M. A. PSYCHOLOGY

SEMESTER - I (CBCS)

PSYCHOLOGY PAPER- COURSE IV

(CORE COURSE)

PSYCHOLOGY OF COGNITION AND EMOTION

SUBJECT CODE : PAPSY104

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SYLLABUS
PSYCHOLOGY
MA Semester System (CBCS), Revised Course, 2022-23
Semester I: Course IV
Core Course: 4 credits, 60 hrs.
PSYCHOLOGY OF COGNITION AND EMOTION: PAPSY 104

Objectives:

- Understanding advanced topics of cognitive science
- Understanding the neuropsychological underpinings of cognitive processes
- Applying cognitive psychology knowledge to real-life problems.
- Understanding theories, biological basis, and development of human emotions

Unit 1: Cognitive Neuroscience, Attention and Perception

A. Cognitive Neuroscience: Neuronal Structure and Function; Intelligence and Neuroscience; Methods of cognitive neuroscience
B. Visual Perception: Visual Object Recognition, Face perception
C. Attention and Consciousness: Attention Processes, Theories of Attention, Consciousness of Mental Processes; Preconscious Processing
D. Neuropsychologicalbasis of Attention and Visual Perception

Unit 2. Memory and Language

A. Memory: Models and Research Methods; Metacognition
B. Memory Processes; Mental Images, Maps, and Propositions
C. Language and language in context
D. Neuropsychological basis of Memory and language

Unit 3. Thinking and Intelligence

A. Problem Solving and Creativity
B. Thinking, Decision Making and Reasoning
C. Human Intelligence. Organization of Knowledge in the Mind
D. Neuropsychological basis of executive functions

Unit 4. Psychology of Emotions

A. Theories of Emotions: Theories of emotions
B. Biologicalbasis of human emotions
C. Measurement of Emotions
D. Emotional Development and regulation

Books for Reading

1. Sternberg, R. J.; Sternberg, K, Mio, J. (2012). Cognitive Psychology. Wadsworth: Belmont, CA.
2. Matlin, M. W. (2009). Cognition. John Wiley & Sons: NJ.
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6. Zilmer, E. A. & Spears, M. V. (2001). *Principals of neuropsychology*. Canada: Wadsworth

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21. Simon-Thomas, E. R., Keltner, D. J., Sauter, D., Sinicropi-Yao, L., & Abramson, A. (2009).
22. The voice conveys specific emotions: Evidence from vocal burst displays. *Emotion, 9,* 838-846.
23. Walsh, K. (1994). *Neuropsychology: A clinical approach*. N.D.: Churchill Livingston

Evaluation:

Internal evaluation: 40 marks

Semester end examination :60 marks

Paper pattern: 7 questions to be set of 15 marks each, out of which 4 are to be attempted. One of them could be short notes question, which could combine more than one unit.

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1

COGNITIVE NEUROSCIENCE, ATTENTION AND PERCEPTION

Unit Structure

1.1 COGNITIVE NEUROSCIENCE: NEURONAL STRUCTURE AND FUNCTION; INTELLIGENCE AND NEUROSCIENCE; METHODS OF COGNITIVE NEUROSCIENCE

1.1.1 Cognitive Neuroscience:

Cognitive neuroscience is the scientific study of the influence of brain structures on mental processes, done through the use of brain scanning techniques such as fMRI. A cognitive neuroscientist is primarily a researcher, on a quest to find out how our brains contribute to our cognitive function. These professionals might conduct research a few different ways. With today's technological boom, scientists and researchers are using computers more and more. Cognitive neuroscience deepens the understanding of the nature of scientific knowledge. Cognitive neuroscience contributes to the solution of problems found in contemporary philosophy of science.

Cognitive Neuroscience refers to the study of how brain structures and biology affect mental processes. Specific brain areas have been found to

be associated with particular actions, moods and emotions, which have been tested through brain-scanning techniques. There are some important differences between cognitive neuroscience and cognitive psychology. While cognitive psychology focuses on thinking processes, cognitive neuroscience is focused on finding connections between thinking and specific brain activity, Neuroscience is the study of the nervous system, including the brain. Much of neuroscience focuses on molecular and cellular processes. Cognitive neuroscience is the study of how cognitive operations (and at CWRU, especially human higher-order cognitive operations) might be illuminated by the study of neurobiology.

Cognitive neuroscience deepens the understanding of the nature of scientific knowledge. Cognitive neuroscience contributes to the solution of problems found in contemporary philosophy of science.

Historical origins:

Cognitive neuroscience is an interdisciplinary area of study that has emerged from neuroscience and psychology.[4] There are several stages in these disciplines that have changed the way researchers approached their investigations and that led to the field becoming fully established.

Although the task of cognitive neuroscience is to describe the neural mechanisms associated with the mind, historically it has progressed by investigating how a certain area of the brain supports a given mental faculty. However, early efforts to subdivide the brain proved to be problematic. The phrenologist movement failed to supply a scientific basis for its theories and has since been rejected. The aggregate field view, meaning that all areas of the brain participated in all behavior,[5] was also rejected as a result of brain mapping, which began with Hitzig and Fritsch's experiments[6] and eventually developed through methods such as positron emission tomography (PET) and functional magnetic resonance imaging (fMRI).[7] Gestalt theory, neuropsychology, and the cognitive revolution were major turning points in the creation of cognitive neuroscience as a field, bringing together ideas and techniques that enabled researchers to make more links between behavior and its neural substrates.

Origins in philosophy:

Philosophers have always been interested in the mind: "the idea that explaining a phenomenon involves understanding the mechanism responsible for it has deep roots in the History of Philosophy from atomic theories in 5th century B.C. to its rebirth in the 17th and 18th century in the works of Galileo, Descartes, and Boyle. Among others, it's Descartes' idea that machines humans build could work as models of scientific explanation." For example, Aristotle thought the brain was the body's cooling system and the capacity for intelligence was located in the heart. It has been suggested that the first person to believe otherwise was the Roman physician Galen in the second century AD, who declared that the brain was the source of mental activity,[9] although this has also been

accredited to Alcmaeon.[10] However, Galen believed that personality and emotion were not generated by the brain, but rather by other organs. Andreas Vesalius, an anatomist and physician, was the first to believe that the brain and the nervous system are the center of the mind and emotion.[11] Psychology, a major contributing field to cognitive neuroscience, emerged from philosophical reasoning about the mind.

Combining neuroscience and cognitive science:

Before the 1980s, interaction between neuroscience and cognitive science was scarce.[25] Cognitive neuroscience began to integrate the newly laid theoretical ground in cognitive science, that emerged between the 1950s and 1960s, with approaches in experimental psychology, neuropsychology and neuroscience. (Neuroscience was not established as a unified discipline until 1971[26]). In the very late 20th century new technologies evolved that are now the mainstay of the methodology of cognitive neuroscience, including TMS (1985) and fMRI (1991). Earlier methods used in cognitive neuroscience include EEG (human EEG 1920) and MEG (1968). Occasionally cognitive neuroscientists utilize other brain imaging methods such as PET and SPECT. An upcoming technique in neuroscience is NIRS which uses light absorption to calculate changes in oxy- and deoxyhemoglobin in cortical areas. In some animals Single-unit recording can be used. Other methods include microneurography, facial EMG, and eye tracking. Integrative neuroscience attempts to consolidate data in databases, and form unified descriptive models from various fields and scales: biology, psychology, anatomy, and clinical practice.

Adaptive resonance theory (ART) is a cognitive neuroscience theory developed by Gail Carpenter and Stephen Grossberg in the late 1970s on aspects of how the brain processes information. It describes a number of neural network models which use supervised and unsupervised learning methods, and address problems such as pattern recognition and prediction.[28]

In 2014, Stanislas Dehaene, Giacomo Rizzolatti and Trevor Robbins, were awarded the Brain Prize “for their pioneering research on higher brain mechanisms underpinning such complex human functions as literacy, numeracy, motivated behaviour and social cognition, and for their efforts to understand cognitive and behavioural disorders”.[29] Brenda Milner, Marcus Raichle and John O’Keefe received the Kavli Prize in Neuroscience “for the discovery of specialized brain networks for memory and cognition”[30] and O’Keefe shared the Nobel Prize in Physiology or Medicine in the same year with May-Britt Moser and Edvard Moser “for their discoveries of cells that constitute a positioning system in the brain”.[31]

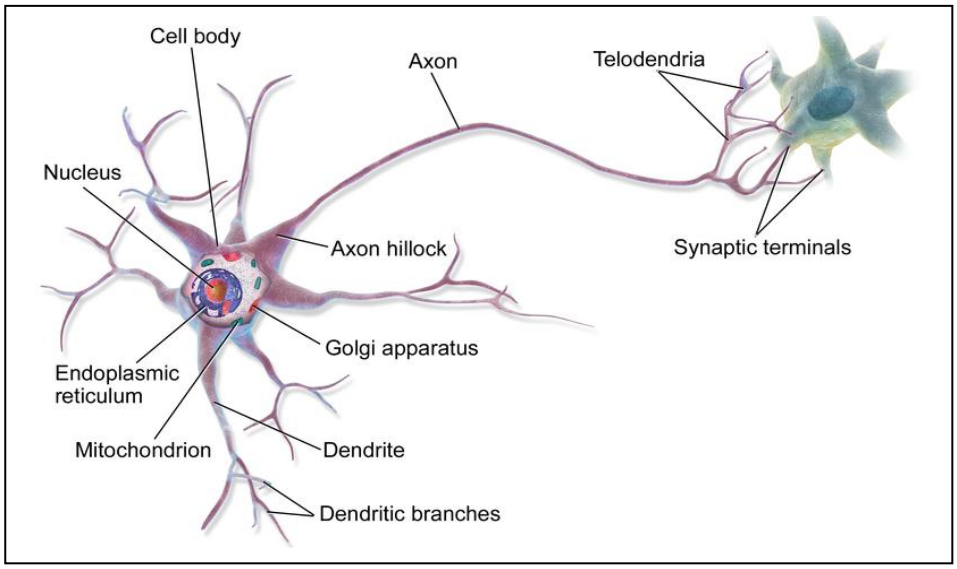
In 2017, Wolfram Schultz, Peter Dayan and Ray Dolan were awarded the Brain Prize “for their multidisciplinary analysis of brain mechanisms that link learning to reward, which has far-reaching implications for the understanding of human behaviour, including disorders of decision-

making in conditions such as gambling, drug addiction, compulsive behaviour and schizophrenia"

1.1.2 Neuronal Structure and Function:

A neuron or nerve cell is an electrically excitable cell that communicates with other cells via specialized connections called synapses. The neuron is the main component of nervous tissue in all animals except sponges and placozoa. Plants and fungi do not have nerve cells.

