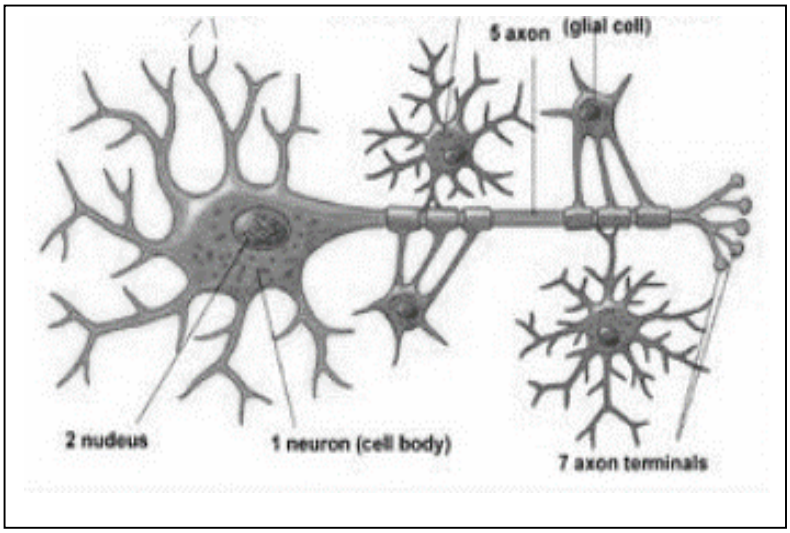
The hippocampus is the Greek word for "seashore". The hippocampus looks like seashore. The hippocampus plays an important role in the consolidation of information from short term memory to long term memory and in spatial memory that enables navigation. It processes conscious memories and converts them in long term memory. Animals or humans who lose their hippocampus due to surgery or injury, lose their ability to form new memories (recent memory) of facts or events. Elderly people who develop memory problems associated with deterioration of the hippocampus tend to forget where they live, where they kept their keys, and similar location problems.

4.3.2 The cerebral cortex:

If we open up the skull of a human being and look inside, the brain looks like a wrinkled organ, almost resembling the meat of an oversized walnut. This wrinkled portion that you are seeing is cerebral cortex. Underneath cerebral cortex is the cerebrum. The cerebrum is the largest part of the brain, forming 85% of its weight. The cerebrum consists of two cerebral hemispheres joined by a curved thick band of nerve fibers called corpus callosum. The cerebral cortex is a thin surface layer that covers two hemispheres of cerebrum just like the bark covers a tree trunk. This thin layer is made up of interconnected neural cells. It is formed of grey and white matter. The two hemispheres are filled with axons connecting the cortex to the brain's other regions. The cerebral cortex – the thin layer contains 20 to 23 billion nerve cells and 300 trillion synaptic connections.

These billions of nerve cells are supported by glial cells (glue cells). Glial cells are the non-excitable supporting cells of the nervous system. These glial cells are nine times more than neurons and look like spiders. They support the neurons and are involved in the nutrition and maintenance of nerve cells. One can say, neurons are like queen bee while glial cells are like worker bees. (See Fig. 4.5)

Fig.4.5

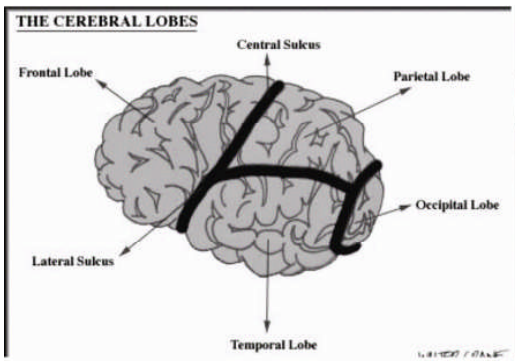


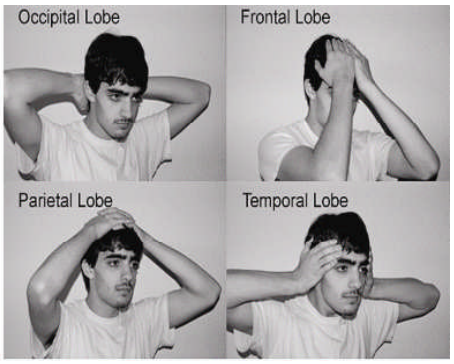
Apart from providing nutrition, they give insulating myelin, guide neural connections and mop up ions and neurotransmitters. Because of their non-conducting nature, the glial cells act as insulators between the neurons and prevent neuronal impulses from spreading in unwanted directions. They also play a part in our learning and thinking. By "chatting" with neurons, they participate in information transmission and memory. Although glia cells DO NOT carry nerve impulses (action potentials) they do have many important functions. In fact, without glia, the neurons would not work properly.

In complex animal brains, the number of glia cells compared to neurons increases. After Einstein's death, scientists carried out a postmortem of his brain and found that though he did not have more or larger than usual neurons but he had more than average concentration of glial cells.

The cerebral cortex is highly wrinkled. Essentially this makes the brain more efficient, because it can increase the surface area of the brain and the number of neurons within it. Animals like frog that have small cortex do not have too many wrinkles in their cerebral cortex. As we move up the ladder of animal life, the cerebral cortex expands and becomes more wrinkled. As the cerebral cortex expands, an organisms' adaptability increases and genetic control loosens. Since human beings and other mammals have larger cortex, their capacity for learning, thinking adaptability is higher. It is the complex functioning of our cerebral cortex that makes us distinctly human. Over time, the human cortex undergoes a process of *corticalization*, or wrinkling of the cortex. This process is due to the vast knowledge that the human brain accumulates over time. Therefore, the more wrinkly your brain, the smarter and more intelligent you are.

Fig.4.6 ***Fig.4.7***





Each hemisphere's cortex is subdivided into four lobes separated by prominent fissures or folds (see Fig. 4.6). These lobes are frontal, occipital, parietal and temporal lobes. The frontal lobes start from the front of the brain and moves upto the top of the brain. Frontal lobes are behind the forehead. The parietal lobes are at the middle section of the brain. The occipital lobes are at the back of the head and temporal lobes are just above the ears. (see approximate locations of lobes in Fig. 4.7) Each of the four lobes carry out many functions and many functions require interplay of several lobes. For instance, the frontal lobe is associated with reasoning, motor skills, higher level cognition, and expressive language. The parietal lobe is associated with processing tactile sensory information such as pressure, touch, and pain. Damage to the temporal lobe can lead to problems with memory, speech perception, and language skills. The occipital lobe is associated with interpreting visual stimuli and information. Damage to this lobe can cause visual problems such as difficulty recognizing objects, an inability to identify colors, and trouble recognizing words.

Motor Cortex:

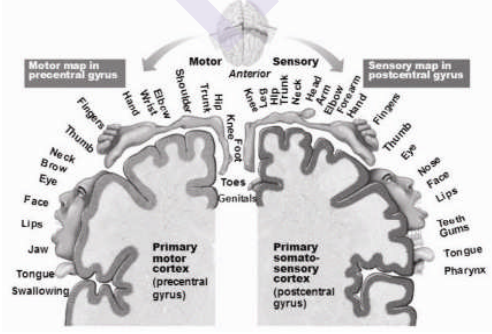
Motor Functions: In 1870 physicians Gustav Theodor Fritsch and Eduard Hitzig, using awake dogs as their subjects, electrically stimulated the area of the brain we now know as the motor cortex and found that the stimulation caused the dogs to move involuntarily. Additionally, they found that stimulating the motor cortex in different locations caused different muscles to move. This experiment led to the identification of the motor cortex as the primary area of our brain involved with planning, controlling and executing voluntary movements. Signals sent to your muscles all originate in the motor cortex region. The motor cortex region is responsible for all voluntary muscle movements, like taking a drink of water or getting yourself out of bed in the morning. Scientists found that body areas that require precise control such as fingers and mouth occupy the greatest amount of cortical space. A Spanish neuroscientist Jose Delgado stimulated a spot on a patient's left motor cortex, triggering the right hand to make a fist. When he

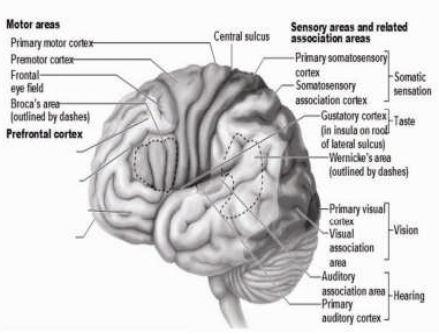
asked the patient to keep his fingers open during the next stimulation, the patient's fingers closed despite his best efforts. This indicated that motor cortex has control over involuntary movements also. In another experiment Gibbs (1996) could predict a monkey's arm motion a 10^{th} of a second before it moved, by repeatedly measuring motor cortex activity before specific arm movement. This indicated that motor cortex is also involved in intention and planningthe movements. Such type of research studies have compelled scientists to look at brain computer interface. Initial studies done with monkeys on brain controlled computers have been successful. Brain controlled computers can be a boon for people who have suffered paralysis or amputation and cannot speak or move. In one of such research study, a paralyzed young man could mentally control a TV, draw shapes on a computer screen and play video games (Hochberg et.al. 2006).

Sensory Funtion:

The cortical area at the front of the parietal lobes, parallel to and just behind the motor cortex is called the sensory cortex. If we stimulate a point on the top of this band of tissue, the person may report being touched on the shoulder and if you stimulate some point on the side of this band of tissue, the person may feel something on the face. Visual information from eyes is received in the visual cortexin occipital lobes, at the back of the brain. If you are hit hard at the back of your head, you may go blind. If that area is stimulated, you may see flashes of light or dashes of color. (See Fig.4.8 & 4.9)The auditory cortex is situated in temporal lobes just above the ears and receives information from the ears. Most of this auditory information travels a circuitous route from one ear to the auditory receiving area above opposite ear.

Fig. 4.8 ***Fig. 4.9***





The amount of cortex devoted to a particular body part is directly proportional to that part's sensitivity. For instance, our supersensitive lips project to a larger cortex area than do our toes.

Association Areas:

Association areas are made up of neurons in the cortex that are devoted to making connections between the sensory

information received in the brain and stored memories, images and knowledge. Association areas give meaning to sensory information coming in the brain. It means that these areas interpret, integrate and act on sensory information and link it to stored memories – a significant part of thinking. Unlike the sensory and motor areas, association area functions cannot be neatly mapped.Association areas take up an increasingly larger percentage of the cerebral cortex as brain size increases among different species.

Association areas are found in all four lobes. In the frontal lobes, they enable judgment, planning, and processing of new memories. Higher order association cortex carries out complex mental processes not associated with any particular sense.These highest mental processes, like language, thinking, and planning, do not depend on specific sensory information.Memory, language, attention and religious experience result from the synchronized activity among distinct brain areas. More than 40 distinct brain regions become active in different religious states, such as praying and meditating. So our mental experiences arise from coordinated brain activity.

People with damaged frontal lobes may have intact memories, high score on intelligence tests and good skills,but they would not be able to plan ahead to begin the skilled task.

Damage to frontal lobe can also change the personality of a person and remove his inhibitions. For example, the case of a railroad worker Phineas Gage. In 1848, he met with an accident, where an iron rod went through his left cheek and came out of the top of his skull. This severely damaged his frontal lobes. He was immediately able to sit and speak and later on return to his work. But he was no more friendly, soft spoken person. After this accident, he became irritable, disrespectful and dishonest person. His mental abilities and memories were intact but his personality had changed.

Similar results have been reported by other studies of damaged frontal lobes. People with damaged frontal lobes become less inhibited, impulsive and their moral judgments are not restrained by normal emotions. Their moral compass gets disconnected from their behavior.

Parts of association areas in the parietal lobes in Einstein’s brain were large and unusally shaped.They are responsible for mathematical and spatial reasoning. Another association area, on the underside of the right temporal lobe, enables us to recognize faces. If this area is destroyed due to injury or stroke, a person would be able to describe facial features and recognize gender and age of the other person but will be unable to identify the person.

The Brain's Plasticity:

The brain plasticity refers to the brain's ability to CHANGE throughout life. In addition to genetic factors, the environment in which a person lives, as well as the actions of that person, play a significant role in plasticity.

Brain plasticity occurs in the brain:

1- At the beginning of life: when the immature brain organizes itself.
2- In case of brain injury: to compensate for lost functions or maximize remaining functions.
3- Through adulthood: whenever something new is learned and memorized

Plasticity and brain injury:

When brain gets damaged, two things happen –

1. Damaged neurons usually do not regerate. If you get a cut on your skin, your skin cells regenerate and your wound gets healed, but that does not happen with neurons. If your spinal cord is severed, you would be paralyzed permanently.
2. Since brain functions seem to be preassigned to specific areas, if a newborn suffers damage to temporal lobe facial recognition areas, later on he will be unable to recognize faces.

However, there is a silver lining to this gloomy picture. Some neural tissues can reogarnize in response to damage. As mentioned above, the brain is constantly changing, building new pathways as it adjusts to minor mishaps and new experiences. In young children, palsticity can occur even after serious damage. But in order to reconnect, the neurons need to be stimulated through activity.

Constraint-Induced Therapy:

This therapy can be used to rewire the brain and improve the dexterity of a brain damaged child or adult stroke victim. In this therapy, therapists force patients to not to use their fully functioning limb and to use "bad" hand or leg. This gradually reprograms the brain. For example, a 50 year old surgeon had suffered a stroke. His left arm was paralyzed. During his rehabilitation, his good arm and hand were immobilized and he was asked to clean tables. At first, the task appeared to be impossible. Then slowly the bad arm remembered how to move. He learnt to write again, to play tennis again. The functions of the brain areas killed in the stroke were transferred themselves to healthy regions. (Doidge,2007).

Research has shown that blindness and deafness makes unused brain areas available for other uses. If a blind person uses one finger to read Braille, the brain area dedicated to that finger expands as the sense of touch invades the visual cortex that

normally helps people to see. Plasticity also explains why deaf people have enhanced peripheral vision. In those people whose native language is sign language only, the temporal area which is normally dedicated to hearing does not get any stimulation and finally it looks for other signals to process and starts processing signals from visual system.

Similarly, if a tumor in left hemisphere disrupts language, the right side hemisphere compensates. If a finger is amputated,the sensory cortex that was receiving input from this finger will start receiving input from the adjacent fingers, which then become more sensitive.

Neurogenesis:

Though brain tries to repair itself by reorganizing existing tissues, sometimes it tries to repair itself by generating new brain cells. This process is known as neurogenesis. It was long considered that the number of neurons was fixed and they did not replicate after maturity of the brain. But in 1990s, scientists discovered the process of neurogenesis in the brains of humans and some other animals such as rats, birds, monkeys. These baby neurons originate deep in the brain and then migrate to other parts of the brain to form connections with neighboring neurons. Master stem cells that can develop into any type of brain cell have been found in the human embryo. When stem cells from the brain are isolated and grown in a dish, they continuously divide and create large spherical masses of cells. If these cells are injected into a damaged brain, neural stem cells turn themselves into replacement for lost brain cells. This research gives hope for brain damaged people. However, there are number of behavioral, environmental, pharmacological and biochemical factors that affect this process. For example, exercise, sleep, nonstressful but stimulating environments, diet, etc. are natural promoters of neurogenesis. Studies have shown that Cardiovascular exercise such as running, interval training, cross fit and yoga are the single most effective ways of boosting neurogenesis. Diet plays an important role in brain health and neurogenesis. Excess refined sugar, refined and processed foods have a detrimental effect on the brain and should be avoided. Blueberries, green tea, spices and turmeric are supportive of neurogenesis. Meditation has been found to increase grey matter density in a number of different brain regions, including the hippocampus and is beneficial for neurogenesis.

4.3.3 Our divided brain; right-left differences in the intact brain

Split Brain:

As we have seen in above discussion, our brain has two same looking hemispheres – left and right hemisphere that serve different functions. These two hemispheres are joined together a

large band of neural fibers called corpus callosum. The corpus callosum carries the messages between the two hemispheres. In one research case, doctors removed this corpus callosum of a patient suffering from major epileptic seizures. The result of this operation was that seizures stopped and in spite of having split brain, there was no change in the personality intellect of the person with split brain.

Many more experiments were conducted to see the effect of cutting corpus callous. For instance, it has been found that -

a.) When split-brain patients are shown an image only in their left visual field (the left half of what both eyes take in, they cannot vocally name what they have seen. This can be explained in three steps: (1) The image seen in the left visual field is sent only to the right side of the brain; (2) For most people, the speech-control center is on the left side of the brain; and (3) Communication between the two sides of the brain is inhibited. Thus, the patient cannot say out loud the name of that which the right side of the brain is seeing.

b.) If a split-brain patient is touching a mysterious object with only the left hand, while also receiving no visual cues in the right visual field, the patient cannot say out loud the name of that which the right side of the brain is perceiving. This can be explained in three steps: (1) Each cerebral hemisphere contains only a tactile (connected with the sense of touch) representation of the opposite side of the body; (2) For most humans, the speech-control center is on the left side of the brain; and (3) Communication between the two sides of the brain is inhibited. In the case that the speech-control center is on the right side of the brain, the object must now be touched only with the right hand to achieve the same effect.

c.) Gazzaniga and Sperry's split-brain research is now legendary. They reported that in patients with split-brain syndrome the right hemisphere, which controls the left hand and foot, acts independently of the left hemisphere and the person’s ability to make rational decisions. This can give rise to a kind of split personality, in which the left hemisphere give orders that reflect the person’s rational goals, whereas the right hemisphere issues conflicting demands that reveal hidden desires. A few people who had undergone split-brain surgery experienced the unruly independence of their left and right hemisphere. So, while a patient’s left hand unbuttoned his shirt, his right hand buttoned it. In another case, a patient’s right hand picked up an item from the shelf and put it in the shopping basket while his left hand put that item back on the shelf. Sperry (1964) said,

split brain surgery leaves people with two separate minds. Both hemispheres can understand and follow an instruction simultaneously to copy different figures with the left and right hand.

d.) Gazzaniga's research found that the right hemisphere of the brain is poor at making inferences. On the other side, the developed human left hemisphere excels at inferences, constantly searching for patterns that can "make sense" of what is going on, bringing order out of chaos, and giving us answers to "why?" questions by discovering causes behind phenomena. Gazzaniga (1988) reported that when two minds are in conflict, the left hemisphere does mental gymnastics to rationalize reactions that it does not understand. For instance, if a patient follows an order sent to the right hemisphere ("walk"). Unaware of the order, the left hemisphere does not know why the patient began walking. Yet, when asked why was he walking, instead of saying "I don't know", due to interpretive left hemisphere, the patient improvised and said, "I am going into the house to get a Coke". This indicates that conscious left hemisphere is an interpreter that instantly constructs theories to explain our behavior.

Right-Left Differences in the Intact Brain:

Myers points out that research with people with split brains and people with intact brains shows that we have unified brains with specialized parts.Thus, if we observe the two hemispheres without optical aids (with the naked eye), they may seem to be the same; however, their differential functioning combines to produce an integrated unit (the harmony of the whole). People with intact brain also show left-right hemisphere differences in mental abilities.

The left hemisphere: It is more responsible for language than the right hemisphere. If you inject a sedative into the left hemisphere, you will lose the ability to speak. This is also the case for those who rely on sign language. Just as hearing people use the left hemisphere to process speech, deaf people use the left hemisphere to process sign language. If left hemisphere is damaged, it will disrupt a deaf person's signing just as it would disrupt a hearing person's speaking.

The left hemisphere is better with literal interpretations of language, e.g., when primed with the word foot, the left hemisphere is more likely to recognize the connected word, heel.