Figure: Structure of Neuron



Neurons are typically classified into three types based on their function. Sensory neurons respond to stimuli such as touch, sound, or light that affect the cells of the sensory organs, and they send signals to the spinal cord or brain. Motor neurons receive signals from the brain and spinal cord to control everything from muscle contractions to glandular output. Interneurons connect neurons to other neurons within the same region of the brain or spinal cord. When multiple neurons are connected together they form what is called a neural circuit.

A typical neuron consists of a cell body (soma), dendrites, and a single axon. The soma is a compact structure and the axon and dendrites are filaments extruding from the soma. Dendrites typically branch profusely and extend a few hundred micrometers from the soma. The axon leaves the soma at a swelling called the axon hillock and travels for as far as 1 meter in humans or more in other species. It branches but usually maintains a constant diameter. At the farthest tip of the axon's branches are axon terminals, where the neuron can transmit a signal across the synapse to another cell. Neurons may lack dendrites or have no axon. The term neurite is used to describe either a dendrite or an axon, particularly when the cell is undifferentiated.

Most neurons receive signals via the dendrites and soma and send out signals down the axon. At the majority of synapses, signals cross from the

axon of one neuron to a dendrite of another. However, synapses can connect an axon to another axon or a dendrite to another dendrite.

The signaling process is partly electrical and partly chemical. Neurons are electrically excitable, due to maintenance of voltage gradients across their membranes. If the voltage changes by a large enough amount over a short interval, the neuron generates an all-or-nothing electrochemical pulse called an action potential. This potential travels rapidly along the axon and activates synaptic connections as it reaches them. Synaptic signals may be excitatory or inhibitory, increasing or reducing the net voltage that reaches the soma.

In most cases, neurons are generated by neural stem cells during brain development and childhood. Neurogenesis largely ceases during adulthood in most areas of the brain.

Neurons vary in shape and size and can be classified by their morphology and function.[12] The anatomist Camillo Golgi grouped neurons into two types; type I with long axons used to move signals over long distances and type II with short axons, which can often be confused with dendrites. Type I cells can be further classified by the location of the soma. The basic morphology of type I neurons, represented by spinal motor neurons, consists of a cell body called the soma and a long thin axon covered by a myelin sheath. The dendritic tree wraps around the cell body and receives signals from other neurons. The end of the axon has branching axon terminals that release neurotransmitters into a gap called the synaptic cleft between the terminals and the dendrites of the next neuron.

Structural classification:

Most neurons can be anatomically characterized as:

- **Unipolar**: single process
- **Bipolar:** 1 axon and 1 dendrite
- **Multipolar:** 1 axon and 2 or more dendrites
- **Golgi I:** neurons with long-projecting axonal processes; examples are pyramidal cells, Purkinje cells, and anterior horn cells
- **Golgi II:** neurons whose axonal process projects locally; the best example is the granule cell
- **Anaxonic:** where the axon cannot be distinguished from the dendrite(s)
- **Pseudounipolar:** 1 process which then serves as both an axon and a dendrite

Some unique neuronal types can be identified according to their location in the nervous system and distinct shape. Some examples are:

- **Basket cells,** interneurons that form a dense plexus of terminals around the soma of target cells, found in the cortex and cerebellum
- **Betz cells**, large motor neurons
- **Lugaro cells**, interneurons of the cerebellum
- **Medium spiny neurons**, most neurons in the corpus striatum
- **Purkinje cells**, huge neurons in the cerebellum, a type of Golgi I multipolar neuron
- **Pyramidal cells**, neurons with triangular soma, a type of Golgi I
- **Renshaw cells,** neurons with both ends linked to alpha motor neurons
- **Unipolar brush cells**, interneurons with unique dendrite ending in a brush-like tuft
- **Granule cells**, a type of Golgi II neuron
- **Anterior horn cells**, motoneurons located in the spinal cord
- **Spindle cells,** interneurons that connect widely separated areas of the brain

Functional classification:

Direction:

- Afferent neurons convey information from tissues and organs into the central nervous system and are also called sensory neurons.
- Efferent neurons (motor neurons) transmit signals from the central nervous system to the effector cells.
- Interneurons connect neurons within specific regions of the central nervous system.
- Afferent and efferent also refer generally to neurons that, respectively, bring information to or send information from the brain.

Action on other neurons:

A neuron affects other neurons by releasing a neurotransmitter that binds to chemical receptors. The effect upon the postsynaptic neuron is determined by the type of receptor that is activated, not by the presynaptic neuron or by the neurotransmitter. A neurotransmitter can be thought of as a key, and a receptor as a lock: the same neurotransmitter can activate multiple types of receptors. Receptors can be classified broadly as excitatory (causing an increase in firing rate), inhibitory (causing a decrease in firing rate), or modulatory (causing long-lasting effects not directly related to firing rate).

The two most common (90%+) neurotransmitters in the brain, glutamate and GABA, have largely consistent actions. Glutamate acts on several types of receptors, and has effects that are excitatory at ionotropic receptors and a modulatory effect at metabotropic receptors. Similarly, GABA acts on several types of receptors, but all of them have inhibitory effects (in adult animals, at least). Because of this consistency, it is common for neuroscientists to refer to cells that release glutamate as "excitatory neurons", and cells that release GABA as "inhibitory neurons". Some other types of neurons have consistent effects, for example, "excitatory" motor neurons in the spinal cord that release acetylcholine, and "inhibitory" spinal neurons that release glycine.

The distinction between excitatory and inhibitory neurotransmitters is not absolute. Rather, it depends on the class of chemical receptors present on the postsynaptic neuron. In principle, a single neuron, releasing a single neurotransmitter, can have excitatory effects on some targets, inhibitory effects on others, and modulatory effects on others still. For example, photoreceptor cells in the retina constantly release the neurotransmitter glutamate in the absence of light. So-called OFF bipolar cells are, like most neurons, excited by the released glutamate. However, neighboring target neurons called ON bipolar cells are instead inhibited by glutamate, because they lack typical ionotropic glutamate receptors and instead express a class of inhibitory metabotropic glutamate receptors.[13] When light is present, the photoreceptors cease releasing glutamate, which relieves the ON bipolar cells from inhibition, activating them; this simultaneously removes the excitation from the OFF bipolar cells, silencing them.

It is possible to identify the type of inhibitory effect a presynaptic neuron will have on a postsynaptic neuron, based on the proteins the presynaptic neuron expresses. Parvalbumin-expressing neurons typically dampen the output signal of the postsynaptic neuron in the visual cortex, whereas somatostatin-expressing neurons typically block dendritic inputs to the postsynaptic neuron.[14]

Discharge patterns:

Neurons have intrinsic electroresponsive properties like intrinsic transmembrane voltage oscillatory patterns.[15] So neurons can be classified according to their electrophysiological characteristics:

- Tonic or regular spiking. Some neurons are typically constantly (tonically) active, typically firing at a constant frequency. Example: interneurons in neurostriatum.
- Phasic or bursting. Neurons that fire in bursts are called phasic.
- Fast spiking. Some neurons are notable for their high firing rates, for example some types of cortical inhibitory interneurons, cells in globus pallidus, retinal ganglion cells.[16][17]

1.1.3 Intelligence and Neuroscience:

Neuroscience and intelligence refers to the various neurological factors that are partly responsible for the variation of intelligence within species or between different species. A large amount of research in this area has been focused on the neural basis of human intelligence. Historic approaches to study the neuroscience of intelligence consisted of correlating external head parameters, for example head circumference, to intelligence.[1] Post-mortem measures of brain weight and brain volume have also been used.[1] More recent methodologies focus on examining correlates of intelligence within the living brain using techniques such as magnetic resonance imaging (MRI), functional MRI (fMRI), electroencephalography (EEG), positron emission tomography and other non-invasive measures of brain structure and activity.[1]

Researchers have been able to identify correlates of intelligence within the brain and its functioning. These include overall brain volume,[2] grey matter volume,[3] white matter volume,[4] white matter integrity,[5] cortical thickness[3] and neural efficiency.[6] Although the evidence base for our understanding of the neural basis of human intelligence has increased greatly over the past 30 years, even more research is needed to fully understand it.[1]

The neural basis of intelligence has also been examined in animals such as primates, cetaceans, and rodents.

Brain volume:

One of the main methods used to establish a relationship between intelligence and the brain is to use measures of brain volume.[1] The earliest attempts at estimating brain volume were done using measures of external head parameters, such as head circumference as a proxy for brain size.[1] More recent methodologies employed to study this relationship include post-mortem measures of brain weight and volume. These have their own limitations and strengths.[8] The advent of MRI as a non-invasive highly-accurate measure of living brain structure and function (using fMRI) made this the pre-dominant and preferred method for measuring brain volume.[1]

Overall, larger brain size and volume is associated with better cognitive functioning and higher intelligence.[1] The specific regions that show the most robust correlation between volume and intelligence are the frontal, temporal and parietal lobes of the brain.[9][10][11] A large number of studies have been conducted with uniformly positive correlations, leading to the generally safe conclusion that larger brains predict greater intelligence.[12][13] In healthy adults, the correlation of total brain volume and IQ is approximately 0.4 when high quality tests are used.[14] A large scale study (n = 29k) using the UK Biobank found a correlation of .275. The strength of this relationship did not depend on sex, contradicting some earlier studies.[15] A study using a sibling-design in two medium sized samples found evidence of causality with an effect size of .19.[16]

This study design rules out confounders that vary between families, but not those that vary within families.

Less is known about variation on scales less than total brain volume. A meta-analytic review by McDaniel found that the correlation between intelligence and in vivo brain size was larger for females (0.40) than for males (0.25).[17] The same study also found that the correlation between brain size and Intelligence increased with age, with children showing smaller correlations.[17] It has been suggested that the link between larger brain volumes and higher intelligence is related to variation in specific brain regions: a whole-brain measure would under-estimate these links.[9] For functions more specific than general intelligence, regional effects may be more important. For instance evidence suggests that in adolescents learning new words, vocabulary growth is associated with gray matter density in bilateral posterior supramarginal gyri.[18] Small studies have shown transient changes in gray-matter associated with developing a new physical skill (juggling) occipito-temporal cortex [19]

Brain volume is not a perfect account of intelligence: the relationship explains a modest amount of variance in intelligence – 12% to 36% of the variance.[8][9] The amount of variance explained by brain volume may also depend on the type of intelligence measured.[8] Up to 36% of variance in verbal intelligence can be explained by brain volume, while only approximately 10% of variance in visuospatial intelligence can be explained by brain volume.[8] A 2015 study by researcher Stuart J. Ritchie found that brain size explained 12% of the variance in intelligence among individuals.[20] These caveats imply that there are other major factors influencing how intelligent an individual is apart from brain size.[1] In a large meta-analysis consisting of 88 studies Pietschnig et al. (2015) estimated the correlation between brain volume and intelligence to be about correlation coefficient of 0.24 which equates to 6% variance.[21] Taking into account measurement quality, and sample type and IQ-range, the meta-analytic association of brain volume in appears to be ~ .4 in normal adults.[14] Researcher Jakob Pietschnig argued that the strength of the positive association of brain volume and IQ remains robust, but has been overestimated in the literature. He has stated that “It is tempting to interpret this association in the context of human cognitive evolution and species differences in brain size and cognitive ability, we show that it is not warranted to interpret brain size as an isomorphic proxy of human intelligence differences”.[21]

Grey matter:

Grey matter has been examined as a potential biological foundation for differences in intelligence. Similarly to brain volume, global grey matter volume is positively associated with intelligence.[1] More specifically, higher intelligence has been associated with larger cortical grey matter in the prefrontal and posterior temporal cortex in adults.[3] Furthermore, both verbal and nonverbal intelligence have been shown to be positively correlated with grey matter volume across the parietal, temporal and

occipital lobes in young healthy adults, implying that intelligence is associated with a wide variety of structures within the brain.

There appear to be sex differences between the relationship of grey matter to intelligence between men and women. Men appear to show more intelligence to grey matter correlations in the frontal and parietal lobes, while the strongest correlations between intelligence and grey matter in women can be found in the frontal lobes and Broca's area. However, these differences do not seem to impact overall Intelligence, implying that the same cognitive ability levels can be attained in different ways.

One specific methodology used to study grey matter correlates of intelligence in areas of the brain is known as voxel-based morphometry (VBM). VBM allows researchers to specify areas of interest with great spatial resolution, allowing the examination of grey matter areas correlated with intelligence with greater special resolution. VBM has been used to correlate grey matter positively with intelligence in the frontal, temporal, parietal, and occipital lobes in healthy adults. VBM has also been used to show that grey matter volume in the medial region of the prefrontal cortex and the dorsomedial prefrontal cortex correlate positively with intelligence in a group of 55 healthy adults. VBM has also been successfully used to establish a positive correlation between grey matter volumes in the anterior cingulate and intelligence in children aged 5 to 18 years old.

Grey matter has also been shown to positively correlate with intelligence in children Reis and colleagueshave found that grey matter in the prefrontal cortex contributes most robustly to variance in Intelligence in children between 5 and 17, while subcortical grey matter is related to intelligence to a lesser extent. Frangou and colleagues examined the relationship between grey matter and intelligence in children and young adults aged between 12 and 21, and found that grey matter in the orbitofrontal cortex, cingulate gyrus, cerebellum and thalamus was positively correlated to intelligence, while grey matter in the caudate nucleus is negatively correlated with intelligence. However, the relationship between grey matter volume and intelligence only develops over time, as no significant positive relationship can be found between grey matter volume and intelligence in children under 11.

An underlying caveat to research into the relationship of grey matter volume and intelligence is demonstrated by the hypothesis of neural efficiency. The findings that more intelligent individuals are more efficient at using their neurons might indicate that the correlation of grey matter to intelligence reflects selective elimination of unused synapses, and thus a better brain circuitry.

White matter:

Similar to grey matter, white matter has been shown to correlate positively with intelligence in humans. White matter consists mainly of myelinated neuronal axons, responsible for delivering signals between neurons. The pinkish-white color of white matter is actually a result of these myelin

sheaths that electrically insulate neurons that are transmitting signals to other neurons. White matter connects different regions of grey matter in the cerebrum together. These interconnections make transport more seamless and allow us to perform tasks easier. Significant correlations between intelligence and the corpus callosum have been found, as larger callosal areas have been positively correlated with cognitive performance. However, there appear to be differences in importance for white matter between verbal and nonverbal intelligence, as although both verbal and nonverbal measures of intelligence correlate positively with the size of the corpus callosum, the correlation for intelligence and corpus callosum size was larger for nonverbal measures than that for verbal measures. Anatomical mesh-based geometrical modeling has also shown positive correlations between the thickness of the corpus callosum and Intelligence in healthy adults.

White matter integrity has also been found to be related to Intelligence White matter tract integrity is important for information processing speed, and therefore reduced white matter integrity is related to lower intelligence. The effect of white matter integrity is mediate entirely through information processing speed. These findings indicate that the brain is structurally interconnected and that axonal fibres are integrally important for fast information process, and thus general intelligence.

Contradicting the findings described above, VBM failed to find a relationship between the corpus callosum and intelligence in healthy adults. This contradiction can be viewed to signify that the relationship between white matter volume and intelligence is not as robust as that of grey matter and intelligence.

Cortical thickness:

Cortical thickness has also been found to correlate positively with intelligence in humans. However, the rate of growth of cortical thickness is also related to intelligence. In early childhood, cortical thickness displays a negative correlation with intelligence, while by late childhood this correlation has shifted to a positive one. More intelligent children were found to develop cortical thickness more steadily and over longer periods of time than less bright children. Studies have found cortical thickness to explain 5% in the variance of intelligence among individuals. In a study conducted to find associations between cortical thickness and general intelligence between different groups of people, sex did not play a role in intelligence. Although it is hard to pin intelligence on age based on cortical thickness due to different socioeconomic circumstances and education levels, older subjects (17 - 24) tended to have less variances in terms of intelligence than when compared to younger subjects (19 - 17). dubious – discuss.

Cortical convolution:

Cortical convolution has increased the folding of the brain’s surface over the course of human evolution. It has been hypothesized that the high degree of cortical convolution may be a neurological substrate that

supports some of the human brain's most distinctive cognitive abilities. Consequently, individual intelligence within the human species might be modulated by the degree of cortical convolution.

An analysis published in 2019 found the contours of 677 children and adolescent (mean age 12.72 years) brains had a genetic correlation of almost 1 between IQ and surface area of the supramarginal gyrus on the left side of the brain.

Neural efficiency:

The neural efficiency hypothesis postulates that more intelligent individuals display less activation in the brain during cognitive tasks, as measured by Glucose metabolism. A small sample of participants (N=8) displayed negative correlations between intelligence and absolute regional metabolic rates ranging from -0.48 to -0.84, as measured by PET scans, indicating that brighter individuals were more effective processors of information, as they use less energy.[6] According to an extensive review by Neubauer & Fink[40] a large number of studies (N=27) have confirmed this finding using methods such as PET scans. EEG and fMRI.

fMRI and EEG studies have revealed that task difficulty is an important factor affecting neural efficiency. More intelligent individuals display neural efficiency only when faced with tasks of subjectively easy to moderate difficulty, while no neural efficiency can be found during difficult tasks. In fact, more able individuals appear to invest more cortical resources in tasks of high difficulty. This appears to be especially true for the Prefrontal Cortex, as individuals with higher intelligence displayed increased activation of this area during difficult tasks compared to individuals with lower intelligence. It has been proposed that the main reason for the neural efficiency phenomenon could be that individuals with high intelligence are better at blocking out interfering information than individuals with low intelligence.