The right hemisphere: It is better at making inferences, for example, when primed with the words foot, cry and glass, the right hemisphere is more likely to recognize "cut" as the associated word. Rights hemisphere helps -

a.) create our sense of self
b.) helps us to modulate our speech to make meaning clear
People with damage to this region might:
a.) Insist they can move a limb that is paralyzed

b.) Have a hard time determining someone's relationship to themselves, e.g., A man who thought medical professionals were his family members

c.) Might not recognize themselves in mirror

d.) Might assign ownership of a limb to someone else, e.g., "That's my husband's arm"

In short, we can compare left hemisphere with right hemisphere by saying that in a normal individual

Left Brain people:

1. Right brain is engaged while completing a perceptual task and left brain is involved when carrying out a linguistic task.
2. Left brain individuals are rational, respond to verbal instructions, process information in a controlled, systematic,linear manner. They solve problem logically and sequentially looking at the parts of things, makes objective judgments.
3. Left brain persons are list makers. They enjoy making a master schedule and doing daily planning. They have no trouble processing symbols, memorizing vocabulary words and math formulas.
4. Analytic reader
5. Primary reliance on language in thinking and remembering
6. Prefers talking and writing
7. Prefers multiple choice test
8. Controls feelings
9. Prefers hierarchical authority structures
10. Talks, and talks, and talks
11. Sees cause and effect
12. Draws on previously accumulated, organized information

Right Brain People:

1. Right brain people process from a whole to a part, holistically. They have difficulty in following a lecture unless they are given the big picture first.

2. They are color sensitive. They try using colors to establish sequences.

3. They are concrete. They want to see, feel, or touch the real object.Right brain individuals need to back up everything visually. They Responds to demonstrated instructions.

4. They may have trouble learning to read using phonics.They may know what they mean but often have trouble finding the right words.

5. They prefer to see words in context and to see how formulas work. They learn better with hands on activities.

6. They are intuitive. They may know the right answer to a problem, but are not sure how they got it.On a quiz, they have a gut feeling as to which answers are correct, and they are usually right. They solve problems with hunches, looking for patterns and they make subjective judgments.

7. The right side of the brain pays attention to coherence and meaning, tells you if it “feels” right.

8. When giving directions, they use their hands and give names of places along the way.

4.4 CLOSE-UP - HANDEDNESS

Handedness refers to individual preference for use of a hand, known as dominant hand. An individual gives better performance with his dominant hand. The less preferred or less capable hand is called the nondominant hand. There are three types of handedness - right-handedness, left handedness and mixed handedness. It is well known fact that almost 90% of human beings are primarily right-handed and only 10% of us (more among males and less among females) are primarily left handed. There are few who use both their hands for different activities, e.g., they may write with right hand and eat with left hand. It has been found that almost all right handers process speech in the left hemisphere and their left hemisphere is slightly larger than their right hemisphere. Left handers are more diverse. Most of them process speech in the left hemisphere only, but some process language in right hemisphere or use both hemispheres.

It has been observed that right-handedness is common in all human cultures and even in monkeys and apes. In fact, right-handedness appears before the influence of culture takes place, e.g., 9 out of 10 fetuses suck the right hand’s thumb. This universal prevalence of right-handedness in humans and other primates suggests that either genes or some prenatal factors are responsible for right-handedness.

In general, people think that it is not right to be left-handed. Studies have shown mixed results for deciding whether being right handed is better or left handed. It has been found that people with reading disabilities, allergies and migraine headaches are mostly left-handed. On the other hand, studies have also reported that left handedness is more common among musicians, mathematicians, professional baseball and cricket players, artists and architects. In Iran, left handed students taking university entrance exam outperformed righties in all subjects (Noroozian et.al.,2003). So, it is difficult to say being right handed is better than being left-handed.

4.5 CHECK YOUR PROGRESS:

Write short notes on

a.) The Brainstem
b.) Pituitary gland
c.) The Hypothalamus
d.) MRI & fMRI
e.) Importance of association cortex
f.) Brain Plasticity
g.) Handedness

4.6 SUMMARY:

In this unit, we have seen that everything psychological is simultaneously biological. We began with looking at the impact of endocrine system. It influences our bodily growth, helps in facing challenges and influences our emotions. We also looked at brain and its complexities. To understand brain, we used techniques like EEG, MRI, PET.

We have old brain consisting of brain stem, the thalamus, the reticular formation and the cerebellum. Between new brain parts and old brain parts lies limbic system. The limbic system contains the amygdala, the hypothalamus and the hippocampus. The new brain is the highest part of our brain and consists of cerebral cortex. The cortex has two hemispheres and four lobes. These two hemispheres are connected with each other with corpus callosum. Even though both hemispheres have different distinct functions, they work in tandem and if one part is damaged, the other part takes over its functions. So, we have brain plasticity. We also read about how our personality changes if our frontal lobes are damaged, that epileptic seizures can be stopped by splitting brain. We studied what kind of difficulties are faced by split brain individuals and what is the difference between right and left hemisphere. Finally, we also looked at how handedness influences our behavior. That means how left-handed people are different from right handed people. I hope you enjoyed knowing about the marvel called brain.

4.7 QUESTIONS:

1. How does the endocrine system transmit information and interact with the nervous system?
2. What structures make up the brainstem, and what are the functions of the brainstem, thalamus, and cerebellum?
3. What are the limbic system's structure and functions?
4. What are the functions of the various cerebral cortex regions?
5. Write a detailed note on brain plasticity.
6. What do split brains reveal about the functions of our two brain hemispheres?

4.8 REFERENCE:

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Unit -5

LEARNING-I

Unit Structure :

5.0 OBJECTIVES:

After studying the unit you must be able

- Define learning and understand its characteristics.
- Highlight the main aspects in Classical Conditioning theory.
- Highlight the main aspects in Operant Conditioning theory.
- Compare the Classical Conditioning theory and Operant Conditioning theory of learning.

5.1 INTRODUCTION: HOW DO WE LEARN?

Learning is perhaps one of the most important human abilities. You might think of learning in terms of what you need to do before an upcoming exam, the knowledge that you take away from your classes, or new skills that you acquire through practice, these changes represent only one component of learning. In fact, learning is a very broad topic that is used to explain not only how we acquire new knowledge and behavior but also a wide variety of other psychological processes including the development of both appropriate and inappropriate social behaviors. Learning allows us

to create effective lives by being able to respond to changes. We learn to avoid touching hot stoves, to find our way home from school, and to remember which people have helped us in the past and which people have been unkind. Without the ability to learn from our experiences, our lives would be remarkably dangerous and inefficient. The principles of learning can also be used to explain a wide variety of social interactions, including social dilemmas in which people make important, and often selfish, decisions about how to behave by calculating the costs and benefits of different outcomes. Learning encompasses everything we do and think. It plays a central role in the language we speak, our thoughts, our attitudes, our beliefs, our goals and our personality traits which could be adaptive or maladaptive. Post this chapter you will be in position to understand how learning plays an important role in many of the psychological processes.

5.1.1 Learning:

Kimble defined learning as a "more or less permanent change in behaviour potentiality, which occurs as a result of repeated practice." Learning can be defined as any relatively permanent change in knowledge or behaviour that occurs as result of practice or experience. This definition has some important components.

1) Learning is a change in behavior for better or worse.
2) It is a change that takes place through practice or experience.
3) Changes due to growth or maturation are not learning.
4) Before it can be called learning, the change must be relatively permanent and it must last a fairly long time.
5) This change may not be evident until a situation arises in which the new behavior can occur.

5.1.2 Characteristics of learning:

1) Learning is a constant modification of behavior that continues throughout life.
2) Learning is dependent upon one's innate intelligence and other capabilities.
3) Learning is not possible without the basic minimum ability needed to learn a task. As the nature of the task becomes complex, so does the requirement for higher abilities.
4) Learning is developmental, time being one of its dimensions. Learning is related to maturation too. The maturity of the individual is an important factor in learning.
5) Environmental aspects of learning like opportunities as well as facilities to learn are also important.

6) What is learned need not be “correct” or adaptive. We learn good habits as well as bad. Learning need not always involve any overt manifestations. Attitudes and emotions can be learnt as well.
7) Learning involves the whole person, socially, emotionally and intellectually. Interest and learning are positively related. The individual learns best those things, which he is interested in learning. Most kids find learning to play games easier than learning to find square root of numbers.
8) Learning is responsive to incentives. In most cases positive incentives such as reward are most effective than negative incentives such as punishments.
9) Learning is always concerned with goals. These goals can be expressed in terms of observable behaviour.

Thus, it is apparent that learning goes on with life and the process of life. It is all pervasive, reaching into various aspects of human life. You learn at each moment of your life.

Philosophers from Aristotle to David Hume were of the opinion that we, human beings learn through association. Our mind naturally connects events that occur in sequence. Learned associations often operate subtly. Learned associations also feed our habitual behavior. As we repeat behaviors in a given context, the behavior becomes associated with the context, e.g., drinking tea in the morning. Our next experience of the context then evokes our habitual response, e.g., the moment we get up in the morning, by habit we want to have tea. Studies have shown that on an average, a particular behavior becomes part of our habits if it takes place consistently for 66 days.

Even other animals learn through association. This is known as associative learning. The process of learning associations is called conditioning. There are two forms of associative learning –

1. Classical Conditioning
2. Operant Conditioning

Let us see both these forms of associative learnings in detail.

5.2 CLASSICAL CONDITIONING

In the early part of the 20th century, Russian physiologist Ivan Pavlov (1849–1936) was studying the digestive system of dogs when he noticed an interesting behavioral phenomenon: The dogs began to salivate when the lab technicians who normally fed them entered the room, even though the dogs had not yet received any food. Pavlov realized that the dogs were salivating because they knew that they were about to be fed; the dogs had begun to

associate the arrival of the technicians with the food that soon followed after their appearance in the room. With his team of researchers, Pavlov began studying this process in more detail.

5.2.1. Pavlov's Experiment:

He conducted a series of experiments in which, over a number of trials, dogs were exposed to a sound immediately before receiving food. He systematically controlled the onset of the sound and the timing of the delivery of the food, and recorded the amount of the dog's salivation. Initially the dogs salivated only when they saw or smelled the food, but after several pairings of the sound and the food, the dogs began to salivate as soon as they heard the sound. The animals had learned to associate the sound with the food that followed.

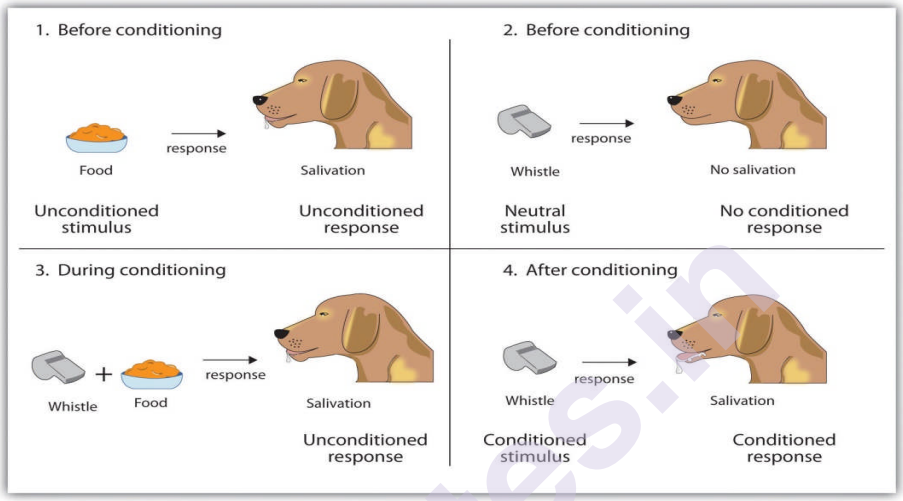
Pavlov had identified a fundamental associative learning process called classical conditioning. Classical conditioning refers to learning that occurs when a neutral stimulus (e.g., a tone) becomes associated with a stimulus (e.g., food) that naturally produces a behavior. After the association is learned, the previously neutral stimulus is sufficient to produce the behavior.

As you can see in the Figure below "Panel Image of Whistle and Dog", psychologists use specific terms to identify the stimuli and the responses in classical conditioning. The unconditioned stimulus (US) is something (such as food) that triggers a naturally occurring response, and the unconditioned response (UR) is the naturally occurring response (such as salivation) that follows the unconditioned stimulus. The conditioned stimulus (CS) is a neutral stimulus that, after being repeatedly presented prior to the unconditioned stimulus, evokes a similar response as the unconditioned stimulus. In Pavlov's experiment, the sound of the tone served as the conditioned stimulus that, after learning, produced the conditioned response (CR), which is the acquired response to the formerly neutral stimulus. Note that the UR and the CR are the same behavior—in this case salivation—but they are given different names because they are produced by different stimuli (the US and the CS, respectively).

Top left: Before conditioning; the unconditioned stimulus (US) naturally produces the unconditioned response (UR). Top right: Before conditioning, the neutral stimulus (the whistle) does not produce the salivation response. Bottom left: The unconditioned stimulus (US), in this case the food, is repeatedly presented immediately after the neutral stimulus. Bottom right: After learning, the neutral stimulus (now known as the conditioned stimulus or CS), is sufficient to produce the conditioned responses (CR).

Conditioning is evolutionarily beneficial because it allows organisms to develop expectations that help them prepare for both good and bad events. Imagine, for instance, that an animal first smells new food, eats it, and then gets sick. If the animal can learn to associate the smell (CS) with the food (US), then it will quickly learn that the food that has bad smell creates the negative outcome, and will not eat it the next time.

Figure5.5.1.: Panel Image of Whistle and Dog (Classical Conditioning)



Key Elements in Classical Conditioning Model:

Pavlov identified four key elements in his classical conditioning model:

1) **Conditioned stimulus (CS):** An originally irrelevant stimulus that, after association with an unconditioned stimulus (US), comes to trigger a conditioned response.
2) **Conditioned response (CR):** The learned response to conditioned stimulus is called Conditioned response.
3) **Unconditioned stimulus (US):** A stimulus that unconditionally—naturally and automatically—triggers a response.
4) **Unconditioned response (UR):** The original response to the unconditioned stimulus is called unconditioned response, such as salivation when food is in the mouth.

Conditioning Processes:

Pavlov and his associates explored five major conditioning processes: acquisition, extinction, spontaneous recovery, generalization and discrimination.

1) Acquisition:

Association between conditioned stimulus and an unconditioned stimulus is called acquisition. In simple words, the conditioned stimulus and the unconditioned stimulus are repeatedly paired together and behavior increases. Acquisition is also called initial learning of stimulus response relationship. Timing is an important factor in acquisition. Pavlov found that the time lapse between presenting neutral stimulus and unconditioned stimulus should not be more than half a second.

Another important point in acquisition is the sequence. Conditioning will not occur if unconditioned stimulus appears before neutral stimulus. This is because classical conditioning is biologically adaptive. It helps humans and animals to prepare for good or bad events, e.g. , in Pavlov's experiment , for the dog , the originally neutral stimulus becomes conditioned stimulus after signaling an important biological event- the arrival of food. If instead of food , something else, such as a flower was presented, the conditioning would have not taken place. If food was presented before presenting sounding the bell, even then conditioning would not have taken place, because the sound of bell does not help dog. It can be concluded that 'conditioning helps an animal survive and reproduce- by responding to cues that help in gaining food, avoid danger, locate mates and produce offspring.(Hollis, 1997)

2) Extinction:

Extinction refers to the repeated presentation of the conditioned stimulus without unconditioned stimulus following it. In other words, the unconditioned stimulus is repeatedly presented. This results in conditioned response decreasing gradually. For example, if buzzer is presented again and again without presenting food, dog will gradually stop salivating to the buzzer.

3) Spontaneous recovery:

After a pause, when the CS is again presented alone, the behavior may occur again, though in weaker form, and then again show extinction. The increase in responding to the CS following a pause after extinction is known as spontaneous recovery.

4) Generalization:

Generalization refers to the tendency to respond to stimuli that resemble the original conditioned stimulus. For example, dog will salivate to the sounds of bell, buzzer, etc. The ability to generalize has important evolutionary significance. If we eat some red berries and they make us sick, it would be a good idea to think twice before we eat some purple berries. Although the berries are not exactly the same, they nevertheless are similar and may have the same negative properties.

Researchers have also found that we like unfamiliar people more if they look somewhat like someone we have learned to like. These examples show that people's emotional reactions to one stimulus have generalized to another similar stimuli.

5) Discrimination:

The tendency to respond differently to stimuli that are similar but not identical. Organisms must also learn that many stimuli that are perceived as similar are functionally different and they have to respond adaptively to each. This learned ability to distinguish between a conditioned stimulus and other irrelevant stimuli is called discrimination. For example, dog could learn to distinguish between different sounds of buzzer depending upon which sound was followed by unconditioned stimulus (food).

6) Second-order Conditioning:

An existing conditioned stimulus can serve as an unconditioned stimulus for a pairing with a new conditioned stimulus, this process is known as second-order conditioning. (provide an example)

Laws of Classical (Pavlovian) conditioning:

There are three basic laws in classical conditioning. Complete information about the laws are given below.

1) Law of Excitation:

It says that if a previously neutral CS is paired with the UCS, the CS acquires excitatory properties. That is, it acquires the properties of eliciting the CR.

2) Law of Internal Inhibition:

Internal inhibition develops when the conditioned stimulus is not attended by the unconditioned, whether this is once or always, but in the latter event only under certain circumstances. This law characterized a group inhibition phenomenon which are caused by change in the conditioned association itself and unlike the various forms of unconditional inhibition are acquired in learning process.

3) Law of External Inhibition:

In essence, this law states that excitatory or inhibitory process in the conditioning can be disrupted by novel distracting stimuli. This is called law of external inhibition since the inhibition is not being acquired in the learning process but from outside.

5.2.2. Pavlov's legacy:

Most psychologists agree that classical conditioning is a basic form of learning. If we judged by today's knowledge of cognitive processes and biological predispositions, Pavlov's ideas were incomplete. But if we see further than Pavlov did, it is because

we stand on his shoulders. Why does Pavlov's work remain so important? If he had merely taught us that old dogs can learn new tricks, his experiments would long ago have been forgotten. Why should we care that dogs can be conditioned to salivate at the sound of a tone? The importance lies first in this finding: Many other responses to many other stimuli can be classically conditioned in many other organisms—in fact, in every species tested, from earthworms to fish to dogs to monkeys to people (Schwartz, 1984). You have to put in mind that subsequent studies have found out that the principle made with the dog is applicable to all types of species including us, human beings. Through Pavlov's work we were able to find out that a process such as learning can be studied objectively. For instance Doctor's use Classical conditioning to cure patients. Patients easily get cured by sugar water because they believed their doctor gave them the proper medication.

Thus, classical conditionings one way that virtually all organisms learn to adapt to their environment. Second, Pavlov showed us how a process such as learning can be studied objectively. He was proud that his methods involved virtually no subjective judgments or guesses about what went on in a dog's mind. The salivary response is a behavior measurable in cubic centimeters of saliva. Pavlov's success therefore suggested a scientific model for how the young discipline of psychology might proceed—by isolating the basic building blocks of complex behaviors and studying them with objective laboratory procedures. These approaches made him one of the leaders in behaviorism and behavior psychology

5.3 OPERANT CONDITIONING

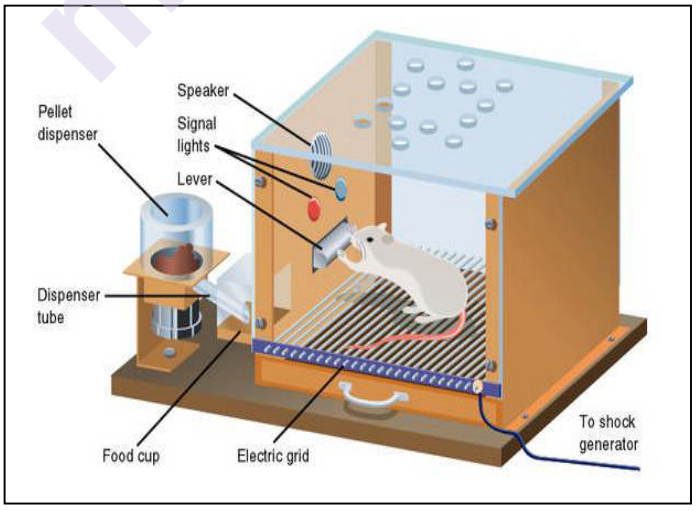
Psychologist Edward L. Thorndike (1874–1949) was the first scientist to systematically study operant conditioning. In his research Thorndike (1898) observed cats that had been placed in a "puzzle box" from which they tried to escape. At first the cats scratched, bit, and swatted haphazardly, without any idea of how to get out. But eventually, and accidentally, they pressed the lever that opened the door and exited to their prize, a scrap of fish. The next time the cat was constrained within the box, it attempted fewer of the ineffective responses before carrying out the successful escape, and after several trials the cat learned to almost immediately make the correct response. Observing these changes in the cat's behavior led Thorndike to develop his law of effect, the principle that responses that create a typically pleasant outcome in a particular situation are more likely to occur again in a similar situation, whereas responses that produce a typically unpleasant outcome are less likely to occur again in the situation (Thorndike, 1911). The essence of the law of effect is that successful

responses, because they are pleasurable, are stamped in by experience and thus occur more frequently. Unsuccessful responses, which produce unpleasant experiences, are stamped out and subsequently occur less frequently.