Further research:

Some scientists prefer to look at more qualitative variables to relate to the size of measurable regions of known function, for example relating the size of the primary visual cortex to its corresponding functions, that of visual performance.

In a study of the head growth of 633 term-born children from the Avon Longitudinal Study of Parents and Children cohort, it was shown that prenatal growth and growth during infancy were associated with subsequent IQ. The study's conclusion was that the brain volume a child achieves by the age of 1 year helps determine later intelligence. Growth in brain volume after infancy may not compensate for poorer earlier growth.

There is an association between IQ and myopia. One suggested explanation is that one or several pleiotropic gene(s) affect the size of the neocortex part of the brain and eyes simultaneously.[51]

Parieto-frontal integration theory:

In 2007, Behavioral and Brain Sciences published a target article that put forth a biological model of intelligence based on 37 peer-reviewed neuroimaging studies (Jung & Haier, 2007). Their review of a wealth of data from functional imaging (functional magnetic resonance imaging and positron emission tomography) and structural imaging (diffusion MRI, voxel-based morphometry, in vivo magnetic resonance spectroscopy) argues that human intelligence arises from a distributed and integrated neural network comprising brain regions in the frontal and parietal lobes.

A recent lesion mapping study conducted by Barbey and colleagues provides evidence to support the P-FIT theory of intelligence.

Brain injuries at an early age isolated to one side of the brain typically results in relatively spared intellectual function and with IQ in the normal range.

1.1.4 Methods of cognitive neuroscience:

Psychophysics:

Psychophysics quantitatively investigates the relationship between physical stimuli and the sensations and perceptions they produce. Psychophysics has been described as "the scientific study of the relation between stimulus and sensation" or, more completely, as "the analysis of perceptual processes by studying the effect on a subject's experience or behaviour of systematically varying the properties of a stimulus along one or more physical dimensions".

Psychophysics also refers to a general class of methods that can be applied to study a perceptual system. Modern applications rely heavily on threshold measurement, ideal observer analysis, and signal detection theory.

Psychophysics has widespread and important practical applications. For example, in the study of digital signal processing, psychophysics has informed the development of models and methods of lossy compression. These models explain why humans perceive very little loss of signal quality when audio and video signals are formatted using lossy compression.

Eye tracking:

Eye tracking is the process of measuring either the point of gaze (where one is looking) or the motion of an eye relative to the head. An eye tracker is a device for measuring eye positions and eye movement. Eye trackers are used in research on the visual system, in psychology, in psycholinguistics, marketing, as an input device for human-computer interaction, and in product design. Eye trackers are also being increasingly used for rehabilitative and assistive applications (related,for instance, to control of wheel chairs, robotic arms and prostheses). There are a number of methods for measuring eye movement. The most popular variant uses

video images from which the eye position is extracted. Other methods use search coils or are based on the electrooculogram.

Functional magnetic resonance imaging or functional MRI:

Functional magnetic resonance imaging or functional MRI (fMRI) measures brain activity by detecting changes associated with blood flow. This technique relies on the fact that cerebral blood flow and neuronal activation are coupled. When an area of the brain is in use, blood flow to that region also increases.

The primary form of fMRI uses the blood-oxygen-level dependent (BOLD) contrast, discovered by Seiji Ogawa in 1990. This is a type of specialized brain and body scan used to map neural activity in the brain or spinal cord of humans or other animals by imaging the change in blood flow (hemodynamic response) related to energy use by brain cells. Since the early 1990s, fMRI has come to dominate brain mapping research because it does not involve the use of injections, surgery, the ingestion of substances, or exposure to ionizing radiation. This measure is frequently corrupted by noise from various sources; hence, statistical procedures are used to extract the underlying signal. The resulting brain activation can be graphically represented by color-coding the strength of activation across the brain or the specific region studied. The technique can localize activity to within millimeters but, using standard techniques, no better than within a window of a few seconds. Other methods of obtaining contrast are arterial spin labeling and diffusion MRI. Diffusion MRI is similar to BOLD fMRI but provides contrast based on the magnitude of diffusion of water molecules in the brain.

In addition to detecting BOLD responses from activity due to tasks or stimuli, fMRI can measure resting state, or negative-task state, which shows the subjects' baseline BOLD variance. Since about 1998 studies have shown the existence and properties of the default mode network, a functionally connected neural network of apparent resting brain states.

fMRI is used in research, and to a lesser extent, in clinical work. It can complement other measures of brain physiology such as electroencephalography (EEG), and near-infrared spectroscopy (NIRS). Newer methods which improve both spatial and time resolution are being researched, and these largely use biomarkers other than the BOLD signal. Some companies have developed commercial products such as lie detectors based on fMRI techniques, but the research is not believed to be developed enough for widespread commercial use.

Electroencephalography (EEG):

Electroencephalography (EEG) is a method to record an electrogram of the electrical activity on the scalp that has been shown to represent the macroscopic activity of the surface layer of the brain underneath. It is typically non-invasive, with the electrodes placed along the scalp. Electrocorticography, involving invasive electrodes, is sometimes called "intracranial EEG".

EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain. Clinically, EEG refers to the recording of the brain's spontaneous electrical activity over a period of time, as recorded from multiple electrodes placed on the scalp. Diagnostic applications generally focus either on event-related potentials or on the spectral content of EEG. The former investigates potential fluctuations time locked to an event, such as 'stimulus onset' or 'button press'. The latter analyses the type of neural oscillations (popularly called "brain waves") that can be observed in EEG signals in the frequency domain.

EEG is most often used to diagnose epilepsy, which causes abnormalities in EEG readings. It is also used to diagnose sleep disorders, depth of anesthesia, coma, encephalopathies, and brain death. EEG used to be a first-line method of diagnosis for tumors, stroke and other focal brain disorders, but this use has decreased with the advent of high-resolution anatomical imaging techniques such as magnetic resonance imaging (MRI) and computed tomography (CT). Despite limited spatial resolution, EEG continues to be a valuable tool for research and diagnosis. It is one of the few mobile techniques available and offers millisecond-range temporal resolution which is not possible with CT, PET or MRI.

Derivatives of the EEG technique include evoked potentials (EP), which involves averaging the EEG activity time-locked to the presentation of a stimulus of some sort (visual, somatosensory, or auditory). Event-related potentials (ERPs) refer to averaged EEG responses that are time-locked to more complex processing of stimuli; this technique is used in cognitive science, cognitive psychology, and psychophysiological research.

Magnetoencephalography (MEG):

Magnetoencephalography (MEG) is a functional neuroimaging technique for mapping brain activity by recording magnetic fields produced by electrical currents occurring naturally in the brain, using very sensitive magnetometers. Arrays of SQUIDs (superconducting quantum interference devices) are currently the most common magnetometer, while the SERF (spin exchange relaxation-free) magnetometer is being investigated for future machines.[1][2] Applications of MEG include basic research into perceptual and cognitive brain processes, localizing regions affected by pathology before surgical removal, determining the function of various parts of the brain, and neurofeedback. This can be applied in a clinical setting to find locations of abnormalities as well as in an experimental setting to simply measure brain activity.

Electrocorticography (ECoG):

Electrocorticography (ECoG), or intracranial electroencephalography (iEEG), is a type of electrophysiological monitoring that uses electrodes placed directly on the exposed surface of the brain to record electrical activity from the cerebral cortex. In contrast, conventional electroencephalography (EEG) electrodes monitor this activity from outside the skull. ECoG may be performed either in the operating room during surgery (intraoperative ECoG) or outside of surgery (extraoperative

ECoG). Because a craniotomy (a surgical incision into the skull) is required to implant the electrode grid, ECoG is an invasive procedure.

Transcranial magnetic stimulation (TMS):

Transcranial magnetic stimulation (TMS) is a noninvasive form of brain stimulation in which a changing magnetic field is used to cause electric current at a specific area of the brain through electromagnetic induction. An electric pulse generator, or stimulator, is connected to a magnetic coil, which in turn is connected to the scalp. The stimulator generates a changing electric current within the coil which induces a magnetic field; this field then causes a second inductance of inverted electric charge within the brain itself.

TMS has shown diagnostic and therapeutic potential in the central nervous system with a wide variety of disease states in neurology and mental health, with research still evolving.

Adverse effects of TMS are rare and include fainting and seizure. Other potential issues include discomfort, pain, hypomania, cognitive change, hearing loss, and inadvertent current induction in implanted devices such as pacemakers or defibrillators

Mathematical model:

A mathematical model is a description of a system using mathematical concepts and language. The process of developing a mathematical model is termed mathematical modeling. Mathematical models are used in the natural sciences (such as physics, biology, earth science, chemistry) and engineering disciplines (such as computer science, electrical engineering), as well as in non-physical systems such as the social sciences (such as economics, psychology, sociology, political science). The use of mathematical models to solve problems in business or military operations is a large part of the field of operations research. Mathematical models are also used in music, linguistics, and philosophy (for example, intensively in analytic philosophy).

A model may help to explain a system and to study the effects of different components, and to make predictions about behavior.

1.2 VISUAL PERCEPTION: VISUAL OBJECT RECOGNITION, FACE PERCEPTION

Visual perception, or sight, is the ability to interpret the surrounding environment through photopic vision (daytime vision), color vision, scotopic vision (night vision), and mesopic vision (twilight vision), using light in the visible spectrum reflected by objects in the environment. This is different from visual acuity, which refers to how clearly a person sees (for example "20/20 vision"). A person can have problems with visual perceptual processing even if they have 20/20 vision.