5.3.1 Skinner's Experiment:

Instrumental conditioning is sometimes also, roughly speaking called as operant conditioning. This term was coined by B.F. Skinner. The influential behavioral psychologist B. F. Skinner (1904–1990) expanded on Thorndike's ideas to develop a more complete set of principles to explain operant conditioning. Skinner created specially designed environments known as operant chambers (usually called Skinner boxes) to systemically study learning. A Skinner box (operant chamber) is a structure that is big enough to accommodate a rodent or bird and that contains a bar or key that the organism can press or peck to release food or water. It also contains a device to record the animal's responses. The most basic of Skinner's experiments were quite similar to Thorndike's research with cats. A rat placed in the chamber reacted as one might expect, scurrying about the box and sniffing and clawing at the floor and walls. Eventually the rat chanced upon a lever, which it pressed to release pellets of food. The next time around, the rat took a little less time to press the lever, and on successive trials, the time it took to press the lever became shorter and shorter. Soon the rat was pressing the lever as fast as it could eat the food that appeared. As predicted by the law of effect, the rat had learned to repeat the action that brought about the food and cease the actions that did not.

Figure 5.2: Skinners Experimental Box



Skinner studied, in detail, how animals changed their behavior through reinforcement and punishment, and he developed terms that explained the processes of operant learning. Skinner

used the term rein forcer to refer to any event that strengthens or increases the likelihood of a behavior and the term punisher to refer to any event that weakens or decreases the likelihood of a behavior. What is reinforcing depends on the animal and the conditions. For people, it may be praise, attention while for a hungry rat it may be food.

Types of Reinforcers:

He used the terms positive and negative to refer to whether a reinforcement was presented or removed, respectively.

1. Positive reinforcement strengthens a response by presenting something pleasant after the response.

2. Negative reinforcement strengthens a response by reducing or removing something unpleasant. For example, giving a child praise for completing his homework represents positive reinforcement, whereas taking aspirin to reduce the pain of a headache represents negative reinforcement. In both cases, the reinforcement makes it more likely that behavior will occur again in the future.

Difference Between Negative Reinforcement and Punishment:

Reinforcement, either positive or negative, works by increasing the likelihood of a behavior. Punishment, on the other hand, refers to any event that weakens or reduces the likelihood of a behavior. Positive punishment weakens a response by presenting something unpleasant after the undesirable response, whereas negative punishment weakens a response by reducing or removing something pleasant. A child who is grounded after fighting with a sibling (positive punishment) or who loses out on the opportunity to go to recess after getting a poor grade (negative punishment) is less likely to repeat these behaviors.

Although the distinction between reinforcement (which increases behavior) and punishment (which decreases it) is usually clear, in some cases it is difficult to determine whether a reinforcer is positive or negative. On a hot day, a cool breeze could be seen as a positive reinforcer (because it brings in cool air) or a negative reinforcer (because it removes hot air). In other cases, reinforcement can be both positive and negative. One may smoke a cigarette both because it brings pleasure (positive reinforcement) and because it eliminates the craving for nicotine (negative reinforcement).

Table 5..1: How Positive and Negative Reinforcement and Punishment Influence Behavior.

Operant conditioning term	Description	Outcome	Example
Positive reinforcement	Add or increase a pleasant stimulus	Behavior is strengthened	Giving a student a prize after he gets an A on a test.
Negative reinforcement	Reduce or remove an unpleasant stimulus	Behavior is strengthened	Taking painkillers that eliminate pain increases the likelihood that you will take painkillers again.
Positive punishment	Present or add an unpleasant stimulus	Behavior is weakened	Giving a student extra homework after she misbehaves in class.
Negative Punishment	Reduce or remove a pleasant stimulus	Behavior is Weakened	Taking away a teen‘s computer after he misses curfew.

It is also important to note that reinforcement and punishment are not simply opposites. The use of positive reinforcement in changing behavior is almost always more effective than using punishment. This is because positive reinforcement makes the person or animal feel better, helping create a positive relationship with the person providing the reinforcement. Types of positive reinforcement that are effective in everyday life include verbal praise or approval, the awarding of status or prestige, and direct financial payment. Punishment, on the other hand, is more likely to create only temporary changes in behavior because it is based on coercion and typically creates a negative and adversarial relationship with the person providing the reinforcement. When the person who provides the punishment leaves the situation, the unwanted behavior is likely to return. Reinforcement helps to increase a behavior, while punishment helps to decrease a behavior. Reinforcers and punishers have different types of consequences.

3. Primary reinforcers: Such as food, water, and caresses, are naturally satisfying.

Primary punishers: such as pain and freezing temperatures, are naturally unpleasant.

4. Secondary reinforcers: Such as money, fast cars, and good grades, are satisfying because they've become associated with primary reinforcers.

Secondary punishers: such as failing grades and social disapproval, are unpleasant because they've become associated with primary punishers.

Secondary reinforcers and punishers are also called conditioned reinforcers and punishers because they arise through classical conditioning. Most real-world reinforcers are not continuous; they occur on a partial (or intermittent) reinforcement schedule—a schedule in which the responses are sometimes reinforced, and sometimes not. In comparison to continuous reinforcement, partial reinforcement schedules lead to slower initial learning, but they also lead to greater resistance to extinction. Because the reinforcement does not appear after every behavior, it takes longer for the learner to determine that the reward is no longer coming, and thus extinction is slower. The four types of partial reinforcement schedules are summarized in below table.

5. Immediate & Delayed Reinforcers: Unlike other animals, humans do respond to delayed reinforcers, for example, the salary at the end of the month, good marks at the end of the exam, trophy at the end of the series of game, etc. To function effectively, human beings need to learn to delay gratification. Experimental studies have shown that even four-year kids show this ability to delay gratification. While choosing a candy, they prefer having a big reward next day rather than eating a small candy today. Children who learn to delay gratification tend to become socially more competent and high-achieving adults.

Shaping

Perhaps you remember watching a movie or being at a show in which an animal—maybe a dog, a horse, or a dolphin—did some pretty amazing things. The trainer gave a command and the dolphin swam to the bottom of the pool, picked up a ring on its nose, jumped out of the water through a hoop in the air, dived again to the bottom of the pool, picked up another ring, and then took both of the rings to the trainer at the edge of the pool. The animal was trained to do the trick, and the principles of operant conditioning were used to train it. The question arises how they learn such complex behaviors. The answer is that it takes place through the

concept of shaping in operant conditioning. Skinner said that in everyday life, we continuously reinforce and shape others' behaviour.

Shaping is based on the method of successive approximation. That is to begin with a person/animal is rewarded or given positive reinforcement even if the response is in the direction of right response and not exactly the right response. Gradually, rewarding responses that are ever-closer to the final desired behavior and ignore all other responses. For example, suppose a trainer wants a rat to learn to press the lever to get the food. In initial stages, the trainer will reward the rat with food even if rat moves in the direction of the lever. Once the rat starts regularly being close to bar, the food will be given only when it moves closer to the lever. Once, the rat regularly remains closer to lever, then food will be given only when it presses the lever. Thus, rat can be trained to press the lever by rewarding it for each step in the right direction. This method is used by human beings and animal trainers alike.

Reinforcement Schedules:

One way to expand the use of operant learning is to modify the schedule on which the reinforcement is applied. To this point we have only discussed a continuous reinforcement schedule, in which the desired response is reinforced every time it occurs; whenever the dog rolls over, for instance, it gets a biscuit. Continuous reinforcement results in relatively fast learning but also rapid extinction of the desired behavior once the reinforcer disappears. The problem is that because the organism is used to receiving the reinforcement after every behavior, the responder may give up quickly when it doesn't appear.

Table5. 2: Reinforcement Schedules.

Reinforcement schedule	Explanation	Real-world example
Fixed-ratio Schedule	Behavior is reinforced after a specific number of responses.	Factory workers who are paid according to the number of products they produce.
Variable-ratio Schedule	Behavior is reinforced after an average, but unpredictable, number of responses.	Payoffs from slot machines and other games of chance.

Fixed-interval Schedule	Behavior is reinforced for the first response after a specific amount of time has passed.	People who earn a monthly salary.
Variable-interval Schedule	Behavior is reinforced for the first response after an average, but unpredictable, amount of time has passed.	Person who checks voice mail for messages.

Partial reinforcement schedules are determined by whether the reinforcement is presented on the basis of the time that elapses between reinforcement (interval) or on the basis of the number of responses that the organism engages in (ratio), and by whether the reinforcement occurs on a regular (fixed) or unpredictable (variable) schedule. In a fixed-interval schedule, reinforcement occurs for the first response made after a specific amount of time has passed. For instance, on a one-minute fixed-interval schedule the animal receives a reinforcement every minute, assuming it engages in the behavior at least once during the minute. Animals under fixed-interval schedules tend to slow down their responding immediately after the reinforcement but then increase the behavior again as the time of the next reinforcement gets closer. (Most students study for exams the same way). In a variable-interval schedule the reinforcers appear on an interval schedule, but the timing is varied around the average interval, making the actual appearance of the reinforcer unpredictable. An example might be checking your e-mail: You are reinforced by receiving messages that come, on average, say every 30 minutes, but the reinforcement occurs only at random times.

Interval reinforcement schedules tend to produce slow and steady rates of responding. In a fixed-ratio schedule, a behavior is reinforced after a specific number of responses. For instance, a rat‘s behavior may be reinforced after it has pressed a key 20 times, or a salesperson may receive a bonus after she has sold 10 products. Animals trained under “Different Partial Reinforcement Schedules", once the organism has learned to act in accordance with the fixed-reinforcement schedule, it will pause only briefly when reinforcement occurs before returning to a high level of responsiveness. A variable-ratio schedule provides reinforcers after a specific but average number of responses. Winning money from slot machines or a lottery ticket are examples of reinforcement that

occur on a variable-ratio schedule. For instance, a slot machine may be programmed to provide a win every 20 times the user pulls the handle, on average. Ratio schedules tend to produce high rates of responding because reinforcement increases as the number of responses increase.

5.3.2 Skinner's legacy:

B. F. Skinner was known as one of the most intellectual psychologist in the late twentieth century. He repeatedly insisted that external influences shape behavior. According to him, internal thoughts and feelings don't shape behaviour. He counseled people to use operant conditioning principles to influence others' behavior. He said we should use rewards to evoke more desirable behavior.

According to Skinner external consequences already haphazardly control people's behavior. Why not administer those consequences toward human betterment? Wouldn't reinforcers be more humane than the punishments used in homes, schools, and prisons? And if it is humbling to think that our history has shaped us, doesn't this very idea also give us hope that we can shape our future? The operant conditioning principles are used considerably in variety of situations. Reinforcement technologies are also work in schools, businesses and homes.

5.4. CONTRASTING CLASSICAL AND OPERANT CONDITIONING

As we have seen, both classical and operant conditionings involve associative learning i.e., the establishment of a relationship between two events. Each learning process produces a new behaviour. Some of the differences between operant and classical conditioning lie in the extent to which reinforcement depends on the behavior of the learner. In classical conditioning, the learner is automatically reinforced. That is how it learns to respond to a once neutral stimulus. In operant conditioning, the learner must provide a correct response in order to receive the reinforcement. Another difference between the two forms of conditioning is the type of behavior to which each method applies. Classical conditioning applies to a behavior that is always wanted. In operant conditioning, a behavior can be learned or extinguished. If you want to train a dog not to do something, you would use a form of punishment. In essence, then in the operant model the learner actively operates on his environment i.e., emits the response while under the classical model the learner simply responds to the environment i.e., the response is elicited from him/her. Classical and operant conditioning are similar, but they do differ in a few ways. Both are fairly reliable ways to teach an organism to act in a specific manner and modify behaviour.

5.5. SUMMARY

In this unit we began by explaining the concept of learning, characteristics of learning and types of learning. We then explained Pavlov's Classical Conditioning theory through experiments. In classical conditioning theory we have studied elements of classical conditioning and different laws of classical conditioning. Following this we have studied operant conditioning theory. Different elements of operant conditioning were explained. In operant conditioning we have also studied concepts like positive reinforcement, negative reinforcement, positive punishment, negative punishment. We have also studied complex behaviors through operant conditioning. Following this we explained the different types of reinforcers (primary reinforcers, secondary reinforcers, primary punishers, secondary punishers) and different types of reinforcement schedules such as Fixed-ratio Schedule, Variable-ratio Schedule, Fixed-interval Schedule and Variable-interval Schedule. Towards the end of the unit we have compared the concepts of classical conditioning and operant conditioning.

5.6. QUESTIONS

a) What is learning? Discuss in details.
b) Explain Operant Conditioning theory?
c) Explain Classical Conditioning theory?
d) Discuss different concepts in Classical Conditioning?
e) Discuss different concepts in Operant Conditioning?
f) What is difference between Classical Conditioning theory and Operant Conditioning theory?

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Unit -6

LEARNING - II

Unit Structure :

6.0 OBJECTIVES

Dear students! Just to refresh your memory, from the previous chapter you must have a fair idea about the nature of learning, factors affecting learning, classical and operant conditioning and their implications in human life. In this unit you will be learning about Cognitive approaches to learning. At the completion of this unit you will be able to

- Explain the relationship between Biology, Cognition, and Learning.
- Highlight Biological constraints on conditioning and cognition's influence on conditioning
- Understand observational learning.
- Explore the Effects of Violence on Aggression.

6.1 INTRODUCTION: BIOLOGY, COGNITION, AND LEARNING

In previous chapter, we have studied classical conditioning and operant conditioning in details. As you have seen in the previous unit, behavioural psychologists emphasize changes in behaviour as the outcome of learning. They are concerned with the effects of external events on the individual's responses. In contrast, Cognitive psychologists say that learning itself is an internal

process that cannot be observed directly. The change occurs in a person's ability to respond to a particular situation. The change in behaviour is only a reflection of the internal change. Interestingly both behaviorism and cognitivism began as opposition to structuralism of Wundt. Wilhelm Wundt, who set up the first experimental psychology laboratory in Europe around 1879, was looking for the basic elements in psychology- the smallest parts of analyzable consciousness analogous with the Physics' atomic theory of matter. Wundt thought that by analyzing consciousness into tiny elements or 'atoms' he would make Psychology as respectable a science as Physics! Wundt, using the technique of introspection trained his subjects to look within themselves and report all of their most fleeting and minute feelings and sensations. We will discuss in detail how biology and cognition influences learning in next two topics.

6.1.1 Biological constraints on conditioning:

The school of behaviorism was born under the impetus of John B. Watson. Watson was very much influenced by Ivan Pavlov's work. Questioning Wundt's attempt to analyze consciousness into all its basic parts, Watson insisted on objectivity and he considered only behaviour that consisted of observable stimuli and response to be worthy of investigations.

Ever since Charles Darwin, scientists have assumed that all animals share a common evolutionary history and thus commonalities in their makeup and functioning. Pavlov and Watson, for example, believed the basic laws of learning were essentially similar in all animals. So it should make little difference whether one studied pigeons or people. Moreover, it seemed that any natural response could be conditioned to any neutral stimulus. As learning researcher Gregory Kimble proclaimed in 1956, "Just about any activity of which the organism is capable can be conditioned and . . . these responses can be conditioned to any stimulus that the organism can perceive."

Twenty-five years later, Kimble (1981) humbly acknowledged that "half a thousand" scientific reports had proven him wrong. More than the early behaviorists realized, an animal's capacity for conditioning is constrained by its biology. Each species' predispositions prepare it to learn the associations that enhance its survival. Environments are not the whole story.

John Garcia was among those who challenged the prevailing idea that all associations can be learned equally well. While researching the effects of radiation on laboratory animals, Garcia and Robert Koelling (1966) noticed that rats began to avoid drinking water from the plastic bottles in radiation chambers. Could classical conditioning be the culprit? Might the rats have linked the plastic-

tasting water (a CS) to the sickness (UR) triggered by the radiation (US)? To test their hunch, Garcia and Koelling gave the rats a particular taste, sight, or sound (CS) and later also gave them radiation or drugs (US) that led to nausea and vomiting (UR).

Two surprising findings emerged: First, even if sickened as late as several hours after tasting a particular novel flavor, the rats thereafter avoided that flavor. This appeared to violate the notion that for conditioning to occur, the US must immediately follow the CS. Second, the sickened rats developed aversions to tastes but not to sights or sounds. This contradicted the behaviorists' idea that any perceivable stimulus could serve as a CS. But it made adaptive sense, because for rats the easiest way to identify tainted food is to taste it. (If sickened after sampling a new food, they thereafter avoid the food—which makes it difficult to eradicate a population of "bait-shy" rats by poisoning.)

Humans, too, seem biologically prepared to learn some associations rather than others. If you become violently ill four hours after eating contaminated mussels, you will probably develop an aversion to the taste of mussels but not to the sight of the associated restaurant, its plates, the people you were with, or the music you heard there. In contrast, birds, which hunt by sight, appear biologically primed to develop aversions to the sight of tainted food (Nicolaus et al., 1983). Organisms are predisposed to learn associations that help them adapt.

The discovery of biological constraints affirms the value of different levels of analysis, including the biological and cognitive, when we seek to understand phenomena such as learning. And once again, we see an important principle at work: Learning enables animals to adapt to their environments. Responding to stimuli that announce significant events, such as food or pain, is adaptive. So is a genetic predisposition to associate a CS with a US that follows predictably and immediately: Causes often immediately precede effects. Often, but not always, as we saw in the taste-aversion findings. Adaptation also sheds light on this exception. The ability to discern that effect need not follow cause immediately—that poisoned food can cause sickness quite a while after it has been eaten—gives animals an adaptive advantage. Occasionally, however, our predispositions trick us. When chemotherapy triggers nausea and vomiting more than an hour following treatment, cancer patients may over time develop classically conditioned nausea (and sometimes anxiety) to the sights, sounds, and smells associated with the clinic (Hall, 1997). Merely returning to the clinic's waiting room or seeing the nurses can provoke these conditioned feelings (Burish& Carey, 1986; Davey, 1992). Under normal circumstances, such revulsion to sickening stimuli would be adaptive.

However, there are limits on operant conditioning. Mark Twain said it so well, “Never try to teach a pig to sing. It wastes your time and annoys the pig.” We can learn and retain behavior that reflects our biological predispositions, e.g., you can teach pigeons to flap their wings to avoid being shocked and to peck to get food. Flapping wings and pecking for food are natural pigeon behaviors. But you can’t teach a pigeon to peck to avoid shock and to flap its wings to get food. So biological constraints predispose organisms to learn associations that are naturally adaptive.

6.1.2. Cognition’s influence on conditioning:

In their dismissal of “mentalistic” concepts such as consciousness, Pavlov and Watson underestimated the importance of cognitive processes (thoughts, perceptions, expectations) and biological constraints on an organism’s learning capacity.