The resulting perception is also known as vision, sight, or eyesight (adjectives visual, optical, and ocular, respectively). The various physiological components involved in vision are referred to collectively as the visual system, and are the focus of much research in linguistics, psychology, cognitive science, neuroscience, and molecular biology, collectively referred to as vision science.

Visual system:

In humans and a number of other mammals, light enters the eye through the cornea and is focused by the lens onto the retina, a light-sensitive membrane at the back of the eye. The retina serves as a transducer for the conversion of light into neuronal signals. This transduction is achieved by specialized photoreceptive cells of the retina, also known as the rods and cones, which detect the photons of light and respond by producing neural impulses. These signals are transmitted by the optic nerve, from the retina upstream to central ganglia in the brain. The lateral geniculate nucleus, which transmits the information to the visual cortex. Signals from the retina also travel directly from the retina to the superior colliculus.

The lateral geniculate nucleus sends signals to primary visual cortex, also called striate cortex. Extrastriate cortex, also called visual association cortex is a set of cortical structures, that receive information from striate cortex, as well as each other. Recent descriptions of visual association cortex describe a division into two functional pathways, a ventral and a dorsal pathway. This conjecture is known as the two streams hypothesis.

The human visual system is generally believed to be sensitive to visible light in the range of wavelengths between 370 and 730 nanometers (0.00000037 to 0.00000073 meters) of the electromagnetic spectrum. However, some research suggests that humans can perceive light in wavelengths down to 340 nanometers (UV-A), especially the young. Under optimal conditions these limits of human perception can extend to 310 nm (UV) to 1100 nm (NIR).

1.2.1 Visual Object Recognition:

Visual object recognition refers to the ability to identify the objects in view based on visual input. One important signature of visual object recognition is “object invariance”, or the ability to identify objects across changes in the detailed context in which objects are viewed, including changes in illumination, object pose, and background context.

Basic stages of object recognition:

Neuropsychological evidence affirms that there are four specific stages identified in the process of object recognition. These stages are:

- Stage 1 Processing of basic object components, such as color, depth, and form.

- Stage 2 These basic components are then grouped on the basis of similarity, providing information on distinct edges to the visual form. Subsequently, figure-ground segregation is able to take place.
- Stage 3 The visual representation is matched with structural descriptions in memory.
- Stage 4 Semantic attributes are applied to the visual representation, providing meaning, and thereby recognition.

Within these stages, there are more specific processes that take place to complete the different processing components. In addition, other existing models have proposed integrative hierarchies (top-down and bottom-up), as well as parallel processing, as opposed to this general bottom-up hierarchy.

1.2.2 Face perception:

Facial perception is an individual's understanding and interpretation of the face. Here, perception implies the presence of consciousness and hence excludes automated facial recognition systems. Although facial recognition is found in other species, this article focuses on facial perception in humans.

The perception of facial features is an important part of social cognition. Information gathered from the face helps people understand each other's identity, what they are thinking and feeling, anticipate their actions, recognize their emotions, build connections, and communicate through body language. Developing facial recognition is a necessary building block for complex societal constructs. Being able to perceive identity, mood, age, sex, and race lets people mold the way we interact with one another, and understand our immediate surrounding.

Though facial perception is mainly considered to stem from visual intake, studies have shown that even people born blind can learn face perception without vision. Studies have supported the notion of a specialized mechanism for perceiving faces

Early development:

Despite numerous studies, there is no widely accepted time-frame in which the average human develops the ability to perceive faces.

Ability to discern faces from other objects:

Many studies have found that infants will give preferential attention to faces in their visual field, indicating they can discern faces from other objects.

While newborns will often show particular interest in faces at around three months of age, that preference slowly disappears, re-emerges late during the first year, and slowly declines once more over the next two years of life.

While newborns show a preference to faces as they grow older (specifically between one and four months of age) this interest can be inconsistent.

Infants turning their heads towards faces or face-like images suggest rudimentary facial processing capacities.

The re-emergence of interest in faces at three months is likely influenced by a child's motor abilities.

Ability to detect emotion in the face:

At around seven months of age, infants show the ability to discern faces by emotion. However, whether they have fully developed emotion recognition is unclear. Discerning visual differences in facial expressions is different to understanding the valence of a particular emotion.

7-month-olds seem capable of associating emotional prosodies with facial expressions. When presented with a happy or angry face, followed by an emotionally neutral word read in a happy or angry tone, their event-related potentials follow different patterns. Happy faces followed by angry vocal tones produce more changes than the other incongruous pairing, while there was no such difference between happy and angry congruous pairings. The greater reaction implies that infants held greater expectations of a happy vocal tone after seeing a happy face than an angry tone following an angry face.

By the age of seven months, children are able to recognize an angry or fearful facial expression, perhaps because of the threat-salient nature of the emotion. Despite this ability, newborns are not yet aware of the emotional content encoded within facial expressions.

Infants can comprehend facial expressions as social cues representing the feelings of other people before they are a year old. Seven-month-old infants show greater negative central components to angry faces that are looking directly at them than elsewhere, although the gaze of fearful faces produces no difference. In addition, two event-related potentials in the posterior part of the brain are differently aroused by the two negative expressions tested. These results indicate that infants at this age can partially understand the higher level of threat from anger directed at them.[20] They also showed activity in the occipital areas.

5-month-olds, when presented with an image of a fearful expression and a happy expression, exhibit similar event-related potentials for both. However, when seven-month-olds are given the same treatment, they focus more on the fearful face. This result indicates increased cognitive focus toward fear that reflects the threat-salient nature of the emotion. Seven-month-olds regard happy and sad faces as distinct emotive categories.

By seven months, infants are able to use facial expressions to understand others' behavior. Seven-month-olds look to use facial cues to understand

the motives of other people in ambiguous situations, as shown in a study where infants watched the experimenter's face longer if the experimenter took a toy from them and maintained a neutral expression, as opposed to if the experimenter made a happy expression. When infants are exposed to faces, it varies depending on factors including facial expression and eye gaze direction.

Emotions likely play a large role in our social interactions. The perception of a positive or negative emotion on a face affects the way that an individual perceives and processes that face. A face that is perceived to have a negative emotion is processed in a less holistic manner than a face displaying a positive emotion.

While seven-month-olds have been found to focus more on fearful faces, a study found that "happy expressions elicit enhanced sympathetic arousal in infants" both when facial expressions were presented subliminally and in a way that the infants were consciously aware of the stimulus. Conscious awareness of a stimulus is not connected to an infant's reaction.

Ability to recognize familiar faces:

It is unclear when humans develop the ability to recognize familiar faces. Studies have varying results, and may depend on multiple factors (such as continued exposure to particular faces during a certain time period).

Early perceptual experience is crucial to the development of adult visual perception, including the ability to identify familiar people and comprehend facial expressions. The capacity to discern between faces, like language[how?], appears to have broad potential in early life that is whittled down to the kinds of faces experienced in early life.

The neural substrates of face perception in infants are similar to those of adults, but the limits of child-safe imaging technology currently obscure specific information from subcortical areas like the amygdala, which is active in adult facial perception. They also showed activity near the fusiform gyrus,

Healthy adults likely process faces via a retinotectal (subcortical) pathway:

Infants can discern between macaque faces at six months of age, but, without continued exposure, cannot do so at nine months of age. If they were shown photographs of macaques during this three-month period, they were more likely to retain this ability.

Faces "convey a wealth of information that we use to guide our social interactions".[30] They also found that the neurological mechanisms responsible for face recognition are present by age five. Children process faces is similar to that of adults, but adults process faces more efficiently. The may be because of advancements in memory and cognitive functioning.

Interest in the social world is increased by interaction with the physical environment. They found that training three-month-old infants to reach for objects with Velcro-covered "sticky mitts" increased the attention they pay to faces compared to moving objects through their hands and control groups.

Ability to 'mimic' faces:

A commonly disputed topic is the age at which we can mimic facial expressions.

Infants as young as two days are capable of mimicking an adult, able to note details like mouth and eye shape as well as move their own muscles to produce similar patterns.

However, the idea that those infants younger than two could mimic facial expressions was disputed by Susan S. Jones, who believed that infants are unaware of the emotional content encoded within facial expressions, and also found they are not able to imitate facial expressions until their second year of life. She also found that mimicry emerged at different ages.

1.3 ATTENTION AND CONSCIOUSNESS: ATTENTION PROCESSES, THEORIES OF ATTENTION, CONSCIOUSNESS OF MENTAL PROCESSES; PRECONSCIOUS PROCESSING

Attention:

Attention is the behavioral and cognitive process of selectively concentrating on a discrete aspect of information, whether considered subjective or objective, while ignoring other perceivable information. William James (1890) wrote that "Attention is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence." Attention has also been described as the allocation of limited cognitive processing resources. Attention is manifested by an attentional bottleneck, in term of the amount of data the brain can process each second; for example, in human vision, only less than 1% of the visual input data (at around one megabyte per second) can enter the bottleneck, leading to inattentional blindness.

Attention remains a crucial area of investigation within education, psychology, neuroscience, cognitive neuroscience, and neuropsychology. Areas of active investigation involve determining the source of the sensory cues and signals that generate attention, the effects of these sensory cues and signals on the tuning properties of sensory neurons, and the relationship between attention and other behavioral and cognitive processes, which may include working memory and psychological vigilance. A relatively new body of research, which expands upon earlier research within psychopathology, is investigating the diagnostic symptoms

associated with traumatic brain injury and its effects on attention. Attention also varies across cultures.