Cognitive Processes:

The early behaviorists believed that rats’ and dogs’ learned behaviors could be reduced to mindless mechanisms, so there was no need to consider cognition. But Robert Rescorla and Allan Wagner (1972) showed that an animal can learn the predictability of an event. If a shock always is preceded by a tone, and then may also be preceded by a light that accompanies the tone, a rat will react with fear to the tone but not to the light. Although the light is always followed by the shock, it adds no new information; the tone is a better predictor. The more predictable the association, the stronger the conditioned response. It’s as if the animal learns an expectancy, an awareness of how likely it is that the US will occur. Such experiments help explain why classical conditioning treatments that ignore cognition often have limited success. For example, people receiving therapy for alcohol dependency may be given alcohol spiked with a nauseating drug. Will they then associate alcohol with sickness? If classical conditioning were merely a matter of “stamping in” stimulus associations, we might hope so, and to some extent this does occur. However, the awareness that the nausea is induced by the drug, not the alcohol, often weakens the association between drinking alcohol and feeling sick. So, even in classical conditioning, it is (especially with humans) not simply the CS–US association but also the thought that counts.

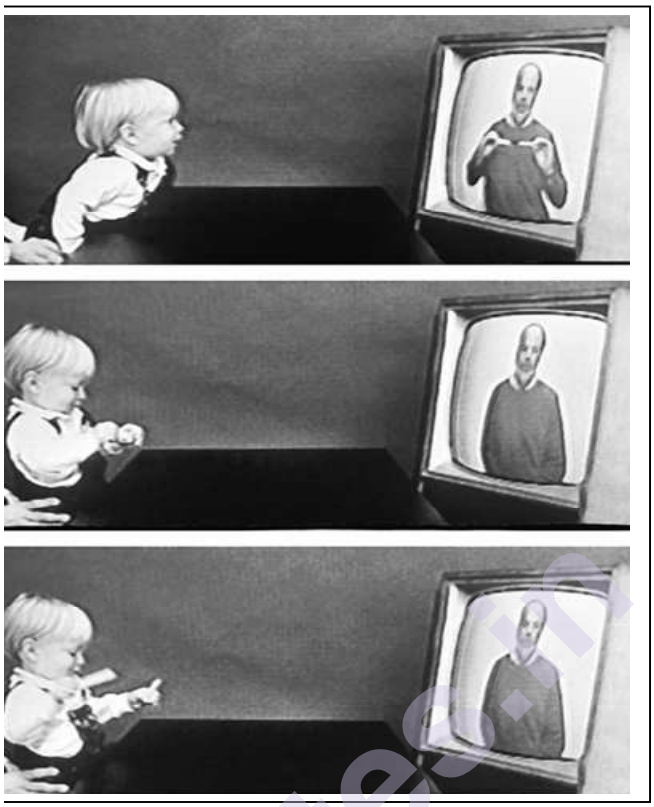
Evidence of cognitive processes have also come from experiments on rats in maze running. In the experiments, Tolman placed hungry rats in a maze with no reward for finding their way through it. He also studied a comparison group that was rewarded with food at the end of the maze. As the unreinforced rats explored the maze, they developed a **cognitive map,** a mental picture of the layout of the maze. After 10 sessions in the maze without reinforcement, food was placed in a goal box at the end of the

maze. As soon as the rats became aware of the food, they were able to find their way through the maze quickly, just as quickly as the comparison group, which had been rewarded with food all along. This is known as **latent learning:** learning that occurs but is not observable in behavior until there is a reason to demonstrate it. The underlying point is that there is more to learning than associating a response to its consequences, there is also cognition.

6.2 LEARNING BY OBSERVATION

Observational learning (modeling) is learning by observing the behavior of others, especially among humans. Bandura and his associates have done research on modeling. The researchers first let the children view one of the three types of modeling(aggressive, non-aggressive and no model condition), and then let them play in a room in which there were some really fun toys. To create some frustration in the children, Bandura let the children play with the fun toys for only a couple of minutes before taking them away. Then Bandura gave the children a chance to play with the Bobo doll. If you guessed that most of the children imitated the model, you would be correct. Regardless of which type of modeling the children had seen, and regardless of the sex of the model or the child, the children who had seen the model behaved aggressively also behaved aggressively just as the model had done. They also punched, kicked, sat on the doll, and hit it with the hammer. Bandura and his colleagues had demonstrated that these children had learned new behaviors, simply by observing and imitating others.

Figure: 6. 1. Learning from observation: This 14-month-old boy in Andrew Meltzoff's laboratory is imitating behavior he has seen on TV. In the top photo the infant leans forward and carefully watches the adult pull apart a toy. In the middle photo he has been given the toy. In the bottom photo he pulls the toy apart, imitating what he has seen the adult do.



Observational learning is useful for animals and for people because it allows us to learn without having to actually engage in what might be a risky behavior. Monkeys that see other monkeys respond with fear to the sight of a snake learn to fear the snake themselves, even if they have been raised in a laboratory and have never actually seen a snake (Cook & Mineka, 1990). As Bandura put it, the prospects for human survival would be slim indeed if one could learn only by suffering the consequences of trial and error. For this reason, one does not teach children to swim, adolescents to drive automobiles, and novice medical students to perform surgery by having them discover the appropriate behavior through the consequences of their successes and failures. The more costly and hazardous the possible mistakes, the heavier is the reliance on observational learning from competent learners. (Bandura, 1977, p. 212). We are especially likely to learn from people we perceive as similar to ourselves, successful or as admirable.

6.2.1 Mirrors and imitation in the brain:

On a 1991 hot summer day in Parma, Italy, a lab monkey awaited its researchers' return from lunch. The researchers had implanted wires next to its motor cortex, in a frontal lobe brain region that enabled the monkey to plan and enact movements. When the monkey moved a peanut into its mouth, for example, the monitoring device would buzz. That day, as one of the researchers reentered the lab, ice cream cone in hand, the monkey stared at

him. As the student raised the cone to lick it, the monkey's monitor again buzzed—as if the motionless monkey had itself moved (Blakeslee, 2006; Iacoboni, 2008). Having earlier observed the same weird result when the monkey watched humans or other monkeys move peanuts to their mouths, the flabbergasted researchers, led by Giacomo Rizzolatti (2002, 2006), eventually surmised that they had stumbled onto a previously unknown type of neuron: mirror neurons, whose activity provides a neural basis for imitation and observational learning. We will discuss mirror neurons in details.

Mirror neurons:

Frontal lobe neurons that fire when performing certain actions or when observing another doing so. The brain's mirroring of another's action may enable imitation and empathy. When a monkey grasps, holds, or tears something, these neurons fire. And they likewise fire when the monkey observes another doing so. When one monkey sees, these neurons mirror what another monkey does.

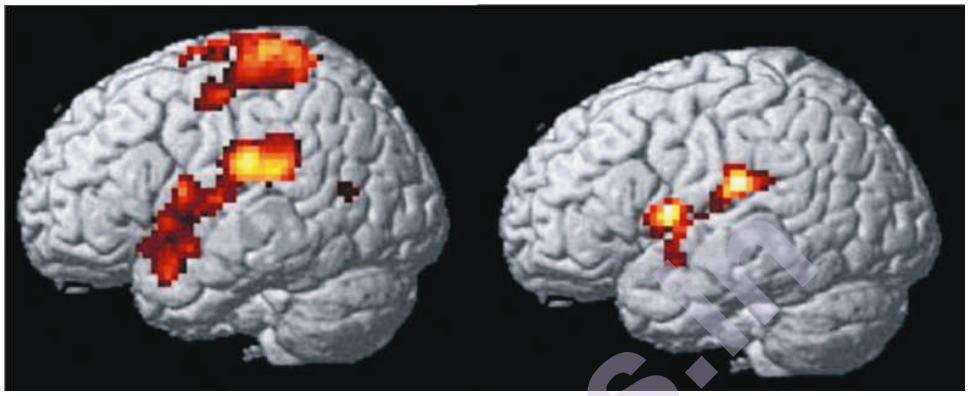
It's not just monkey business. Imitation shapes even very young humans' behavior. Shortly after birth, a baby may imitate an adult who sticks out his tongue. By 8 to 16 months, infants imitate various novel gestures (Jones, 2007). By age 12 months, they begin looking where an adult is looking (Brooks & Meltzoff, 2005). And by age 14 months (FIGURE 6.4.A.), children imitate acts modeled on TV (Meltzoff, 1988; Meltzoff & Moore, 1989, 1997). Children see, children do.

PET scans of different brain areas reveal that humans, like monkeys, have a mirror neuron system that supports empathy and imitation (Iacoboni, 2008). As we observe another's action, our brain generates an inner simulation, enabling us to experience the other's experience within ourselves. Mirror neurons help give rise to children's empathy and to their ability to infer another's mental state, an ability known as theory of mind. People with autism display reduced imitative yawning and mirror neuron activity—"broken mirrors," some have said (Ramachandran & Oberman, 2006; Senju et al., 2007; Williams et al., 2006).

For most of us, however, our mirror neurons make emotions contagious. We grasp others' states of mind—often feeling what they feel by mental simulation. We find it harder to frown when viewing a smile than when viewing a frown (Dimberg et al.,2000, 2002). We find ourselves yawning after observing another's yawn, laughing when others laugh. When watching movies, a scorpion crawling up someone's leg makes us tighten up; observing a passionate kiss, we may notice our own lips puckering. Seeing a loved one's pain, our faces mirror their emotion. But

asfigure6.3.1.A.shows, so do our brains. In this fMRI scan, the pain imagined by an empathic romantic partner has triggered some of the same brain activity experienced by the loved one actually having the pain (Singer et al., 2004). Even fiction reading may trigger such activity, as we mentally simulate the experiences described (Mar & Oatley, 2008). The bottom line: Our brain's mirror neurons underlie our intensely social nature.

Figure 6.2: Pain Empathy



6.2.2 Applications of Observational Learning:

From the basis of observational learning, we learn that there are both negative and positive aspects towards observational learning. Through positive learning, pro-social models have positive effects. They are nonviolent and have a helpful influence. On the other hand, there are antisocial models that have a negative effect, arousing problems such as abuse in families and violence amongst children. We would discuss in details.

Pro-Social Behaviour:

Pro-social (positive, helpful) models can have prosocial effects. To encourage children to read, read to them and surround them with books and people who read. To increase the odds that your children will practice your religion, worship and attend religious activities with them. People who exemplify nonviolently, helpful behavior can prompt similar behavior in others. India's Mahatma Gandhi and America's Martin Luther King, Jr., both drew on the power of modeling, making the nonviolent action a powerful force for social change in both countries. Parents are also powerful models. Models are most effective when their actions and words are consistent. Sometimes, however, models say one thing and do another. Many parents seem to operate according to the principle "Do as I say, not as I do." Experiments suggest that children learn to do both (Rice & Grusec, 1975; Rushton, 1975). Exposed to a hypocrite, they tend to imitate the hypocrisy by doing what the model did and saying what the model said.

Anti-Social Behaviour:

Observational learning may have antisocial effects. This helps us understand why abusive parents might have aggressive children, and why many men who beat their wives had wife battering fathers (Stith et al., 2000). Critics note that being aggressive could be passed along by parents' genes. But with monkeys, we know it can be environmental. In study after study, young monkeys separated from their mothers and subjected to high levels of aggression grew up to be aggressive themselves (Chamove, 1980). Television is the easiest way to get influenced. Imitation is one of the main roles. Television and learning have a positive relationship. TV is a powerful source of observational learning. While watching TV, children may "learn" that bullying is an effective way to control others, that free and easy sex brings pleasure without later misery or disease, or that men should be tough and women gentle.

6.2.3 Thinking critically about: Does viewing media violence trigger violent behaviour?

The average American child watches more than 4 hours of television every day, and 2 out of 3 of the programs they watch contain aggression. It has been estimated that by the age of 12, the average American child has seen more than 8,000 murders and 100,000 acts of violence. At the same time, children are also exposed to violence in movies, video games, and virtual reality games, as well as in music videos that include violent lyrics and imagery (The Henry J. Kaiser Family Foundation, 2003; Schulenburg, 2007; Coyne & Archer, 2005). The most important thing is that India is not exception to this scenario.

It might not surprise you to hear that these exposures to violence have an effect on aggressive behavior. The evidence is impressive and clear: The more media violence people, including children, view, the more aggressive they are likely to be (Anderson et al., 2003; Cantor et al., 2001). The relation between viewing television violence and aggressive behavior is about as strong as the relation between smoking and cancer or between studying and academic grades. People who watch more violence become more aggressive than those who watch less violence.

It is clear that watching television violence can increase aggression, but what about violent video games? These games are more popular than ever, and also more graphically violent. Youths spend countless hours playing these games, many of which involve engaging in extremely violent behaviors. The games often require the player to take the role of a violent person, to identify with the character, to select victims, and of course to kill the victims. These behaviors are reinforced by winning points and moving on to higher levels, and are repeated over and over. Again, the answer is clear

playing violent video games leads to aggression. A recent meta-analysis by Anderson and Bushman (2001) reviewed 35 research studies that had tested the effects of playing violent video games on aggression. The studies included both experimental and correlational studies, with both male and female participants in both laboratory and field settings. They found that exposure to violent video games is significantly linked to increases in aggressive thoughts, aggressive feelings, psychological arousal (including blood pressure and heart rate), as well as aggressive behavior. Furthermore, playing more video games was found to relate to less altruistic behavior.

However, although modeling can increase violence, it can also have positive effects. Research has found that, just as children learn to be aggressive through observational learning, they can also learn to be altruistic in the same way (Seymour, Yoshida, & Dolan, 2009).

6.3 SUMMARY

In this unit we studied the relationship Biology, Cognition and learning. Learning is an important form of new behaviour. It involves establishing new associations and permanent change in behaviour. Putting the terms cognition and learning together gives a definition of cognitive learning. A change in the way of information is processed as result of experience a person or animal has had. In other words, due to past experiences, the significance and meaning of events have been changed, new associations have been formed and these changes have been stored in the memory for future use. Obviously, much learning is of the cognitive variety. Indeed, as you read this text, we hope you are doing some cognitive learning.

We have briefly discussed observational learning. The pioneer of the school of behavioral psychology John B. Watson, who himself was very much influenced by Ivan Pavlov's work. Questioning Wundt's attempt to analyze consciousness into all its basic parts, Watson insisted on objectivity and he considered only behaviour that consisted of observable stimuli and response to be worthy of investigations, The cognitive school of psychology was founded by Max Wertheimer who felt that, Wundt in order to produce his neat atomic chart of psychology, had lost sight of the reality of human experience.

Observational learning is learning by observing the behavior of others. Observational learning is useful for animals and for people because it allows us to learn without having to actually engage in what might be a risky behavior

Towards the end of the chapter we have discussed the effects of violence on aggression. It might not surprise you to hear that these exposures to violence have an effect on aggressive behavior. The more media violence people, including children, view, the more aggressive they are likely to be(Anderson et al., 2003; Cantor et al., 2001). It is clear that watching television violence can increase aggression. Although modeling can increase violence, it can also have positive effects. Research has found that, just as children learn to be aggressive through observational learning, they can also learn to be altruistic in the same way (Seymour, Yoshida, & Dolan, 2009).

6.4 QUESTIONS

a) Explain the relationship between Biology, Cognition, and Learning.
b) Explain cognition's influence on conditioning.
c) Explain Mirror neurons and imitation in the brain
d) What is Pro-social behaviour?
e) What is Anti-Social Behaviour?
f) Explain observational learning.
g) Explain applications of observational learning.
h) Explain the Effects of Violent TV programs on Aggression?

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Unit -7

MEMORY- I

Unit Structure :

7.0 OBJECTIVES

After reading this unit you will be able–

- To understand the importance of studying the topic of memory
- To understand how memories are formed and stored
- To understand how memorization can be improved

7.1 INTRODUCTION

Memory is a fundamental component of daily life and life without memory would be close to impossible. Our very survival depends on our ability to remember who we are, who others are, our past experiences, our learning to cope with our environment, skills that we have learned. what is dangerous, what is safe, etc. If we don't have memory then everyone else would be a stranger to us, in fact, we will not be able to recognize ourselves also when we look into a mirror, every day every task will be new for us, every place will be new for us and living a normal routine life will be impossible. We use memory at every moment of our lives, either consciously or unconsciously. For example, right now, while typing the words I'm writing, I'm using my memory of the alphabets, words and their meanings that I have learned in my childhood. My brain is focused on the content, but while I'm doing that, I'm not recalling how to type on a conscious level. So, let us explore together this fascinating subject.

7.2 STUDYING MEMORY

David Myers (2013) refers to memory as the persistence of learning over time through the storage and retrieval of information.

Baron defined memory as “an ability of the brain to retain and later retrieve information”.

“Memory is an active system that receives information from senses, organizes and alters that information as it stores it away, and then retrieves the information from storage” Ciccarelli & Meyer (2008)

Psychologists use three ways to find out that learning has taken place and memory’s dominant role in these three ways is obvious. These three ways are –

1. **Recall:** This process involves retrieving or bringing back previously learned information, thought or idea, that is not in our immediate conscious awareness but that we had stored in our memory. For example, when you are answering an essay type of question or fill in the blank type of question in exam, you are recalling information that you have stored in memory previously.
2. **Recognition:** In recognition, you only need to identify previously learned information, e.g., while answering multiple choice questions in exam, various possible answers are given along with the question and you are merely recognizing the correct answer out of those various options. Recognition is much easier than recall.
3. **Relearning:** Relearning refers to learning something more quickly when you learn it a second time. It is a way of measuring retention of information stored in memory. For example, while preparing for exam, it may take you two hours to learn this lesson. After a gap of two months, suppose you feel that you need to learn it again as you are not able to recall it perfectly. This time, it will take you much less time to relearn it because it is already there in your memory.

Psychologists have conducted many empirical studies to understand the phenomenon of memory. For instance, psychologists have been intrigued to find that memory gets affected by biological and environmental occurrences such as stroke, accidents, traumas, etc. For instance, Myers (2013) observed that people who suffer stroke may have warm personality as before and may be able to do every day routine work, they may indulge in enjoyable recollection of past events but they can’t remember new memories of everyday happening. Such a person may not be able

to recall what he had for lunch or the name of the person whom he had met just half an hour back. Similarly, there are others, who cannot remember past events from their lives after an accident or a trauma.

Another interesting observation brought up by empirical research is that though most of the people have to put in considerable effort to learn a series of information or notes, on the other hand, there are few people, who can remember such details even by listening it or seeing it just once. Moreover, such people, might be able to recall these numbers or words, backward as easily as forward. Studies showed that such people could recall correctly the series of these numbers or words and the details of the setting in which they were first exposed to these series(such as the room layout and the clothes worn by the experimenter), even after many years.

However, even in case of people with ordinary memory, Konkleet.al. (2010) reported that people who were exposed to 2800 images for only 3 seconds each, could spot the repeats with 82% accuracy. In another experiment, Mitchell(2006) found that people who had seen a picture, 17 years back, could recognize the that picture correctly even when they were shown that picture in fragmented form.

Every day, we are exposed to countless images, voices, sounds, tastes, smells, textures, places, faces, etc. The question arises, how does our brain choose information out of this vast expanse of information and store that information away for later use? How can we recollect information we have not thought about for years? How exactly memories are formed and stored? Let us try to get answers for some of these questions in the further part of this unit.

7.3 MEMORY MODELS:

Psychologists have developed memory models to explain how our brain forms and retrieves memories. Here we are going to talk about various information processing models.

Information Processing Models:
Following are the three important Information Processing models.

- Computer functioning and human memory
- Connectionism
- Richard Atkinson & Richard Shiffrin's Three Stage Model.