The relationships between attention and consciousness are complex enough that they have warranted perennial philosophical exploration. Such exploration is both ancient and continually relevant, as it can have effects in fields ranging from mental health and the study of disorders of consciousness to artificial intelligence and its domains of research.

Consciousness:

Consciousness, at its simplest, is sentience or awareness of internal and external existence.Despite millennia of analyses, definitions, explanations and debates by philosophers and scientists, consciousness remains puzzling and controversial, being "at once the most familiar and [also the] most mysterious aspect of our lives". Perhaps the only widely agreed notion about the topic is the intuition that consciousness exists. Opinions differ about what exactly needs to be studied and explained as consciousness. Sometimes, it is synonymous with the mind, and at other times, an aspect of mind. In the past, it was one's "inner life", the world of introspection, of private thought, imagination and volition. Today, it often includes any kind of cognition, experience, feeling or perception. It may be awareness, awareness of awareness, or self-awareness either continuously changing or not. There might be different levels or orders of consciousness, or different kinds of consciousness, or just one kind with different features. Other questions include whether only humans are conscious, all animals, or even the whole universe. The disparate range of research, notions and speculations raises doubts about whether the right questions are being asked.

Examples of the range of descriptions, definitions or explanations are: simple wakefulness, one's sense of selfhood or soul explored by "looking within"; being a metaphorical "stream" of contents, or being a mental state, mental event or mental process of the brain; having phanera or qualia and subjectivity; being the 'something that it is like' to 'have' or 'be' it; being the "inner theatre" or the executive control system of the mind.

1.3.1 Attention Processes:

Right now, as you are reading these lines, you are exercising attention. Often studied by cognitive psychologists, attention has been found to play vital role in every aspect of human behaviour. Ross (1951) has defined it as "the process of getting an object or thought clearly before the mind". Whereas, according to William James, "attention is focusing of consciousness on a particular object. It implies withdrawal from some things in order to deal effectively with others. It is taking possession of one, out of several simultaneous objects or trains of thought by the mind, in clear and vivid form". There are broadly four forms of attention: selective attention, divided attention, sustained attention, and executive attention.

Selective attention:

When bombarded with numerous attention grabbing environmental factors or stimuli, our brain selectively focus on particular stimuli and block out other stimuli consciously. This term of attention is known as selective attention.

Divided attention:

It refers to the ability to maintain attention on two or more tasks simultaneously. For example, texting while talking to someone. According to some psychologists it is the ability to multi-task.

Executive attention:

This form of attention helps us in blocking out unimportant features of the environment and motivates us to attend only those features that are important of our goal accomplishment.

Sustained attention:

This form of attention helps us in maintaining focus or concentration on one task for a prolonged period of time.

1.3.2 Theories of Attention:

Chun et al. [5] distinguished attention according to the types of information that attention operates over. Therefore, external attention refers to the selection and modulation of sensory information (perceptual attention), whereas internal attention includes cognitive control as well as the contents of working memory, long-term memory, task sets or response selection (central/reflective attention). Cognitive control mechanisms prioritize, independent of sensory modality, which perceptual information to select, encode and maintain in working memory, while suppressing distraction. Moreover, executive processes and working memory influence perceptual processes and guide eye movements. However, perceptual attention can also influence what gets maintained in working memory. Unattended objects or events can be processed if the primary target task is easy, indicative of late selection. On the contrary, if the primary task is very difficult, all of attention becomes devoted to the target, revealing patterns of early selection. Increased central load, such as increased working memory load or task switching, increases interference from distractors and results in full perceptual identification of ignored items (late selection). Finally, overt training of attention represents a highly promising area for interdisciplinary and translational research.

Kerr et al. [14] proposed a neural framework to explain how body-focused attention could exert “upward” influence on metacognition and on cognitive and emotion regulation. More specifically, body-focused attentional practice enhances localized attentional control over the 7-14 Hz alpha rhythm that is thought to play a key role in regulating sensory input to sensory neocortex as well as enhancing signal-to-noise properties across the neocortex. The generalization of top-down, attentional alpha rhythm

modulation to other thalamocortical circuits could enhance one's ability to filter and prioritize the flow of information throughout the brain, such as selective attention and working memory. Somatic attentional modulation proved to bring about a more generalized improvement in selective spatial attention both in visual and auditory modalities. Moreover, increased alpha power facilitated working memory processes through suppressing irrelevant, internal stimuli by attending to a sensory stimulus such as breadth. Furthermore, somatotopically focused attention enabled the broader modulation of the sensory field, which in turn enabled a more sustained, yet homeostatically, regulated attention to distressing thoughts, feelings and sensations.

Finally, working through the sequence from mindfulness of the body to mindfulness of thoughts evoked one's ability to maintain greater attentional flexibility and thus, be present, but non-reactive to his internal experiences, such as negative cognitions and strong negative emotions.

Tsuchiya et al. [27] made a review study on the relationship between consciousness and attention. There is a common belief, originating from the pre-frontal parietal network (PPN) that consciousness in different senses is always interrelated with a type of attention. Moreover, the pre-frontal parietal network (PPN) is also associated with working memory, executive control and chunking, thus, attention complements the set of the core psychological components of consciousness. However, others are in favor of attention and consciousness following an independent path in their route to decision making processes. Except from the variable types of attention and consciousness and, possibly, their separable function, researchers point to the intermodal effects of attention on consciousness. Conscious auditory perception, olfactory consciousness as well as conscious retrieval of memories were all found to be influenced by attention.

Notwithstanding, there is an ample field for empirical investigation regarding the effects of top-down attention on the conscious perception of an isolated stimulus that is either dominant (visual input or input present in time) or non-dominant (olfaction and memory or past memory/future planning). Therefore, peripheral vision, unexpected strong olfactory stimuli as well as the feeling of familiarity may all interfere with top-down attention and its interrelation with conscious experience.

1.3.3. Consciousness of Mental Processes:

Consciousness, at its simplest, is sentience or awareness of internal and external existence.[1] Despite millennia of analyses, definitions, explanations and debates by philosophers and scientists, consciousness remains puzzling and controversial, being "at once the most familiar and [also the] most mysterious aspect of our lives". Perhaps the only widely agreed notion about the topic is the intuition that consciousness exists. Opinions differ about what exactly needs to be studied and explained as consciousness. Sometimes, it is synonymous with the mind, and at other times, an aspect of mind. In the past, it was one's "inner life", the world of

introspection, of private thought, imagination and volition. Today, it often includes any kind of cognition, experience, feeling or perception. It may be awareness, awareness of awareness, or self-awareness either continuously changing or not. There might be different levels or orders of consciousness, or different kinds of consciousness, or just one kind with different features. Other questions include whether only humans are conscious, all animals, or even the whole universe. The disparate range of research, notions and speculations raises doubts about whether the right questions are being asked.

Examples of the range of descriptions, definitions or explanations are: simple wakefulness, one's sense of selfhood or soul explored by "looking within"; being a metaphorical "stream" of contents, or being a mental state, mental event or mental process of the brain; having phanera or qualia and subjectivity; being the 'something that it is like' to 'have' or 'be' it; being the "inner theatre" or the executive control system of the mind.

Mental processes:

Mental processes encompass all the things that the human mind can do naturally. Common mental processes include memory, emotion, perception, imagination, thinking and reasoning. Since the human mind is constantly active, mental processes are continuously relevant and affecting or intaking events from daily life. Cognitive psychology is defined as the study of individual-level mental processes such as information processing, attention, language use, memory, perception, problem solving, decision-making, and thinking.

The 8 basic psychological processes are: (a) perception, (b) learning, (c) language, (d) thought, (e) attention, (f) memory, (g) motivation, and (h) emotion. Let's look at each process individually. All are closely related to each other.

1.3.4 Preconscious Processing:

Preconscious processing, a term coined to design a neural process that potentially carries enough activation for conscious access, but is temporarily buffered in a nonconscious store,

Hypnosis:

There may be a connection between hypnosis and creativity because they both involve the preconscious. As Krippner (1965) put it, "hypnosis … may aid the breakdown into the preverbal realm where the creative inspiration has its origin" (p. 94). The preverbal realm is the preconscious. In this light there may be a connection because creative persons and creative processes do sometimes draw from the preconscious (Rothenberg 1990; Smith & Amner 1997Rothenberg, 1990Smith and Amner, 1997) and because they tend to be open to experience (McCrae 1987). Openness may allow them to consider ideas in the preconscious—and the possibility of being hypnotized—as reasonable and feasible. Note the wording,

however: some creative persons, some creative processes, and some of the time. Not all creativity relies on the preconscious. Some creative acts are intentional and tactical instead. Furthermore, differences among creative persons suggest that whereas some employ certain paths in their creative efforts, others take other paths.

Bowers (1979) also reported an association between hypnotizability and creativity. It is difficult to interpret this particular study, however, because of its only moderate sample size (N = 32) and the use of a composite index of creativity. That composite did include a divergent thinking test (i.e., consequences), but scores were combined with ratings from a measure of creative activities. She also reported moderate but statistically significant correlations between creativity and absorption, and between what she called effortless experiencing and creativity. Effortless experiencing would seem to parallel Langer's (1989) concept of mindfulness, as well as absorption and flow (Csikszentmihalyi 1999). Indeed, we have a set of parallel processes, with these and absorption (also see Bowers 1967, 1978Bowers, 1967Bowers, 1978).