7.3.1 Computer functioning and human memory:

This information processing model is based on the assumption that human memory can be compared to a computer's operations. Like the computer, the human mind takes in information, performs operations on it to change its form and content, stores the information and retrieves it when it is needed. This entire operation is done in three step processes –

1. **Encoding:** The information gets in our brain in a way that allows it to be stored.
2. **Storage:** The information is held in a way that allows it to be retrieved later.
3. **Retrieval:** This refers to getting back the information at a later stage, through reactivating and recalling that information and producing it in a form similar to what was encoded.

However, there is a difference between computer functioning and human memory-

I. Our memories are less literal, more fuzzy and fragile than a computer's. That means that computer encodes the words without assigning any meaning to them or using figures of speech.

II. Most computers process information sequentially, even while alternating between tasks. Our dual track brain processes many things simultaneously, some of them unconsciously, by means of parallel processing. In other words, computers process one piece of data at a time, while human memory can process a lot of information at the same time.

III. In computer, once a piece of information is stored, it will not change one bit over the years. But in case of human memory, memories will be continuously changed and reconstructed in response. Unlike a computer, we are not dealing with a physical limit of size. Humans are constantly removing some of their stored information through disuse and adding some more information as they come across new information.

7.3.2 Connectionism:

Another information-processing model is called **connectionism**. It is based on the view that memories are products of interconnected neural networks. Specific memories arise from particular activation patterns within these networks. Every time you learn something new, your brain's neural connections change, forming and strengthening pathways that allow you to interact with and learn from your constantly changing environment.

7.3.3 Richard Atkinson & Richard Shiffrin's A Three-Stage Model:

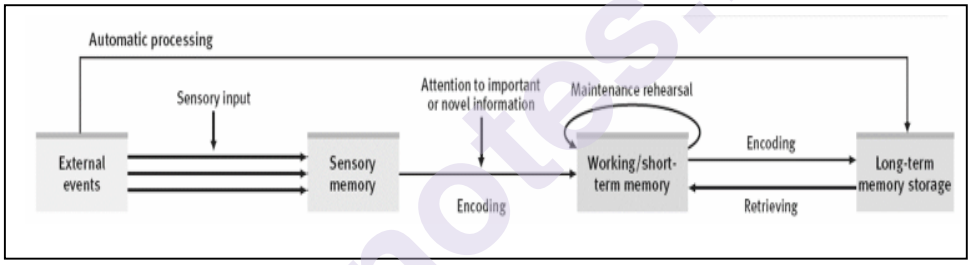
Atkinson & Shiffrin (1968) model is the most popular model based on information-processing concept explained above. According to them memory-forming process passes through a three-stage model. They proposed that information passes through three stages before it is stored. (see Fig. 7.1) These are:

Sensory Memory: We first receive information from the environment that needs to be remembered. Stimuli are recorded by our senses and held briefly in sensory memory.

Short – term Memory: Some of the information is processed into short – term memory and encoded through rehearsal.

Long- term Memory: Finally, the information is stored in long term memory after being processed in short term memory. From long term memory, it can be retrieved anytime when it is required.

Fig. 7.1



Dual -Track Memory: Atkinson and Shiffrin's model emphasized on storing information that we pay attention to or are aware of. But other psychologists pointed out that our mind works on two tracks. Some information skips conscious encoding in short term memory and directly goes into storage, that is long term memory. This automatic processing happens without our awareness. We will discuss automatic processing in detail later on in this unit.

This is a brief description of three components of this model. Now let us look at each component in detail.

Sensory Memory:

It is also called sensory register. It is the first and most immediate form of memory that you have. It refers to an initial encoding of sensory information that comes from environmental in its raw form. For any information to enter our memory, it has to be first picked up by our five senses, that is, taste, smell, sight, sound and touch. The information received from five sense organs lasts from a fraction of a second to a few seconds. It is a system of memory that holds information briefly, but long enough so that it can be processed further. However, unless we pay attention to the

information coming through our senses, the sensation will decay and be lost immediately.

Sensory memory allows individuals to retain impressions of sensory information even after the original stimulus has ceased. For example, while walking in a market and getting exposed to many faces passing by, an individual may turn around, if he feels that a familiar face has passed by, even though the image of that person from his sensory memory has already faded away, or if you look at an object and then close your eyes, an icon, or fleeting image will persist for one -half second afterwards. In other words, sensory memory holds impressions briefly, it holds them long enough so that series of perceptions are psychologically continuous. Without sensory memory, a movie will look like a sequence of still pictures.

Though this store is generally referred to as "the sensory register" or "sensory memory", it is actually composed of multiple registers, one for each sense. Information is transferred to short term memory only when attention is given to it. But there are two types of sensory memory that are most talked about. They are:

a) Iconic Memory:

The mental representations of visual stimuli are referred to as icons (i.e., fleeting images). The sensory register that holds icons is called iconic memory. Iconic memories are accurate but last for a few tenths of a second.

George Sperling (1960) conducted an experiment to show the existence and length of iconic memory. The participants of the experiment were asked to sit in front of a screen upon which 9 letters (three rows of three letters each) appeared for only $1/20^{th}$ of a second. After the presentation, participants were asked to recall a particular row of letters. Sperling used a tone, immediately after presenting the nine letters, to indicate which row the participants should recall. A high-pitched tone meant that the participants need to recall the first row, a medium tone indicated to recall the middle row and the low tone indicated to recall the last row. Without the tone, people recalled about 50% of the letters; with the tone, recall for any of the rows was typically 100%.

However, it was found that if participants responded immediately with 0 second delay after seeing the letters, they remembered an average of nine letters. But if there was a delay of merely 0.5 seconds, they could recall only six letters and if there was a delay of 1.0 seconds, they could recall an average of only 4 letters, showing that all nine letters were momentarily available in their sensory memory.

b) Echoic Memory:

The mental representations of auditory stimuli are called echoes. echoic memory is a form of sensory memory that holds auditory information for one or two seconds. For example, if you are watching T.V. and your mother asks you a question. You stop watching T.V. and ask, “What did you say?”. The moment you say this, you realize that you can recall your mother’s exact words. You can recall these words because they are still in your echoic memory. The memory traces of auditory stimuli can last for much longer than the traces of visual stimuli. Echoic memory can last for 3 to 4 seconds. Echoic memory also lets you hold speech sounds long enough to identify them as words. Yet, echoes like icons will fade with the passage of time. If they are to be retained, we need to pay attention to them. By selectively attending to certain stimuli, we sort them out from the background noise.

The main functions of sensory memory can then be described as:

i) Sensory memory prevents us from being overwhelmed by many thousands of incoming stimuli. All incoming sensory information will vanish within seconds unless we attend to it.

ii) Sensory memory gives us the time that we need to decide whether or not the incoming data should be processed further.

iii) Iconic memory provides stability and makes visual world appear smooth and continuous and echoic memory allows us to play back information and recognize words.

Short-term Memory (STM):

Of the thousands of visual and auditory sensations, only a small percentage gets automatically transferred into short-term memory. Short term memory can hold a limited amount of information for a short period of time which can be lengthened if the information is rehearsed. Information held in STM is active information, that is, information to which you are paying attention.

Without rehearsal, short term memory can hold information for only 2 seconds to 30 seconds. To show this, Lloyd Peterson and Margaret Peterson conducted an experiment. Participants were asked to remember three consonant groups such as CHJ. To prevent rehearsal, the participants were asked to start at 100 and count aloud backwards by threes. Participants were then tested at various times for recall. After 3 seconds, they were asked to stop counting backward and recall the consonants that they were shown, they could recall only half of them, and after 12 seconds most memory of the consonants had decayed and could not be recalled. This clearly showed that without active processing (rehearsal) short term memory has limited life.

Short-term memory can hold about seven items, give or take two. If nothing distracts us, we can recall seven items. In other words, short term memory holds about 5-9 items at one time. The capacity differs depending upon age and other factors. Experiments have demonstrated that compared with children and older adults, young adults have more working memory capacity. That means that young adults can do multitasking more efficiently than other two groups. However, people from all age groups can do better and more efficient work when there are no distractions and they are focused on one task at a time.

Working Memory:

The terms working memory and short-term memory are sometimes used interchangeably. Working memory refers to the active, conscious manipulation of temporarily stored information. Working memory is where active thinking takes place. The term working memory emphasizes the fact that short-term memory is not merely a box into which information is placed but is a working, active system that focuses on the manipulation of information that it contains at any given moment.

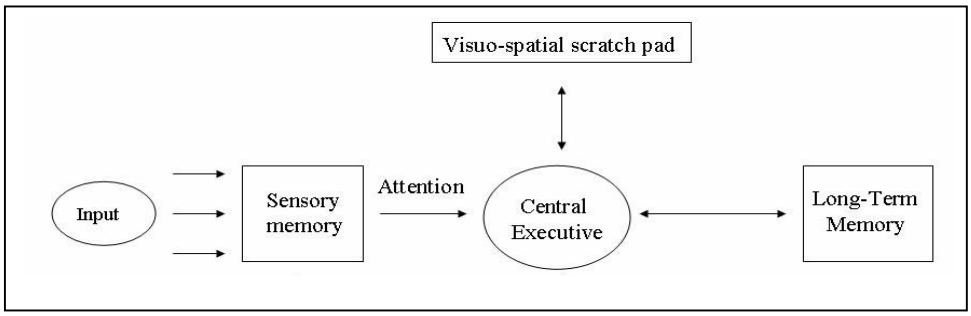
Cowan (2008) held that working memory capacity reflects intelligence level and an ability to maintain focus. People with good working memory are less likely to report than others that their mind was wondering.

Alan Baddeley et.al. (2001;2002) challenged Atkinson and Shiffrin's view of short term memory as a small, brief storage space for recent thoughts and experiences. Baddeley and Hitch (1974) developed an alternative model of short-term memory which they called working memory. They argue that the picture of short-term memory (STM) provided by the Multi-Store Model is far too simple. According to Atkinson and Shiffrin's model, STM holds limited amounts of information for short periods of time with relatively little processing. This means it is a single system or store without any subsystems.

They stated that working memory is not just a temporary shelf for holding incoming information. It is an active desktop where your brain processes information, making sense of input and linking it with long-term memories. In other words, the short-term memory is working in many ways. It holds information not just to rehearse it for storage but also to process it, for example, hearing a word problem in math, keeping it in mind and solving the problem in head. Let us take another example, the pages that you are reading right now are entering your working memory through vision. You might also repeat the information using auditory rehearsal. As you integrate this visual input with your long-term memory, your

attention is focused. Baddeley (1998,2002) called this focused processing the central executive. (See Fig. 7.2)

Fig. 7.2



According to Baddeley the central executive is the most important component of working memory. The central executive decides what working memory pays attention to. Central executive acts more like a system which controls attentional processes rather than as a memory store. Without focused attention, information often fades.

Sparrow et.al. (2011) empirically showed that people invest less energy in remembering the information if they know that information is available online. One can say, sometimes Google replaces rehearsal and mobile phone replaces remembering phone numbers of even family and friends.

Long Term Memory (STM):

Long-term memory (LTM) is the final stage of the multi-store memory model proposed by Atkinson & Shiffrin. Theoretically, the capacity of LTM is unlimited. If we are not able to recall any information, it is due to accessibility and not due to availability. Encoding in LTM, generally, can be in semantic (meaning) mode and visual (pictorial) mode but it can be in acoustic mode also.

There are three types of long term memories:

- Procedural Memory
- Semantic Memory
- Episodic Memory

Procedural memory: It is responsible for knowing how to do things. It is involved in motor skills. It is at unconscious level, automatic and declarative.

Semantic memory: It is responsible for storing information about the world and involves knowledge about the meaning of words, as well as general knowledge.

Episodic memory: It is responsible for storing information about events that we have experienced in our lives. It involves conscious thoughts and is declarative.

We have discussed LTM in detail in building memories, encoding and effortful processing, and levels of processing.

Check your Progress:

Write a short note on
a.) Information processing models with reference to comparison with computers and as connectionism views.
b.) Sensory memory
c.) Short term memory
d.) Working memory

7.4 BUILDING MEMORIES

7.4.1 Encoding and Automatic Processing:

The facts and experiences that we consciously know and declare are part of explicit memories and are called declarative memory.

The content that we retain without conscious recollection is part of implicit memories and is called non-declarative memory. Our implicit memories include:

a.) **Procedural memory** for automatic skills such as how to swim, drive a car, eating, typing on keyboard etc.

b.) **Classically conditioned association** among stimuli. For example, you experience fear when you visit a dentist's clinic because you automatically link a dentist's clinic with painful drill and when you visit a dentist's clinic, you have sweaty palm. You did not plan to feel fear but it happens automatically. Another example can be a pleasant smell that triggers the thoughts of a favorite place.

It has been observed that people absorb some information without paying attention to it. Some forms of processing take effort but over time and with experience, becomes automatic. Many skills are developed like this. For example, without conscious effort you automatically process information about:

- **Space:**

While reading a textbook, you often encode the place on a page where certain material appears; later, when struggling to recall information, you may visualize its location. Similarly, you

visualize a road map when you are giving directions to a person for any destination. Another example can be being able to visualize where things are after walking through a room.

- **Time:**

While going about your day, you unintentionally note the sequence of the day's events. Later, when you realize that you left your purse somewhere, you re-create the sequence of what you did that day and retrace your steps.

- **Frequency:**

You effortlessly keep track of how many times things happen, thus enabling you to realize "this is the fifth time I have come across this beggar today".

As mentioned before, we have two track mind that engages in vast information processing in a very impressive and efficient way. One track automatically stores many routine details while the other track focuses on conscious effortful processing. So, let us now look at effortful processing.

7.4.2 Encoding and Effortful Processing:

Automatic processing happens so effortlessly that it is difficult to shut off. For example, you automatically wake up at 5 O'clock in the morning, even if you forget to set up the alarm. Automatic processing does not require attention or effort. Things happen subconsciously. However, effortful processing requires conscious processing. The learning requires a lot of effort and thought so that it can be stored. Most new or complex tasks require undivided attention and utilize effortful processing. Once the task is learned, it becomes part of automatic processing. For example, consider learning to drive a car; at first, drivers intensely grip the steering wheel and pay undivided attention to the road ahead. But with experience and practice, as they get used to driving, they relegate some part of driving, such as when to press brake or hour much to press accelerator to automatic processing. This helps the driver to do other tasks such as changing the music CD.

Same is true for other skills such as learning to read, write or speak a new language, singing, playing cricket, gymnastics, etc. The basic principle being that when the task is new we need to use effortful processing to put it in memory and once it is learned properly, we use automatic processing and perform that task without paying conscious effort to it.

Effortful Processing Strategies:

Committing new information to memory requires efforts just as learning a concept from a textbook. Empirical studies have shown that many strategies can be used to increase our ability to

form new memories. Whether we will be able to recall this new information from our long-term memory depends upon how successfully we have used these strategies. If these strategies are used effectively, they lead to durable and accessible memories. Let us look at some of the strategies that can be used to remember new information.

1. Chunking:

George Miller was the first one to use the concept of chunking in 1950s to increase STM. People can group information into familiar manageable units to expand their short-term memory capacity called "chunking". In other words, chunking is a term referred to the process of taking individual pieces of information (chunks) and grouping them into larger units. A chunk is a collection of elements having strong association with elements of other chunks of information. Chunking usually occurs so naturally that we take it for granted. We can remember information best when we can organize it into personally meaningful arrangements.

Chunking can be based on:

- Language patterns, for example, RATSHOELACE can be chunked as RAT SHOE LACE. A paragraph can be chunked into phrases and sentences. To learn a song or a poem, you break it into pieces of three lines or four lines and learn it, once you have mastered each piece you link it again in proper sequence. A shopping list can be broken down into smaller groupings based on whether the times on the list are vegetables, fruits, dairy or grains.
- Random digits are best chunked into groups of about three items. The most common example of chunking occurs in phone numbers. For example, if you think of a telephone number as one large piece of information, then to easily remember this number such as 8082892988, you can break it down to 808 289 29 88

In nutshell, to use chunking technique effectively, you must use practice, look for connections, associate groups of items to things from your memory and of course use other memory strategies, such as mnemonics, along with chunking.

2. Mnemonics:

Ancient Greek scholars and orators used Mnemonics to encode lengthy passages and speeches. Mnemonics are memory aids (such as images, maps, peg – words, etc.) that use vivid imagery. We are good at remembering mental pictures. It is easier to remember concrete, visualizable words than abstract words. Human mind more easily remembers spatial, personal, surprising, physical humorous or otherwise relatable information rather than

abstract or impersonal information. Acronyms, rhyme or a jingle are other mnemonics often used.

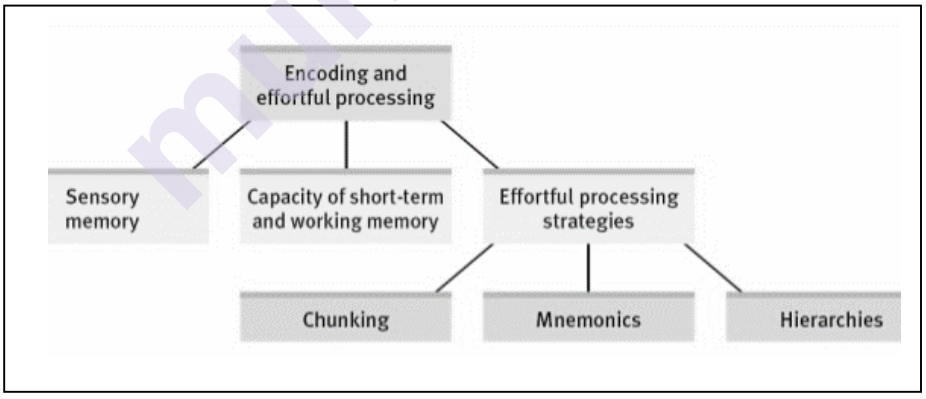
An acronym is a word formed from the first letters or groups of letters in a name or phrase. For example, UNICEF is an acronym for The United Nations Children's Fund, OCEAN is an acronym for the big five personality traits- openness, conscientiousness, extraversion, agreeableness and neuroticism.

A rhyme is a saying that has similar terminal sounds at the end of each line. Rhymes are easier to remember because they can be stored by acoustic encoding in our brains. For example, in fourteen hundred and ninety-two Columbus sailed the Ocean Blue.

A peg word system refers to the technique of visually associating new words with an existing list that is already memorized along with numbers. A peg system is a technique for memorizing a list of words that must be recalled in a particular order. One can use several types of pegs together such as rhymes, numbers, shapes and alphabets. So, a peg is a mental hook on which you hang information. For example, to learn numbers, you associate each number with a word that rhymes with that number – one-sun, two-shoe, three-tree, four- door, five- hive, etc.

3. Hierarchies:

Fig.7.3



Hierarchy is a way of organizing information for encoding. When complex information is broken down into broad concepts and further subdivided into categories and subcategories, it is called hierarchy system. We are more likely to recall a concept if we encode it in a hierarchy. For example, see the hierarchy of the topic that we are studying right now (Fig 7.3)

Gordon Bower et.al.(1969) conducted an experiment in which words were presented either randomly or grouped in categories such as minerals, animals, clothing, and transportation. These words were presented for one minute each. It was found that

participants could recall two to three times better when words were organized in categories rather than when presented randomly.

4. Distributed Practice:

More than 300 experiments over a century have shown that we can memorize better, that is have better long - term retention, when our encoding is distributed over time rather than concentrated at one particular time. This is called **spacing effect.** The spacing effect was first noted by Herman Ebbinghaus in the late 1800s.

For memorizing any information, we use two types of practices – mass practice and distributed practice.

Mass practice: Mass practice refers to a practice schedule in which the amount of rest between practice sessions or trials is very short. Mass practice is essentially cramming. Mass practice can produce speedy short-term learning and feeling of confidence. But Hermann Ebbinghaus (1885) said that those who learn quickly also forget quickly.

Distributed Practice: Distributed practice refers to a practice schedule in which the amount of rest between practice sessions or trials is relatively long. As distributed practice takes longer in absolute terms, individuals using this technique often falsely feel that they are being less efficient.