It may be that the relationship between hypnosis and verbal creativity is different from that between hypnosis and nonverbal material (Ashton & McDonald 1985).

Manmiller et al. (2005) found certain creative styles to be related to absorption more than hypnotizability. They did not, however, administer EEG, PET, or MRIs (Ashton & McDonald 1985; Bowers 1968, 1971; Bowers & van der Meulen 1970; P. Bowers 1967; Gur & Reyher 1976Ashton and McDonald, 1985Bowers, 1968Bowers, 1971Bowers and van der Meulen, 1970Bowers, 1967Gur and Rayner, 1976).

Visual Masking:

Visual masking is an experimental paradigm widely used in different domains of cognitive research such as studying preconscious processes (e.g., priming), neural correlates of consciousness, spatiotemporal limits of visual discrimination, perception-related endophenotypes associated with psychopathology, etc. However, a comprehensive review of the state of the psychological science of visual masking has not been published recently. Masking research can be categorized into two mutually related varieties. In a broader sense masking is an experimental tool for the precise control over the availability of visual information used in a wide variety of studies of sensory, perceptual, cognitive, and affective processes and the set of studies belonging to this category is virtually limitless. In a more narrow sense masking research focuses on studying the sensory, perceptual, decision- and consciousness-related mechanisms responsible for the emergence of the phenomenon of masking itself and on the description of the varied effects subsumed under the concept of masking. The present book gives an overview of the recent research in visual masking specifically in terms of the latter above-mentioned aspect. Special emphasize is put on the novel aspects having emerged just recently that have not been comprehensively reviewed so far.

1.4 NEUROPSYCHOLOGICAL BASIS OF ATTENTION AND VISUAL PERCEPTION

Attention in Neuroscience and Psychology:

The scientific study of attention began in psychology, where careful behavioral experimentation can give rise to precise demonstrations of the tendencies and abilities of attention in different circumstances. Cognitive science and cognitive psychology aim to turn these observations into models of how mental processes could create such behavioral patterns. Many word models and computational models have been created that posit different underlying mechanisms (Driver, 2001; Borji and Itti, 2012).

The influence of single-cell neurophysiology in non-human primates along with non-invasive means of monitoring human brain activity such as EEG, fMRI, and MEG have made direct observation of the underlying neural processes possible. From this, computational models of neural circuits have been built that can replicate certain features of the neural responses that relate to attention (Shipp, 2004).

In the following sub-sections, the behavioral and neural findings of several different broad classes of attention will be discussed.

Attention as Arousal, Alertness, or Vigilance:

In its most generic form, attention could be described as merely an overall level of alertness or ability to engage with surroundings. In this way it interacts with arousal and the sleep-wake spectrum. Vigilance in psychology refers to the ability to sustain attention and is therefore related as well. Note, while the use of these words clusters around the same meaning, they are sometimes used more specifically in different niche literature (Oken et al., 2006).

Studying subjects in different phases of the sleep-wake cycle, under sleep deprivation, or while on sedatives offers a view of how this form of attention can vary and what the behavioral consequences are. By giving subjects repetitive tasks that require a level of sustained attention—such as keeping a ball within a certain region on a screen—researchers have observed extended periods of poor performance in drowsy patients that correlate with changes in EEG signals (Makeig et al., 2000). Yet, there are ways in which tasks can be made more engaging that can lead to higher performance even in drowsy or sedated states. This includes increasing the promise of reward for performing the task, adding novelty or irregularity, or introducing stress (Oken et al., 2006). Therefore, general attention appears to have limited reserves that won't be deployed in the case of a mundane or insufficiently rewarding task but can be called upon for more promising or interesting work.

Interestingly, more arousal is not always beneficial. The Yerkes-Dodson curve (Figure 1B) is an inverted-U that represents performance as a function of alertness on sufficiently challenging tasks: at low levels of alertness performance is poor, at medium levels it is good, and at high

levels it becomes poor again. The original study used electric shocks in mice to vary the level of alertness, but the finding has been repeated with other measures (Diamond, 2005). It may explain why psychostimulants such as Adderall or caffeine can work to increase focus in some people at some doses but become detrimental for others (Wood et al., 2014).

Attention and Visual Perception:

Saccades are small and rapid eye movements made several times each second. As the fovea offers the highest visual resolution on the retina, choosing where to place it is essentially a choice about where to deploy limited computational resources. In this way, eye movements indicate the locus of attention. As this shift of attention is outwardly visible it is known as overt visual attention.

By tracking eye movements as subjects are presented with different images, researchers have identified image patterns that automatically attract attention. Such patterns are defined by oriented edges, spatial frequency, color contrast, intensity, or motion (Itti and Koch, 2001). Image regions that attract attention are considered "salient" and are computed in a "bottom-up" fashion. That is, they don't require conscious or effortful processing to identify and are likely the result of built-in feature detectors in the visual system. As such, saliency can be computed very quickly. Furthermore, different subjects tend to agree on which regions are salient, especially those identified in the first few saccades (Tatler et al., 2005).

Salient regions can be studied in "free-viewing" situations, that is, when the subject is not given any specific instructions about how to view the image. When a particular task is assigned, the interplay between bottom-up and "top-down" attention becomes clear. For example, when instructed to saccade to a specific visual target out of an array, subjects may incorrectly saccade to a particularly salient distractor instead (van Zoest and Donk, 2005). More generally, task instructions can have a significant effect on the pattern of saccades generated when subjects are viewing a complex natural image and given high-level tasks (e.g., asked to assess the age of a person or guess their socio-economic status). Furthermore, the natural pattern of eye movements when subjects perform real world tasks, like sandwich making, can provide insights to underlying cognitive processes (Hayhoe and Ballard, 2005).

When subjects need to make multiple saccades in a row they tend not to return to locations they have recently attended and may be slow to respond if something relevant occurs there. This phenomenon is known as inhibition of return (Itti and Koch, 2001). Such behavior pushes the visual system to not just exploit image regions originally deemed most salient but to explore other areas as well. It also means the saccade generating system needs to have a form of memory; this is believed to be implemented by short-term inhibition of the representation of recently-attended locations.

While eye movements are an effective means of controlling visual attention, they are not the only option. "Covert" spatial attention is a way of emphasizing processing of different spatial locations without an overt shift in fovea location. Generally, in the study of covert spatial attention, subjects must fixate on a central point throughout the task. They are cued to covertly attend to a location in their peripheral vision where stimuli relevant for their visual task will likely appear. For example, in an orientation discrimination task, after the spatial cue is provided an oriented grating will flash in the cued location and the subject will need to indicate its orientation. On invalidly-cued trials (when the stimulus appears in an uncued location), subjects perform worse than on validly-cued (or uncued) trials (Anton-Erxleben and Carrasco, 2013). This indicates that covert spatial attention is a limited resource that can be flexibly deployed and aids in the processing of visual information.

Covert spatial attention is selective in the sense that certain regions are selected for further processing at the expense of others. This has been referred to as the "spotlight" of attention. Importantly, for covert—as opposed to overt—attention the input to the visual system can be identical while the processing of that input is flexibly selective.

Covert spatial attention can be impacted by bottom-up saliency as well. If an irrelevant but salient object is flashed at a location that then goes on to have a task relevant stimulus, the exogenous spatial attention drawn by the irrelevant stimulus can get applied to the task relevant stimulus, possibly providing a performance benefit. If it is flashed at an irrelevant location, however, it will not help, and can harm performance (Berger et al., 2005). Bottom-up/exogenous attention has a quick time course, impacting covert attention for 80–130 ms after the distractor appears (Anton-Erxleben and Carrasco, 2013).

In some theories of attention, covert spatial attention exists to help guide overt attention. Particularly, the pre-motor theory of attention posits that the same neural circuits plan saccades and control covert spatial attention (Rizzolatti et al., 1987). The frontal eye field (FEF) is known to be involved in the control of eye movements. Stimulating the neurons in FEF at levels too low to evoke eye movements has been shown to create effects similar to covert attention (Moore et al., 2003). In this way, covert attention may be a means of deciding where to overtly look. The ability to covertly attend may additionally be helpful in social species, as eye movements convey information about knowledge and intent that may best be kept secret (Klein et al., 2009).

To study the neural correlates of covert spatial attention, researchers identify which aspects of neural activity differ based only on differences in the attentional cue (and not on differences in bottom-up features of the stimuli). On trials where attention is cued toward the receptive field of a recorded neuron, many changes in the neural activity have been observed (Noudoost et al., 2010; Maunsell, 2015). A commonly reported finding is an increase in firing rates, typically of 20–30% (Mitchell et al., 2007). However, the exact magnitude of the change depends on the cortical area

studied, with later areas showing stronger changes (Luck et al., 1997; Noudoost et al., 2010). Attention is also known to impact the variability of neural firing. In particular, it decreases trial-to-trial variability as measured via the Fano Factor and decreases noise correlations between pairs of neurons. Attention has even been found to impact the electrophysiological properties of neurons in a way that reduces their likelihood of firing in bursts and also decreases the height of individual action potentials (Anderson et al., 2013).