Distributed practice is more likely to result in success; however, it takes some maturity to be able to do a little bit each day. For example, let us say there are two students preparing for exam, having similar intelligence and abilities. One student studies whole night before exam while another student has studied one hour per day over six months, the second student will do better in the exam than the one who studies for the whole night one day before exam.

However, this does not mean that you need to study every day. Memory researcher Harry Bahrick noted that the longer the time between study sessions, the better the long-term retention will be and the fewer sessions will be needed. After you have studied long enough to master the material, further study becomes inefficient. In other words, over learning or over memorizing is of no use. It is better to use that extra reviewing time a day later if you need to recall that information after 10 days or a month later if you need to recall that information after 6 months. In other words, to prepare for annual exam, it is better to study and memorize material in consistent manner over the months rather than studying in a crammed manner, in a month immediately before the exam.

In fact, Harry Bahrick along with his three family members conducted a 9-year long experiment. His conclusion was that if you spread your learning over several months, rather than over a short period, you can retain information for a life time.

Testing Effect: One effective way to distribute practice is repeated self-testing. Henry Roediger and Jeffrey Karpicke (2006) called self-testing as testing effect. They stated that it is better to practice retrieval (that is try to answer the questions about the material as in exam) than merely to reread material. Just rereading material will lull you into a false sense of mastery.

Levels of Processing:

Memory researchers believe that we process verbal information at different levels, and the depth of our processing affects our long-term retention of the information. The levels of processing can be shallow and deep processing. Let us discuss each one of them.

Shallow Processing: It encodes information at a very basic level that is memorizing the appearance or sound of words.

Deep Processing: It encodes semantically. That means it -

- Attaches meaning of the words,
- Links them to existing memories, and
- Uses self -reference effect, that is, people remember things that are personally relevant to them.

The deeper (more meaningful) the processing, the better our retention will be. Fergus Craik and Endel Tulving (1975) conducted an experiment to investigate the effects of different types of processing on recall. Participants were presented with words that either were written in capital letters (appearance) or rhymed with other words (sound) or fitted in a sentence (semantic). Results showed that processing a word deeply, by its meaning (semantically) produced better recognition of that word at a later time than the shallow processing of words by attending to their appearance or sounds. This clearly shows that deeper levels of processing based on meaning of information is better than shallower recall method. It means that learning by rote or cramming without understanding a lesson will not help in retaining it in long term. To retain it in long term, you need to understand the meaning of the material that you are studying and to related it with other information that you already have.

Making Material Personally Meaningful:

We have difficulty in processing and storing the information that does not appear meaningful to us or does not relate to our experiences. Ebbinghaus (1850-1909) believed that compared to

learning material that appears to be nonsense to us, learning meaningful material takes just 1/10th of the effort.

Wayne Wickelgren (1977) said “The time you spend thinking about material you are reading and relating it to previously stored material is about the most useful thing you can do in learning any new subject matter”.

People remember information significantly better when they process that information in reference to themselves. The more it is personalized, the better will be recall of that information. This is called the self-reference effect. This tendency of self-reference effect is especially strong in members of individualistic western cultures (Symons & Johnson, 1997).

There can be three explanations for self-reference effect –

1. Information relevant to self is processed more deeply and rehearsed more often. May be due to better elaboration, such information remains more accessible.
2. Information relevant to self leads to high arousal and that may enhance memory.
3. People have special mechanism for encoding information relevant to themselves.

Check your Progress:

Write short notes on

a.) Automatic Processing of information
b.) Effortful processing of information and Dual track memory
c.) Chunking & Mnemonics
d.) Hierarchies & Distributed Practice
e.) Shallow processing and deep processing

7.5 SUMMARY

In this unit, we began with why it is important to understand human memory. Without memory, we cannot lead a normal life and maybe we will not be human enough. Our entire learning depends on memory. We also looked at the three methods used by psychologists to know that learning has taken place. These three methods are recall, recognition and relearning. Research studies have shown that it is easier to use recognition than recall to extract any information from memory. Similarly, while relearning if we take less time than previous attempt at learning, it shows better retention of the information.

Next, we looked at three information processing models- one compared the functioning of human memory with the functioning of computers, second one emphasized that the neural connections in brain are different from the wires connecting different parts of

computers. Whenever we learn something new, these neural connections change. In other words, this model states that human memory system is more dynamic than computers. The third model is the most popular model of understanding how memories are formed. This is Atkinson & Shiffrin's model of three stages. It emphasizes that we have three types of memory systems- first one being the sensory memory, which is the entry point of receiving information from the environment. This act of receiving information can be at the conscious level or unconscious level. If attention is paid to the information for sufficient time the information will go to short term memory and if the information is processed there also for sufficient time it will go to long term memory. However, we will be discussing long term memory in next unit.

We elaborated on sensory memory by saying that information is received through all five sense organs and we have separate memory for each sense organ. The most prominent ones are Iconic memory- information received through eyes in the form of visual stimuli, and echoic memory- information received through ears in the form of auditory stimuli. Then we discussed short term memory and working memory, emphasizing that short term memory can hold on an average only seven items at a time and that too for only 2 to 30 seconds depending upon the type of sensory information received.

Working memory is also short-term memory only, except the fact that it underlines the fact that short term memory is not merely receiving the information and passing it on to long term memory, it is actively manipulating the received information by understanding the meaning of information received and linking it to information already stored in long term memory.

Next, we talked about building memories where we said that encoding can take place either automatically or through effortful processes. Automatic processing takes place in procedural memory or through classically conditioned association among stimuli. It is also influenced by space, time and frequency.

Effortful processing is a conscious effort put in to memorize some information and the techniques that can be used for that are chunking, mnemonics, hierarchies and distributed practices.

We also discussed the levels of processing. There can be shallow processing, when you don't pay attention to the meaning of the information and there can be deep processing, when you pay attention to the meaning of the information. Research studies have shown that retention of information is better when people use deep processing and when self-reference effect takes place, that is , they get information that is related or relevant to them.

7.6 QUESTIONS

1. Explain in detail Atkinson and Shiffrin's three – stage information processing model of memory.
2. Discuss in detail short-term memory and working memory.
3. Distinguish between automatic and effortful processing of information. What are some effortful processing strategies that can help us remember new information?

7.7 REFERENCE

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Unit -8

MEMORY - II

Unit Structure :

8.0 OBJECTIVES

After reading this unit, you will be able to understand

- how explicit and implicit memories are stored in the brain
- how retrieval takes place
- the causes of forgetting
- the techniques to improve memory

8.1 INTRODUCTION

In last unit, we mentioned that it is important to study memory as it connects the present moment to what came before and is the basis for the formation of one's life story. Basically, we as a person are derived from experiences that have been stored in our long-term memory. Atkinson & Shiffrin's three stage model stated that from short term memory the information goes to long term memory- its last destination. So, let us see briefly, what are the characteristics of long- term memory. Long-term memory stores memories for years and sometimes for entire life. Its capacity is unlimited, but storing and retrieval of information depends upon changes in neuronal structure. This physical change is relatively permanent. Think of it, there is never a situation when a person says I can't learn anything anymore in my life. If people sometimes can't retrieve memories that were stored in childhood, it only means those memories are available in memory but not accessible. Non-accessibility can be for various reasons, but memories are there.

There are different types of long term memories such as explicit memories, implicit memories, flash bulb memories, etc. After this short introduction to long term memory, let us see what kind of physiological changes take place when we are processing information and storing in long term memory and where it gets stored. We will also discuss various techniques to retrieve the information and how memory can be improved.

8.2 MEMORY STORAGE

8.2.1 Retaining Information in the brain:

Initially, people believed that long term memory is like an empty room which has to be filled up with memories. It was also believed that it does not have elasticity and has limited capacity, to fill new information old information items need to be thrown out. But later on, psychologists empirically showed that our long-term memory is flexible and has endless capacity to store information.

However, we do not store information as books are stored in libraries -carefully staked in distinctly labeled racks and having precise locations. Instead, many parts of the brain interact as we encode, store and retrieve the information from our memories. Memories are not stored in any single site of the brain, instead they are stored throughout the brain. To show that memories are not stored in any single specific spot of the brain, Karl Lashley (1950) conducted an experiment in which he trained rats to find their way out of a maze. After that he surgically removed pieces of their brain's cortex and retested their memories. He found that no matter what small brain section he removed, the rats always found their way out of the maze, as they retained at least partial memory. This indicated that while storing memories various parts of brain are interacting. In fact, different parts of the brain are active in storing different types of memories. Let us look at which parts are active for implicit and explicit memories.

A) Explicit – Memory System: The Frontal Lobes and Hippocampus

Explicit or declarative memory is one of the two main types of long-term human memory. It stores facts, stories, meaning of the words, previous experiences and concepts that can be consciously recalled.

The network that processes and stores explicit memories includes frontal lobes and hippocampus.

Frontal Lobes:

The frontal lobes are important in working memory. The left and right frontal lobes process different types of memories. The left frontal lobe is more active in memorizing verbal material, e.g., when you recall a password and hold it in working memory, you are using

the left frontal lobe. The right frontal lobe is more active in recalling non-verbal material, e.g., if you are recalling a party scene, or thinking about a painting, you are using your right frontal lobe.

Hippocampus:

The hippocampus is a small, curved neural center located in the limbic system in each temporal lobe. It is involved in the formation of new memories and emotional responses. It instantly evaluates incoming data from the five senses and decides whether to store or discard the information. So, for the brain, it is equivalent to "save button" in computer. Studies have shown that explicit memories of names, images and events are laid down through the hippocampus. Therefore, damage to hippocampus disrupts recall of explicit memories. Just like humans, birds also have hippocampus in their brains. It has been found that birds, with their hippocampus intact, can store food in hundreds of places and can still find it months later when they return to these unmarked hiding places. But they can't remember, where they had stored the food if their hippocampus is damaged (Kaamil & Chang,2001). Shettleworth (1993) stated that among animals, a bird called Nutcracker can locate 6000 pine seeds during winter season which it had buried months back.

Furthermore, in case of human beings, it has been reported that people cannot remember verbal information, if their left hippocampus is damaged, but they have no difficulty in remembering visual designs and locations. They cannot recall visual designs and locations if their right hippocampus is damaged. We would not be able to remember where our house is without the work of the hippocampus.

Research has also found that different sub regions of the hippocampus itself play important roles in certain types of memory. For example, the rear part of the hippocampus is involved in the processing of spatial memories. Studies of London cab drivers have found that navigating complex mazes of big city streets is linked to the growth of the rear region of the hippocampus. (Maguire et.al.2003a) Another study reported that anterior hippocampus is active when people learn to associate names with faces (Zeineh et.al.,2003) and another part of hippocampus is active when people use spatial mnemonics (Maguire et.al.,2003b). The reason is that the left hippocampus is more involved in the memory of facts, episodes, words; it is responsible for constructing episodic memory. The right hippocampus is more involved in spatial memory.

Memories are not permanently stored in hippocampus. Events or episodes (such as its smell, feel, sound and location) are held there temporarily for a couple of days before consolidating,

moving to other parts of the brain for long-term storage. For example, Tse et.al. (2007) showed in an experiment that if a rat's hippocampus is removed three hours after it has learnt the location of some tasty food, it will not be able to locate food after the operation, because its hippocampus did not get a chance to send the information to different locations of long term memory. But if the hippocampus us removed 48 hours after the rat has learned the location of the tasty food, it could remember the location.

Much of this consolidation of memory occurs during sleep. During deep sleep, the hippocampus processes memories for later retrieval. Other studies have shown that getting a full eight hours of sleep after learning a new task, such as a finger-tapping exercise, or after studying a long list of words can boost recall the next day. Even a one-hour nap can improve performance on certain tasks. Researchers have watched the hippocampus and brain cortex showing simultaneous activity rhythms during sleep, indicating as if they are having a dialogue (Euston et.al.,2007). What happens is that when you sleep at night, your brain "replays" the day's events. During these nightly recaps, hippocampus and the neocortex, "talk" to one another and transfer day's experiences to the cortex for long-term storage. Cortex areas surrounding the hippocampus support the processing and storing of explicit memories. This transfer of information from hippocampus to cortex is called consolidation. In addition to strengthening memories, sleep can also help integrate new information, leading to creative insight. In one experiment, researchers showed how sleep restructures information to help subjects see new patterns, linking new information with prior knowledge.

B) Implicit -Memory System: The Cerebellum and Basal Ganglia –

Implicit memory is sometimes referred to as unconscious memory or automatic memory or no declarative memory. As mentioned before, implicit memory includes skills and habits, conditioned associations, priming and perceptual learning. Even if you lose your hippocampus and frontal lobe, you will still be able to do many activities because of implicit memory.

No declarative memory is expressed through performance rather than recollection. The unconscious status of no declarative memory creates some of the mystery of human experience. Here arise the habits and preferences that are inaccessible to conscious recollection, but they nevertheless are shaped by past events, they influence our current behavior and mental life. For example, LeDoux (1996) reported a case of a brain damaged patient who suffered from amnesia and could not form immediate memories. Every day, her doctor shook her hand and introduced himself as she could not form memories of the current events. One day when

doctor shook hand with her, she suddenly pulled her hand back with a jerk because doctor has a drawing board pin in his hand and that had pricked her. The next day, when doctor returned to introduce himself, she refused to shake his hand but she could not explain why she was refusing to shake hand. She was classically conditioned.

The **cerebellum** plays a very important role in formation and storage of implicit memories created by classical conditioning. If cerebellum is damaged, people cannot develop certain conditioned reflexes, such as associating a tone with about to come puff of air and thus do not blink in anticipation of the puff (Daum & Schugens;1996). Similarly, when researchers surgically disrupted the function of different pathways in the cerebellum of rabbits, the rabbits could not learn a conditioned eye blink response. It was also reported that if cerebellum is damaged, voluntary motor movement become slow and uncoordinated. It is clearly evident from these experiments that cerebellum plays an important part in formation of implicit memories.

A subset of implicit memory, **procedural memory**, enables us to perform many everyday physical activities, such as walking and riding a bike, without having to give it thought. A large majority of implicit memories are procedural in nature. Procedural memory primarily depends on the cerebellum and basal ganglia. The basal ganglia are deep brain structures involved in motor movements and memories of skills. The cerebellum plays a part in correcting movement and fine tuning the motor agility found in procedural skills such as painting, instrument playing and in sports such as cricket, swimming, etc. Damage to this area may prevent the proper relearning of motor skills.

The Basal Ganglia receives input from the cortex, but it does not return the inputs to the cortex for conscious awareness of procedural learning. For example, once you know how to ride a bike, you never forget this skill, thanks to your basal ganglia. You can ride the bicycle even if you can't recall having taken the lesson for this skill.

Infantile amnesia:

Implicit memory from infancy can be retained right up to adulthood, including skills and conditioned responses. However, explicit memories such as our recall of episodes, goes back to about age 3 for most people. This nearly 3 years "blank" in our memories is called infantile amnesia. For example, in an experiment conducted by Bauer et.al. (2007), the events children experienced and discussed with their mothers, when they were 3 years old, they could recollect 60% of these events at the age of 7 but could recollect only 35% of these events at the age of 9. This

demonstrated that as we grow old we can't recollect the events that took place either before or at the age of 3. The question arises, why we can't remember these evets that take place in infancy stage. Psychologists have come up with two reasons for it-

1. Encoding: Some psychologists believe that explicit memories in childhood develop with language acquisition because the ability to use words and concepts helps in memory retention. It is believed that after developing linguistic skills, memories that were not encoded verbally get lost within the mind. Another explanation is that young children encode and store memory as images or feelings. In adulthood, our language dominated memories do not have retrieval cues appropriate for gaining access to the stored memory of childhood.
2. The hippocampus, that plays a significant part in explicit memories, is one of the last brain structure to mature.
3. Still other psychologists believe that children younger than 3 or 4 do not perceive contexts well enough to store memories accurately.

8.2.2 The Amygdala, Emotions, And Memory:

It is a common knowledge that generally we remember emotionally charged events better than boring ones. The brain region that is most strongly involved in emotional memory is the amygdala. The question arises how does intense emotions cause the brain to form intense memories? Psychologists say

1. Emotions can trigger a rise in stress hormones that influences memory formation. Heightened emotions (stress related or otherwise) make for stronger memories. Stress hormones make more glucose energy available to fuel brain activity. In a way, emotions trigger stress hormones telling the brain that something important just happened.
2. These hormones trigger activity in the amygdala and provoke it to increase memory-forming activity in the frontal lobes and basal ganglia and also to "tag" the memories as important. The amygdala is critically involved in calculating the emotional significance of events, and, through its connection to brain regions dealing with sensory experiences, also appears to be responsible for the influence of emotion on perception - alerting us to notice emotionally significant events even when we're not paying attention. Emotional arousal can blaze certain events into the brain, while disrupting memory of certain other neutral events at the same time. As a result, the memories are stored with more sensory and emotional details. These details can trigger a rapid, unintended recall of the memory.

3. Emotions often persist without our being consciously aware of what caused them. For instance, in an experiment, patients with damaged hippocampus (so that they could not form new explicit memory) watched a sad film and later a happy film. After the viewing, they did not consciously recall the films, but the sad or happy emotion persisted. (Feinstein et.al.,2010).
4. Stressful events can form very long-lasting memories. Especially, traumatic events such as rape, house fire, terrorist attack, etc. may lead to vivid recollection of the horrific event again and again. James Mc Gaugh (1994) noted that stronger emotional experiences make for stronger, more reliable memories. This helps in our survival also, because memory serves to predict the future and alert us to future dangers.
5. **Flashbulb memories:** These tend to be memories of highly emotional events. These events can be traumatic such as 9/11 terror attack, an earthquake, Tsunami, rape, news of a loved one, etc. or it can be a pleasant but emotionally charged event, such as first date outing. Typically, people can accurately recall-
    - Place (where they were when the event happened),
    - Ongoing activity (what they were doing),
    - Own affect (the emotion they felt),
    - Informant (who broke the news)
    - Others' Affect (how others felt)
    - Aftermath (Importance of the event)

Flashbulb memories register like a photograph. It is as if the brain commands, "Capture this". People can recall them vividly and with high confidence. However, as we relive, rehearse and discuss them, these memories may get distorted as misinformation seeps in. So, flashbulb memories are not as accurate as it was initially thought.

8.2.3 Synaptic Changes:

When people form memories, their neurons release neurotransmitters to other neurons across the synapses. With repetition, the synapses undergo **long-term potentiation (LTP),** that is, the signals are sent across the synapse more efficiently. It is defined as a long-lasting increase in synaptic efficacy following high frequency stimulation of presynaptic neurons.

Synaptic changes include a reduction in the prompting needed to send a signal and an increase in the number of neurotransmitter receptor sites. In other words, **n**eurons can show history- dependent behavior by responding differently as a function of prior input, and this plasticity of nerve cells and synapses is the

basis of memory. Neurons that fire together wire together. It means, through repeated pairing, there will be structural and chemical changes that will result in strengthening of active synapses forming a stronger circuit.

LTP occurs throughout the brain, but a high concentration of LTP occurs in the hippocampus and is believed to play a role in learning and memories. Many experiments have proved that LTP is a physical basis for memory. For instance –

1. Drugs that block LTP interfere with learning Lynch & Staubli (1991).
2. In an experiment, rats that were given a drug to increase their LTP learned a maze with half of the usual number of mistakes (Service, 1994).
3. When rats were injected with a chemical that could block the preservation of LTP, rats' immediate memories were erased (Pastalkova et.al.2006). After LTP has occurred, if electric current is passed through the brain, it won't disrupt old memories, but it will erase current memories. This is exactly what happens when depressed people are given electroconvulsive therapy or somebody gets hit very hard on the head. For example, football players or boxers who become temporarily unconscious after a hit by the opponent, typically have no memory of what happened before the hit (yarnell & Lynch, 1976).
4. Some pharmaceutical companies manufacture memory-boosting drugs. These drugs are consumed by people suffering from Alzheimer's disease or having mild cognitive impairment that may later on become Alzheimer's disease, or simply by people who are having age related memory decline. This memory improving drugs are of two types –

a.) Drugs that enhance neurotransmitter glutamate.

b.) Drugs that improve production of CREB, a protein that enhances the LTP process. Increased production of CREB triggers enhanced production of some other proteins that help in reshaping synapse and transfer short term- memories into long-term memories and patients who take these drugs show enhanced learning.

However, there are some people who wish to take drugs to block the memories. These are the people who have gone through traumatic experiences and do not want to go through the memories of those events. A drug that helps in erasing such memories is Propranolol. In an experiment, it was found that when victims of traumatic event such as accident or rape were given this drug for 10 days immediately after the incident, it helped them to overcome their experiences as after three months they did not show any sign of stress disorder.

The following charts shows the summary of encoding of both types of memories and how the brain stores memories in its two – track system (See Fig. 8.1 & Fig. 8.2)

Fig.8.1

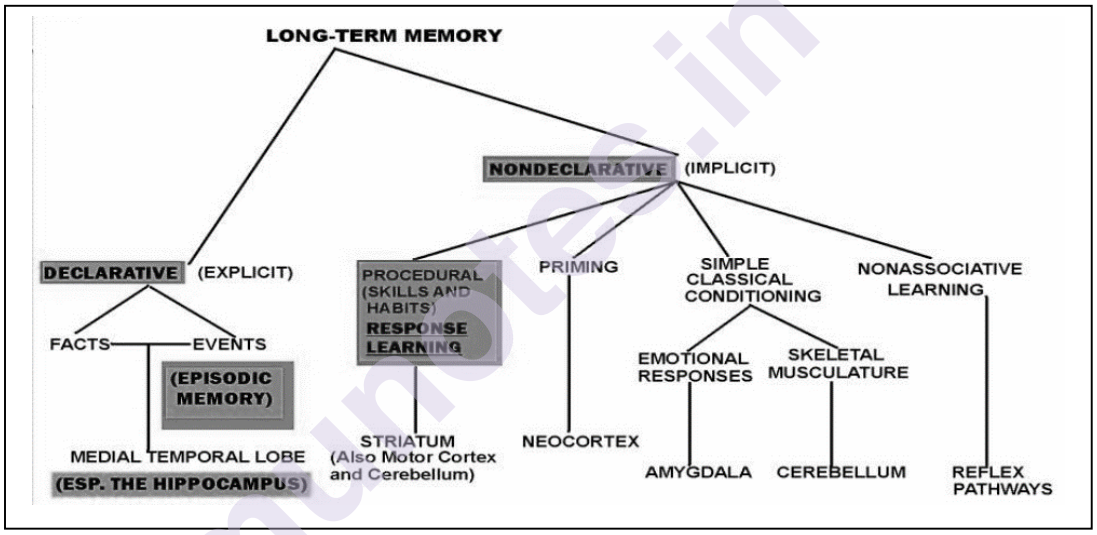
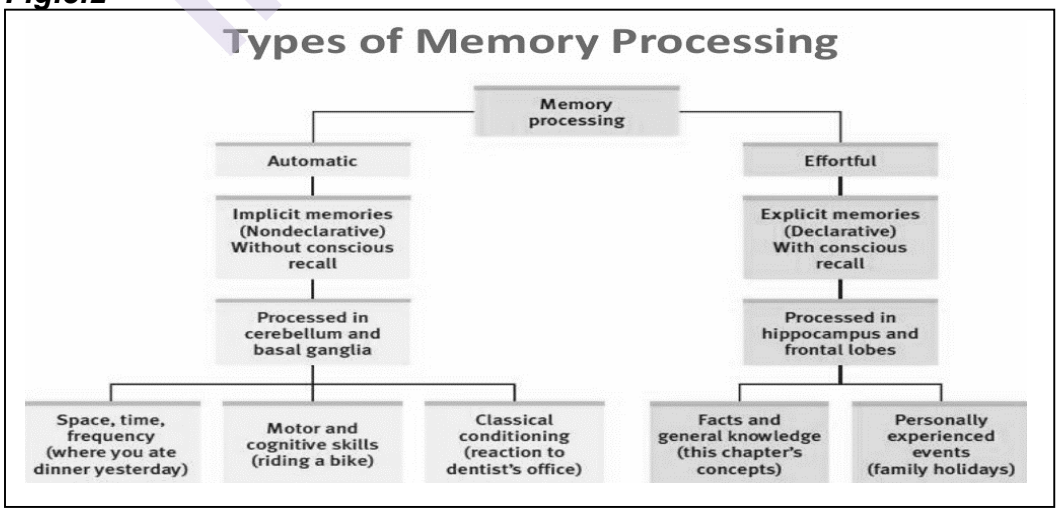


Fig.8.2



8.3 RETRIEVAL: GETTING INFORMATION OUT

Measures of Retention:

There are three measures of retention – recall, recognition and relearning speed. It is easier for us to recognize the information than to recall. Our recognition memory is impressively quick and vast. Our speed of relearning also indicates how much we have learned. Herman Ebbinghaus showed this in his learning experiments, using a nonsense syllables. He found that the more times he practiced a list of nonsense syllables on day 1, the fewer repetitions he required to retain it on day 2. Additional rehearsal (over learning) of verbal information increases retention, especially when practice is distributed over days.

Retrieval Cues:

Generally, it is believed that memory retrieval is a simple process. Information has been stored in long term memory and can be retrieved at will. But it is far from reality. Just because a memory has been fully encoded is no guarantee that it can be retrieved and applied at will, because memories are held in storage by a web of associations, each piece of information interconnected with others. These associations are like anchors that help retrieve memory. In other words, memory is not stored as a file that can be retrieved by searching alphabetically. Instead, it is stored as a web of associations – conceptual, contextual and emotional.

One process that can improve the likelihood of remembering previously learned knowledge is retrieval cues. Retrieval cues can be defined as any stimulus or words that help us remember stored memories (Goldstein, 2011).

Retrieval cues are clues or reminders which direct memory search to the appropriate part of the LTM.

The more retrieval cues you have, the better will be your chances of finding a route to your stored memory. Retrieval is good when conditions favor rich and elaborate encoding because it provides readily available retrieval cues. Retrieval cues can be external such as place, color, sound that can help you to retrieve the specific memories. For example, in various Hindi movies, we have seen the use of external retrieval cue (such as a specific shaped charm bracelet, a song learned in childhood, etc.) being used to trigger memories. Retrieval cues can be internal also such as internal such as feelings of sadness that reminds you of some unfortunate event in your life.

Priming:

Retrieval is affected by activation of our associations. Priming triggers a thread of associations that bring us to a concept,

just as a spider feels movement in a web and follows it to find the bug. Our minds work by having one idea trigger another; this maintains a flow of thought.

Priming has been called “invisible memory”, “memoryless memory” because it affects us unconsciously. Priming is an implicit memory effect in which exposure to one stimulus influences the response to another stimulus. Priming influences our behavior. For example, Joly & Stapel (2009) empirically reported that Dutch children primed with items associated with Santa Claus shared more chocolate than did other children who were not primed with Santa Claus. This is because Santa Claus is associated with kindness and generosity and children who were primed with Santa Claus were reminded of these qualities.

Priming effects are not always positive. We may have biases and associations stored in memory that also influence our choices. For example, Vohs (2006) showed that participants primed with money related words were less likely to help another person when asked to do so. Ariely (2009) explained these findings and said that in such cases, money primes our materialism and self-centeredness rather than the social norm of helping.

Context-Dependent Memory:

Part of the web of associations of a memory is the context. We retrieve a memory more easily when in the same context as when we formed the memory. For example, words learned underwater are better retrieved underwater. Students better on tests if they study in the same place where they take the test. Eyewitness can recollect better when they are taken back to the scene of crime where they saw the crime occurring. A student may go to a stationary shop and may not remember what he wanted to buy, but when he comes home and again sits on his study table, he may recollect that he wanted to buy a specific pencil from the stationary store.

When people visit their old school, they can recall memories that they believed they had forgotten. This explains why people experience the ‘flood’ of memories after revisiting their old school or house after a gap of many years. When an individual moves to a new location with different contextual information, remembering and recalling information from this new environment may interfere with the old memories and result in "forgetting". However, when returning to the former location, the presence of contextual information "reactivates" these old memories, allowing them to be recalled, even after many years of absence. Experiments have shown that a familiar context can activate memories even in 3-month-old infants.

State- Dependent Memory:

Unlike context – dependency memory, which involves an individual's external environment and conditions, state-dependent memory applies to the individual's internal conditions. Our memories are not just linked to the external context in which we learned them. Memories can also be tied to the emotional state we were in when we formed the memory.

State-dependent memory is the phenomenon through which memory retrieval is most efficient when an individual is in the same state of consciousness as they were when the memory was formed. Alcohol-related state-dependent memory is known to occur with humans as well as with animals. Heavy drinkers may forget what they did while drunk, only to remember again the next time they drink. For instance, someone who hides money when drunk may forget the location until drunk again. Rats were taught to run a maze under the influence of a depressant drug often forgot the route through the maze if tested later without the drug. Given the drug again, they could retrieve their memory and run the maze successfully.

Similarly, emotions that accompany good or bad events become retrieval cues (Fiedler et.al. 2001). So, we can say that our memories are mood congruent. Mood-congruent memory occurs where current mood helps recall of mood-congruent material, regardless of our mood at the time the material was stored. Thus, when we are happy, we are more likely to remember happy events. If you are in gloomy mood, you may recall other bad events from your past. Research has shown that people put in a cheerful mood – either through hypnosis or through positive events of the day – recalled the world in very positive terms. They judged themselves as competent and effective and judged others as benevolent and in general were optimistic about world's future. This retrieval effect helps to explain why our moods persist. When happy, we recall happy events and therefore see the world as happy place and our happy mood prolongs and vice versa.

This clearly indicates that our moods color our thinking. When we feel happy, we think happy. We see and recall a good world. When our mood is gloomy, our thoughts switch to a different track. The bad mood primes our recollection of negative events. Our relationships seem to sour, our self-image plunges, our hopes for the future dim and other people's behavior seems sinister. As depression increases, memories and expectations dive down. It was found that currently depressed people recall their parents as having been rejecting and punitive. But formerly depressed people recall their parents in the same positive terms as do never depressed people (Lewinsohn & Rosenbaum, 1987).

Similarly, Bornstein et.al.(1991) reported that adolescents' ratings of their parental warmth differed from time to time depending upon their mood. When teens were depressed or in low mood, they rated their parents as inhuman and when their mood brightened up, they rated their parents as angels. This indicates that our perception of reality changes depending upon our changing moods. We change our judgments, memories, interpretations of a situation depending upon our moods. For instance, when we are in bad mood and we find a person is constantly looking at us, we may interpret it as a glare and feel even worse and avoid that person. On the other hand, when we are in good mood and we find a person constantly looking at us, we may interpret it as interest and feel even better and strike a conversation with him.

The serial Position Effect:

Priming and context cues are not the only factors which make memory retrieval selective. The serial position effect refers to the tendency to retrieve items at the beginning and at the end of a long list. This happens due to the primacy effect (items at the beginning of the list) and recency effect (items at the end of the list).Memory researchers explain that the primacy effect happens because information encoded earlier has more time and opportunity to be rehearsed and elaborated in short-term memory, has less competition in working memory, and has a higher chance of getting stored in long-term memory. On the other hand, the recency effect happens because information encoded later is still undergoing rehearsal in working memory, and is therefore readily available for recall.

Check your Progress:

Write short notes on

a.) Explicit memory
b.) Implicit memory
c.) Synaptic changes
d.) Infantile amnesia
e.) Retrieval cues

8.4 FORGETTING

People often feel that it will be wonderful to have a brain that won't forget anything that it is exposed to. There will be no need to memorize anything. The question arises is it really a good idea. In fact, the research shows that forgetting has its own advantages. If we remembered everything that we came across, we could not prioritize the important memories. We might have difficulty thinking abstractly and making connections if our brain was devoted to compiling isolated bits of information. If we were unable to forget, we might not focus well on current stimuli because of intrusive

memories such as traumatic or discouraging memories. "Forgetfulness is a form of freedom." (Khalil Gibran)

8.4.1 Forgetting and the two-track mind:

While it is true that forgetting has its own advantages as mentioned above, the fact remains that for some people memory loss can be severe and permanent affecting their day to day life. There are two types of such severe memory losses called anterograde amnesia and retrograde amnesia.

Anterograde amnesia: It refers to an inability to form new long-term declarative/explicit memories from a particular date, usually the date of an accident or operation of the brain. It is an inability to transfer new information from the short-term memory to long-term memory. The brain damage can be caused by stroke, head trauma, or surgery.

Retrograde amnesia: It is a loss of memory-access to events that occurred, or information that was learned, before an injury or the onset of a disease. People suffering from retrograde amnesia cannot recall their past – the old memories stored in long term memory that were stored before the injury, but they can form new memories and store them in long term memory. Generally, the memory loss is not for the individual's entire lifetime. In a Hindi movie Sadma (1983), Shridevi competently essayed the role of a retrograde amnesia patient.

As an example of anterograde amnesia, Dittrich (2010) reported a case of Henry Molaison (called H.M. in short) who used to suffer from seizures and to stop his seizures, doctors conducted a brain surgery. After brain surgery, H.M. developed severe anterograde amnesia. He was unable to form new conscious memories, though his working memory and procedural memory were intact. His memory prior to operation was intact. He could remember much of his childhood, he knew his name and family history. He was intelligent and did daily crossword puzzles, but he forgot daily events nearly as fast as they occurred. He underestimated his own age, apologized for forgetting the names of persons to whom he had just been introduced. His doctor Corkin (2005) said "I've known H.M. since 1962, and he still does not know who I am". For about 20 seconds during conversation he could keep something in mind. When distracted, he would lose what was just said or what had just occurred. So he could never learn how to use a TV remote.

Similarly, Oliver Sacks reported the case of Jimmie, who was suffering from anterograde amnesia. He had no sense of how much time has passed after he suffered his injury at the age of 19 in 1945. When he was 49 years old and doctor asked him his age,

he replied that he was 19 years old. Doctor placed a mirror before him and asked him to say what he could see. Jimmie was shocked by his appearance in the mirror and became frantic. He asked is it a nightmare, or a joke? When his attention was diverted to some children playing outside the room, his panic ended and he totally forgot about seeing himself in the mirror. Even more interesting was that when Sacks left the room and returned a few minutes later Jimmy had no memory of ever meeting the doctor.

The strange facts about patients such as H.M., Jimmie and others like them are that they can learn nonverbal tasks. They can find their way to the bathroom, but if you ask them to explain where is the bathroom, they will not be able to tell you. They can learn to read mirror image writing and solve jigsaw puzzle and many other complicated job skills. They can be classically conditioned, but they do all these things with no awareness of having learned them. That means their automatic processing ability is intact and they can form new implicit memories, but they lose their explicit memory as they cannot consciously recall learning of these new skills. These examples confirm that we have two distinct memory systems, controlled by different parts of the brain.

8.4.2 Reasons for Forgetting

Encoding Failure:

As discussed previously, whatever is not encoded and passed on to long term memory will never be remembered by us. Very often we hear people saying that with age they have become more forgetful. Research studies have also shown that with advancing age our encoding efficiency reduces. The brain areas that are instantly active when young adults encode new information become less responsive as we grow old. However, no matter what our age is, we are selective while paying attention to and encoding information that continuously keeps bombarding us. For example, we have seen many coins in our life time, we can recall their size, shape and color but if I ask you to recall what is engraved on head side and what is engraved on tail side or can you differentiate a fake coin from a real one, the chances are the most people cannot do that. But a coin collector will be able to differentiate a fake coin from a real one and will remember the details engraved on the head and tail side of the coin. This is because a coin collector will encode the important features of the coins to his memory through effortful processing. He would have paid close attention to those features and that must have facilitated in encoding that information and storing in long-term memory. Without putting effort, many potential memories are never formed.

Storage Decay:

Very often we can't recollect information despite putting effort in encoding it. For example, you must have learned certain

study material for your exam last year and must have successfully reproduce in the exam, but if I ask you to recall it now, the chances are that you will not be able to recall it. Memories are lost over time. To study the duration of stored memories, Ebbinghaus (1885) learned lists of nonsense syllables and measured how much he retained while relearning each list, from 20 minutes to 30 days later. He found that the course of forgetting was initially rapid and then leveled off with time. Harry Bahrick (1984) conducted a similar experiment with students learning Spanish in school. He found that compared to those who were just finishing school, people who passed out from school 3 years back had forgotten much of what they had learned in school but whatever they could remember at that time (after this lapse of 3 years) they could recall after 25 years later also. Their forgetting had leveled off.

One of the reasons for this leveling off in forgetting can be that physical memory traces fade gradually. Memories may be inaccessible for various reasons such as –

a.) Some memories were never acquired/ not encoded, e.g , maybe we never paid attention to the details of the coin, or even if paid attention to it enough to get it into our working memory, maybe we still didn't bother to rehearse it and encode it into long term memory.
b.) Some memories are discarded, that is, stored memories decay, memory encoded into long-term memory will decay if the memory is never used, recalled and re-stored.
c.) Some memories we are not able to retrieve.

Retrieval Failure – Tip of the Tongue:

a.) Very often forgetting takes place not because memories have faded but because we are unable to retrieve them. For example, try to recall a song that was your favorite 15 years back but after that you have not heard it again or sang it again. You will find it difficult to recall its lyrics. You feel the lyrics on the tip of your tongue but just not able to say it. You will hum the tune but not able to get the lyrics. But if somebody else gives you a clue such as first few words, you will be able to recall that song. This is called Tip-of-the-Tongue phenomenon.
b.) To prevent retrieval failure when storing and rehearsal memories, you can build retrieval cues such as linking your memorized material to images, rhymes, categories, initials, lists, etc.

Interference:

Sometimes retrieval problem occurs due to interference. Old and new memories can interfere with each other, making it difficult to store new memories and retrieve old ones. There are two types of interference

Proactive Interference: It occurs when past information interferes (in a forward-acting way) with learning new information. You have many strong memories of a previous teacher, and this memory makes it difficult to learn the new teacher's name. Or if you change your password on your email account after a long time, your memory of old password may interfere with remembering the new password.

Retroactive Interference: It occurs when new stimuli/learning interferes with the storage and retrieval of previously formed memories. For example, if you hear a new song set on the tune of an old song, you may have trouble recalling the words of old song. Studies have shown that information presented just before the eight hours sleep is protected from retroactive interference because the chances of interference are minimized. This was first discovered by John Jenkins and karl Dallenbach (1924) in an experiment. They asked two people to memorize nonsense syllables and then try to recall them after 8 hours of being awake or asleep at night. This exercise was for many days. It was found that forgetting occurred more rapidly after being awake and being involved in other daily activities than for those who slept after memorizing the list. This clearly shows that "forgetting is not so much a matter of the decay of old impressions and associations as it is a matter of interference, inhibition or obliteration of the old by the new." karl Dallenbach (1924).

This, however, does not mean that you should commit information to your memory just few seconds before sleeping. Such information is not encoded. Research shows that we have very little memory for information that is played aloud in the room during sleep, although ears do register it. (Wood et.al., 1992) In both types of interference, the greater the similarity of the interfering material, the greater the interference will be.

Motivated Forgetting:

The concept of motivated forgetting was invented by Sigmund Freud. He proposed that we repress (unconsciously) or suppress (consciously)Motivated painful or unacceptable memories to protect our self-concept, to prevent guilt, embarrassment, shame and to minimize anxiety. But the repressed memories linger and can be retrieved by some later cue or during therapy. Motivated forgetting is a form of self-defense mechanism.

C. Tavris and Elliot Aronson (2007) pointed out that memory is an "unreliable, self-serving historian". For example, Ross et.al. (1981) reported from their experiment that when some people were told about the benefits of frequent tooth brushing, they recalled having brushed their teeth frequently in the next two weeks than those who were not told the benefits of tooth brushing.

The concept of motivated forgetting was very popular in mid-twentieth century psychology but today, many memory researchers think repression occurs rarely. People's efforts to intentionally forget neutral material often succeed, but not when the to be forgotten material is emotional. So, we may have intrusive memories of the very traumatic experiences that we would like to forget.

8.5 MEMORY CONSTRUCTION ERRORS

Memory not only gets forgotten, but it also gets constructed. Memory is not precise. We infer our past from stored information plus what we later imagined, selected, changed, expected, rebuilt, saw or heard. We often construct our memories as we encode them, and every time we replay a memory, we replace the original with a slightly modified version. Memory researchers call this reconsolidation. No matter how accurate and video like our memory seems, it is full of alterations, even fictions. Joseph LeDoux (2009) rightly said, "Your memory is only as good as your last memory. The fewer times you use it, the more pristine it is".

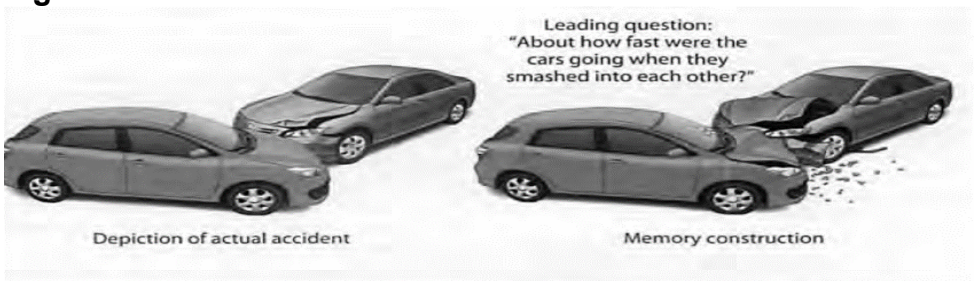
8.5.1 Misinformation and Imagination Effects:

Misinformation Effect:

Generally, it is believed that people's long-term memory records events that we experience exactly as they happened. But this is not true. In reality, researchers have found that long term memory is very prone to errors and can easily be altered and molded. The inaccuracy of long term memory is enhanced by the misinformation effect, which occurs when misleading information is incorporated into one's memory after an event. For example, Elizabeth Loftus and John Palmer (1974) conducted over 200 experiments involving more than 20,000 participants. Different groups of participants saw a video of a car accident and then afterwards were questioned about what they had seen in the video.

It was found that the answers to such questions varied depending on the way the questions were worded. When asked the question" How fast were the cars going when they smashed into each other?" the answer typically involved a higher rate of speed than when the question was framed as "How fast were the cars going when they hit each other?". Additionally, when the participants were asked a week later to report whether or not there was glass at the scene of the accident, those who had heard the word 'smashed' in their initial interview were twice as likely to report broken glass, when in the video there was not any. In fact the video has not shown any broken glass. (See Fig 8.3)

Fig.8.3



Many other follow-up experiments confirmed that misinformation effect takes place. If we are exposed to misleading information, we tend to misremember. In fact, researchers said that so powerful is the misinformation effect that it can influence later attitudes and behaviors. Since we are not aware that we are being presented with misinformation, it is not possible for us to pick and remove suggested ideas out of large pool of real memories.

Filling Memory Gaps:

Our memories get influenced by not only misinformation effect, but we also tend to fill memory gaps. While describing a childhood experience to somebody, we tend to fill in the memory gaps with reasonable guesses and assumptions. After numerous times of saying the same story, we accept the guesses as real memory.

Implanted False Memories:

Just listening to a vivid retelling of an event may implant false memories. In one experiment, University students were suggested that as children, they became ill after eating spoiled egg salad. After absorbing the suggestion, many of them did not eat egg-salad sandwich, both immediately and even after four months (Geraerts et.al. 2008).

Imagining:

Even repeatedly imagining nonexistent actions and events can create false memories. For example, in another study by Elizabeth Loftus**,** people were asked to provide details of a incident in childhood when they had been lost in a shopping mall (which had NOT happened). By trying to picture details, most people came to believe that the incident had actually happened; they had acquired an implanted memory. In another study, Garry et.al. (1996) asked university students were asked to imagine certain childhood events, such as breaking a window with their hand or having a skin sample removed from a finger. One out of four students later recalled the imagined event as something that really happened.

Imagination Inflation:

Once we have an inaccurate memory, we tend to keep adding more imagined details. For example, in one experiment, researcher digitally altered photos from a family album to show

some family members taking a hot-air balloon ride. kids with an implanted memory of a balloon ride later added even more imagined details, making the memory longer, more vivid, with high confidence in their memories. When they were interviewed several days later, they reported even richer details of their false memories.

The question arises why these misinformation and imagination effect occurs. Gonsalves et.al. (2004) explained that misinformation and imagination effects occur because visualizing something and actually seeing it activates similar brain areas. So, imagined events also later appear to be more familiar and familiar things seem more real. The more vividly we can imagine things, the more likely they are to become memories. The human mind, it seems, comes with built-in photo shopping software.

8.5.2 Source Amnesia:

Very often, it happens that I come across a person whom I recognize as someone I know but I am unable to place where I have met this person. Jean Piaget, a famous psychologist, was surprised as an adult to learn that a vivid detailed memory from his childhood – about a nursemaid preventing his kidnapping- was totally false. He constructed this memory from a story often heard from the nursemaid. So, a person's memory for the event may be accurate, but he may forget where the story came from and attribute the source of that information to his own experiences. The information may have come from a story someone told him about his childhood (as in case of Jean Piaget), from a movie that a person has seen, or book he read, from a dream that he used to have or from a sibling's experience, etc. These all are sources for amnesia. Source amnesia or misattribution is at the heart of many of these false memories.

Source amnesia is the inability to remember where, when or how previously learned information has been acquired, while retaining the factual knowledge. This branch of amnesia is associated with the malfunctioning of one's explicit memory. Authors and songwriters often suffer from this type of amnesia. They think an idea came from their own creative imagination which in fact they have unintentionally plagiarized from something they have earlier read , heard or seen.

Source amnesia also explains déjà vu feeling that almost two third of us have experienced at some time or the other. Déjà vu refers to a feeling that you are in a situation that you have already seen or have been in before. The most common technical definition of déjà vu (French for "already seen") is "any subjectively inappropriate impression of familiarity of a present experience with an undefined past."

This can be seen as source amnesia - a memory (from current sensory memory) that we misattribute as being from long term memory. It generally happens to well-educated, well-traveled, wealthy, liberal and imaginative young adults (15 to 25 years old), especially when they are tired or stressed out. Research shows that it is more likely to occur late in the day and late in the week. People experiencing déjà vu wonder "how can I recognize a situation I am experiencing for the first time?" or they may think of reincarnation ("I must have experienced this in my previous life") or they may think that they had premonition/precognition ("I saw this scene in my mind before experiencing it").

Alan Brown and Elizabeth Marsh (2009) conducted an experiment in a laboratory to study déjà vu phenomenon. In their trials, they flashed a symbol at a subliminal level, on a computer screen, followed by a longer view of the same symbol or different symbols or no symbols. When a flash was followed by its identical symbol, participants were five times more likely to say they had seen that symbol sometime before the experiment. So, half the participants experienced déjà vu without being aware of why they are feeling this familiarity. The key to déjà vu seems to be familiarity with a stimulus without being clear where we have encountered it before.

Reasons for Déjà vu:

1. Brown and Marsh explained that it is a case of double perception that suggests that a quick glance at a scene can make it appear strangely familiar when it is fully perceived moments later. Brown said, "This is easy to imagine in today's distracted society. Let's say you enter a new museum, glancing at artwork while talking on your cell phone. Upon hanging up, you look around and sense you've been there long ago."

2. By studying patients suffering from epilepcy, neurologists believe that déjà vu occurs due to temporal lobe processing. Christopher Moulin and O'Connor studied four patients with damaged temporal lobes who suffered from chronic déjà vu. These patients greeted strangers like old friends, had no interest in watching TV or reading newspaper because they were convinced that they have seen everything before. This suggests that déjà vu may be the result of a small seizure in the part of the temporal lobe that governs our sense of familiarity. Hippocampus and frontal lobe processing is responsible for our consciously remembered details. When temporal lobe and hippocampus and frontal lobe are out of sync, we experience a feeling of familiarity without conscious recall. Then we have déjà vu as our source amnesia forces us to do our best to make sense of an odd moment.

8.5.3 Discerning True and False Memories:

False memories created due to misinformation or misattribution feel as real as true memories and they can be very persistent. False memories are often the cause of faulty eyewitness testimony and faulty eyewitness identification. Hypnotically refreshed memories may prove to be inaccurate, especially if the hypnotist asks leading questions such as “Did you hear loud noises?”

McFarland & Ross(1987) examined dating partners’ evaluation of their relationship over time. People who fell more in love after their initial evaluation retrospectively exaggerated the intensity of earlier reports of love; those who broke up the relationship underestimated their original reports of caring for their partners. Similarly, when people were asked what was their view about marijuana or gender issues 10 years ago, recalled attitudes that were similar to their current views rather than the views they had actually reported 10 years back.

8.5.4 Children’s Eyewitness Recall:

One interesting question faced by psychologists is how reliable are children’s eyewitness descriptions. The credibility of children’s testimony is often questioned due to their underdeveloped frontal lobes and memory capacity. Ceci & Bruck’s(1993,1995) have researched the theme of children’s eyewitness recall many times. In 1993 and 1995, using anatomically correct dolls they asked 3-year-old children to indicate where the pediatrician had touched them. 55% of the children who had not received genital or anal examinations indicated that they had been touched in their private parts. In a different experiment, Ceci & Bruck (1999,2004) found that by using suggestive questioning techniques most preschoolers and even many older children could be induced to report false events, like seeing a thief stealing food at their daycare.

In another study, Ceci & Bruck had children choose from a deck of cards with possible events on them such as getting a mousetrap on your finger and going to the hospital. Once the card was chosen by a child, an adult would read to that child and ask “Think real hard, and tell me if this ever happened to you…”. The same adult repeatedly asked children to think about many real and fictitious events during the interviews. After 10 weeks, a new adult asked the same questions and 58% of preschoolers produced false stories with vivid details about one or more events they had never experienced. Because the stories were so vivid and seemed so authentic, psychologists could not tell the difference between real and imagined memories and neither could some of the children.

Similarly, in another experiment, when preschoolers merely overheard an erroneous remark that a magician's missing rabbit had gotten loose in their classroom, 78% of children recalled actually seeing the rabbit in their classroom.

In the light of these studies, the question arises, can we trust children as eyewitnesses? The answer is yes, if we question children about the events in neutral words that they understand, children can often recall accurately what happened and who did it. Children are especially accurate when they have not talked with an involved adult prior to the interview and when their disclosure is made in a first interview with a neutral person who asks non-leading questions.

8.5.5 Repressed or Constructed Memories of Abuse?

Many psychotherapists believe that early childhood sexual abuse results in repressed memories. But other psychologists believe that such memories may be constructed.

Myers said that two types of tragedies happen when an adult recollects childhood abuse:

1.) Disbelief of those who come forward. Trauma survivors may not be believed when telling their secrets.

2.) Falsely accusing the innocent. While trying to dig up supposed lost child-abuse memories, therapists use techniques like hypnosis, drugs and guided imagery and thus create the memories that they are trying to discover. Patients exposed to such techniques may form an image of a threatening person and with further visualization, the image grows more vivid. The patient ends up stunned, angry and ready to confront or sue the remembered abuser. The equally stunned and devastated parent or relative, who has been accused, vigorously denies the accusation.

So, while the therapists have noble intention of uncovering the truth, they unintentionally trigger false memories that damage innocent adults. Psychologists have criticized the therapists' use of "memory work" techniques such as guided imagery, hypnosis and dream analysis to recover memories. The use of such techniques and creation of false memories has devastated and broken many families. On the other hand, therapists have accused these critics to be adding to the trauma of victims and helping child molesters. To overcome this memory war among psychologists, many professional bodies of psychology have issued public statements as given below.

People who are committed to protecting abused children and to protecting wrongly accused adults agree on following points –

1. Sexual abuse happens: It is too common but there is no characteristic “survivor syndrome”- no group of symptoms that can allow us to identify the victims of sexual abuse.
2. Injustice happens: Sometimes the guilty walk free and the innocent are charged.
3. Forgetting happens: The person may simply have been too young to remember or may not have understood the meaning of his/her experience.
4. Recovered memories are commonplace: When cued, it is common to dig up old memories. But memories that surface on their own are more reliable than cued ones.
5. Memories of things happening before the age 3 are unreliable.
6. Memories recovered under hypnosis or the influence of drugs is especially unreliable: Under hypnosis, people will incorporate all kinds of suggestions into their memories, even memories of “past lives”.
7. Memories, whether real or false, can be emotionally upsetting: Both the accuser and the accused may suffer when what was born of mere suggestion becomes like an actual trauma that drives bodily stress.

Richard McNally and Elke Geraerts (2009) stated that victims of childhood sexual abuse do not repress their abuse, they simply stop devoting thoughts and emotions to it and letting go of the memory is most likely when

- The experience, when it occurred was strange, uncomfortable and confusing rather than being severely traumatic
- The abuse only once or only a few times
- Victim have not spent time thinking about the abuse, either because of their own resilience or because no reminders are available.

8.6 IMPROVING MEMORY

Now lastly let us see how we can use this knowledge of memory to improve our memory, so that you can prepare better for your exams.

a.) **Study Repeatedly:** To master any material, use distributed practice. Give yourself many separate study sessions. Take advantage of little breaks such as travelling to college/office, taking a lunch break, etc. Thomas Landauer (2001) advises that to memorize specific facts and figures, rehearse the name or number that you are trying to memorize, wait for a few seconds and then rehearse again, wait a little longer, rehearse again, then wait still longer and then rehearse again. The wait should

be as long as possible without losing the information. Use recall method to determine how much you have memorized. Reading complex material with minimal rehearsal will result in little retention. Rehearsal and critical reflection helps more. It pays to study actively. Avoid cramming and establish regular study sessions.

b.) **Make the Material Meaningful:** You can do this by building up a network of retrieval cues. Apply the concept to your own life, form images, understand and organize information, relate to what you already know or have experienced, put it in your own words instead of mindlessly repeating someone else's words. Previous knowledge helps understanding and understanding improves memory, so the more that you know about a topic the easier it is to learn new, related facts. Making sense of what you are studying is essential to maximize learning. Relating new information to familiar information helps, even when the link is otherwise unimportant. Because you've generated the links, you're likely to remember them, and they will cue the new information. When encountering names, we normally ignore the meaning of the words, but if you use that meaning and link it to the person, it will help you remember their name.

c.) **Activate retrieval Cues:** Mentally recreate the situation and the mood in which your original learning took place. We have better retrieval when it occurs in the same situation in which we learned the material.

d.) **Use Mnemonic Devices:** Associate items with peg words. Make up a story that incorporates vivid images of the items. The best mnemonics are those that utilize positive imagery, humor, or novelty. You might come up with a rhyme, song, or joke to help remember a specific segment of information. Chunk information into acronyms. Create rhythmic rhymes.

e.) **Minimize interference:** Study before sleep. Do not study topics one after the other that are likely to interfere with each other. For example, studying subjects like English, Hindi, Marathi one after the other.

f.) **Adequate Sleep:** Get enough sleep so that when you awake you feel fresh. As mentioned before, during sleep the brain reorganizes and consolidates information for long-term memory. Sleep deprivation disrupts this process and information does not get stored in long term memory.

g.) **Test Your Own Knowledge:** Test Your Own Knowledge, both to rehearse It and to find out what you don't know: Don't get carried away into overconfidence by your ability to recognize information. Test your recall using the retrieval method. Take practice tests.

Check your Progress:

Write short notes on:

a.) Forgetting and two tracks- mind
b.) Encoding failure, storage decay and retrieval failure
c.) Interference and motivated forgetting
d.) Misinformation and imagination effects
e.) Source Amnesia
f.) Children's eyewitness recall and repressed/constructed memories
g.) Techniques to improve memory

8.7 SUMMARY

In this unit, we talked about why it is important to understand the functioning of human memory. While discussing the memory storage, we said there are two types of memory - explicit and implicit. In brain, frontal lobes and hippocampus play a major role in formation of explicit memory. If left side of hippocampus is damaged, we cannot retain verbal information, though we can retain spatial information because rear part of hippocampus is involved. It was also emphasized that much of consolidation of explicit memory occurs during sleep, because hippocampus processes memories for later retrieval.

The cerebellum and basal ganglia are responsible for implicit memory. Implicit memory includes skills and habits, conditioned associations, priming and perceptual learning. Infantile amnesia is part of implicit memory. Infantile amnesia refers to the fact that children can't remember events of up to 3 years of age but retain their procedural memory, that is, whatever skills they have learned in the first three years remain intact but not the memory for the events. The amygdala is responsible for memory of emotions. Emotionally charged events are stored much better in our memory than boring events. That is why we can remember details of a three-hour movie but not of the one-hour lecture. Flashbulb memories are the memories of a highly emotional event and may trigger with/ without any cue. These memories can be pleasant/ unpleasant. It has also been found that synaptic changes also take place if we are exposed to same stimuli repeatedly and these changes help in improved learning and storing memories. Once the memories are stored, the next question is how do we know whether memories were stored or no and if they are stored, how to retrieve them. The research has shown that there are three methods that indicate whether memory is stored or no. These are recall, recognition and relearning. Memories can be retrieved with the help of retrieval cues. Retrieval cues can be priming, context-dependent memory, state-dependent memory and the serial position effect.

Next, we look at what is forgetting and why do people forget previously stored information. Psychologists are of the opinion that our brain does not function like computer, it is much more than that. We have two track mind which works simultaneously. They talked about two types of amnesia- anterograde and retrograde amnesia. Both types of amnesia can take place due to injury, stroke or disease. In anterograde amnesia we cannot form new memories from the day we suffer from injury/accident and in retrograde amnesia, we cannot recall the past events that took place before the injury/accident. Some of the reasons for forgetting are encoding failure, storage decay, retrieval failure, interference, motivated forgetting.

Apart from that we can have memory construction errors such as misinformation and imagination effect, source amnesia. This brings us to the question of how to differentiate between true and false memories and can we rely on children's eyewitness testimony. It also raises questions about whether child abuse memories are repressed or constructed memories.

Lastly, we talk about how memory can be improved. Though there are many methods to improve memory, here we talk about few of them such as repetition, making material meaningful, activating retrieval cues, using mnemonic devices, minimizing interference, having sufficient sleep, and testing our own knowledge repeatedly by using recall method.

8.8 QUESTIONS

1. How do external cues, internal emotions and order of appearance influence memory retrieval?
2. Define forgetting. Elaborate on any two reasons for forgetting
3. Write a detailed note on memory construction errors.
4. Discuss in detail how memory can be improved.

8.9 REFERENCE

1) Myers, D. G. (2013).Psychology.10th edition; International edition. New York: Worth Palgrave Macmillan, Indian reprint 2013
2) Ciccarelli, S. K. & Meyer, G. E. (2008). Psychology.(Indian sub-continent adaptation). New Delhi: Dorling Kindersley (India) pvt ltd.

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Modified Pattern of Question Paper for Semester End Assessment implemented from 2020-2021 For Psychology courses at F.Y.B.A.

Duration = 3 hours Total Marks = 100 (per semester)

All 5 questions carry 20 marks and are compulsory.
There will be internal choice in each Question.

Q1. Attempt any two questions (module 1) 20 marks
A
B
C

Q2. Attempt any two questions (module 2) 20 marks
A
B
C

Q3. Attempt any two questions (module 3) 20 marks
A
B
C

Q4. Attempt any two questions (module 4) 20 marks
A
B
C

Q5. Attempt any two questions (module 1, 2, 3, 4 One question from each module) 20 marks
A
B
C
D