In general, the changes associated with attention are believed to increase the signal-to-noise ratio of the neurons that represent the attended stimulus, however they can also impact communication between brain areas. To this end, attention's effect on neural synchrony is important. Within a visual area, attention has been shown to increase spiking coherence in the gamma band—that is at frequencies between 30 and 70 Hz (Fries et al., 2008). When a group of neurons fires synchronously, their ability to influence shared downstream areas is enhanced. Furthermore, attention may also be working to directly coordinate communication across areas. Synchronous activity between two visual areas can be a sign of increased communication and attention has been shown to increase synchrony between the neurons that represent the attended stimulus in areas V1 and V4, for example (Bosman et al., 2012). Control of this cross-area synchronization appears to be carried out by the pulvinar (Saalmann et al., 2012).

In addition to investigating how attention impacts neurons in the visual pathways, studies have also searched for the source of top-down attention (Noudoost et al., 2010; Miller and Buschman, 2014). The processing of bottom-up attention appears to culminate with a saliency map produced in the lateral intraparietal area (LIP). The cells here respond when salient stimuli are in their receptive field, including task-irrelevant but salient distractors. Prefrontal areas such as FEF, on the other hand, appear to house the signals needed for top-down control of spatial attention and are less responsive to distractors.

While much of the work on the neural correlates of sensory attention focuses on the cortex, subcortical areas appear to play a strong role in the control and performance benefits of attention as well. In particular, the superior colliculus assists in both covert and overt spatial attention and inactivation of this region can impair attention (Krauzlis et al., 2013). And, as mentioned above, the pulvinar plays a role in attention, particularly with respect to gating effects on cortex (Zhou et al., 2016).

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2

MEMORY AND LANGUAGE

Unit Structure

2.1 MEMORY

Memory is the faculty of the mind by which data or information is encoded, stored, and retrieved when needed. It is the retention of information over time for the purpose of influencing future action. If past events could not be remembered, it would be impossible for language, relationships, or personal identity to develop. Memory loss is usually described as forgetfulness or amnesia.

Memory is often understood as an informational processing system with explicit and implicit functioning that is made up of a sensory processor, short-term (or working) memory, and long-term memory. This can be related to the neuron. The sensory processor allows information from the outside world to be sensed in the form of chemical and physical stimuli and attended to various levels of focus and intent. Working memory serves as an encoding and retrieval processor. Information in the form of stimuli is encoded in accordance with explicit or implicit functions by the working memory processor. The working memory also retrieves information from previously stored material. Finally, the function of long-term memory is to store data through various categorical models or systems.

Declarative, or explicit, memory is the conscious storage and recollection of data.[10] Under declarative memory resides semantic and episodic memory. Semantic memory refers to memory that is encoded with specific

meaning, while episodic memory refers to information that is encoded along a spatial and temporal plane. Declarative memory is usually the primary process thought of when referencing memory. Non-declarative, or implicit, memory is the unconscious storage and recollection of information. An example of a non-declarative process would be the unconscious learning or retrieval of information by way of procedural memory, or a priming phenomenon. Priming is the process of subliminally arousing specific responses from memory and shows that not all memory is consciously activated, whereas procedural memory is the slow and gradual learning of skills that often occurs without conscious attention to learning.

Memory is not a perfect processor, and is affected by many factors. The ways by which information is encoded, stored, and retrieved can all be corrupted. Pain, for example, has been identified as a physical condition that impairs memory, and has been noted in animal models as well as chronic pain patients. The amount of attention given new stimuli can diminish the amount of information that becomes encoded for storage. Also, the storage process can become corrupted by physical damage to areas of the brain that are associated with memory storage, such as the hippocampus. Finally, the retrieval of information from long-term memory can be disrupted because of decay within long-term memory. Normal functioning, decay over time, and brain damage all affect the accuracy and capacity of the memory

2.1.1 Models and Research Methods:

To assess infants:

Infants do not have the language ability to report on their memories and so verbal reports cannot be used to assess very young children's memory. Throughout the years, however, researchers have adapted and developed a number of measures for assessing both infants' recognition memory and their recall memory. Habituation and operant conditioning techniques have been used to assess infants' recognition memory and the deferred and elicited imitation techniques have been used to assess infants' recall memory.

Techniques used to assess infants' recognition memory include the following:

Visual paired comparison procedure (relies on habituation): infants are first presented with pairs of visual stimuli, such as two black-and-white photos of human faces, for a fixed amount of time; then, after being familiarized with the two photos, they are presented with the "familiar" photo and a new photo. The time spent looking at each photo is recorded. Looking longer at the new photo indicates that they remember the "familiar" one. Studies using this procedure have found that 5- to 6-month-olds can retain information for as long as fourteen days.

Operant conditioning technique: infants are placed in a crib and a ribbon that is connected to a mobile overhead is tied to one of their feet. Infants

notice that when they kick their foot the mobile moves – the rate of kicking increases dramatically within minutes. Studies using this technique have revealed that infants' memory substantially improves over the first 18-months. Whereas 2- to 3-month-olds can retain an operant response (such as activating the mobile by kicking their foot) for a week, 6-month-olds can retain it for two weeks, and 18-month-olds can retain a similar operant response for as long as 13 weeks.

Techniques used to assess infants' recall memory include the following:

Deferred imitation technique: an experimenter shows infants a unique sequence of actions (such as using a stick to push a button on a box) and then, after a delay, asks the infants to imitate the actions. Studies using deferred imitation have shown that 14-month-olds' memories for the sequence of actions can last for as long as four months.

Elicited imitation technique: is very similar to the deferred imitation technique; the difference is that infants are allowed to imitate the actions before the delay. Studies using the elicited imitation technique have shown that 20-month-olds can recall the action sequences twelve months later.

To assess children and older adults:

Researchers use a variety of tasks to assess older children and adults' memory. Some examples are:

Paired associate learning: When one learns to associate one specific word with another. For example, when given a word such as "safe" one must learn to say another specific word, such as "green". This is stimulus and response.

Free recall: During this task a subject would be asked to study a list of words and then later they will be asked to recall or write down as many words that they can remember, similar to free response questions. Earlier items are affected by retroactive interference (RI), which means the longer the list, the greater the interference, and the less likelihood that they are recalled. On the other hand, items that have been presented lastly suffer little RI, but suffer a great deal from proactive interference (PI), which means the longer the delay in recall, the more likely that the items will be lost.

Cued recall: One is given a significant hints to help retrieve information that has been previously encoded into the person's memory; typically this can involve a word relating to the information being asked to remember. This is similar to fill in the blank assessments used in classrooms.

Recognition: Subjects are asked to remember a list of words or pictures, after which point they are asked to identify the previously presented words or pictures from among a list of alternatives that were not presented in the original lisThis is similar to multiple choice assessments.

Detection paradigm: Individuals are shown a number of objects and color samples during a certain period of time. They are then tested on their visual ability to remember as much as they can by looking at testers and pointing out whether the testers are similar to the sample, or if any change is present.

Savings method: Compares the speed of originally learning to the speed of relearning it. The amount of time saved measures memory.

Implicit-memory tasks: Information is drawn from memory without conscious realization.

2.1.2 Metacognition:

Metacognition about memory, sometimes called metamemory, refers to the self-monitoring and self-control of one's own memory in the acquisition and retrieval of information. It is a relatively new topic, having been investigated by psychologists for approximately forty years. Before then, researchers viewed learners as passive, as blank slates onto which new ideas were etched through repetition. By contrast, subsequent researchers viewed the learner as an active controller of his or her learning, whether acquiring new or retrieving old information. Moreover, researchers now know that people can monitor their progress during both learning and retrieval. For example, imagine a student who is studying for an examination that will occur tomorrow in French class, say on French-English vocabulary such as " chateau/castle" and " rouge/red." Let us keep that student in mind as we consider the monitoring and the control of the student's learning of the new vocabulary and his or her attempts to retrieve the answers during the test the next day.

A theoretical framework that integrates all of these processes into an overall system can be found in Nelson and Narens (1990). Different kinds of monitoring processes can be distinguished in terms of when they occur in the learning/retrieval sequence and whether they pertain to the person's future performance (in which case the focus is said to be on prospective monitoring) or to the person's past performance (in which case the focus is said to be on retrospective monitoring).

2.2 MEMORY PROCESSES; MENTAL IMAGES, MAPS, AND PROPOSITIONS

2.2.1 Memory Processes:

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.

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.

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.

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.

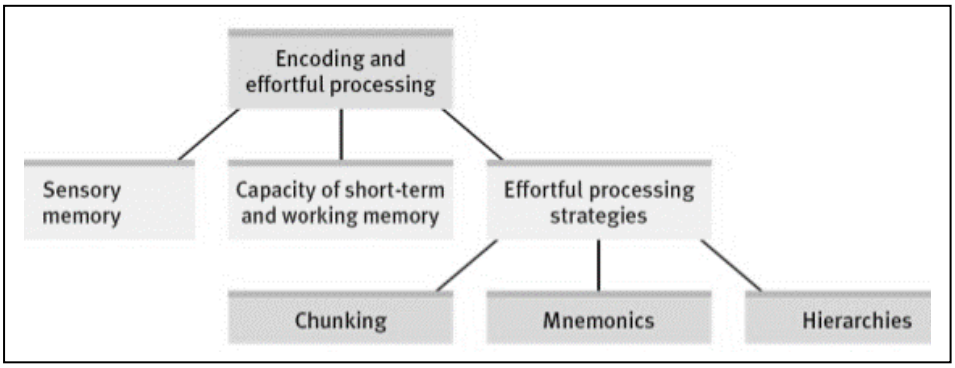
A rhyme is a saying that has similar terminal sounds at the end of each line. Rhymes are easier to remember because they can be stored by

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 $1/10^{th}$ 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.

2.2.2 Mental Images, Maps, and Propositions:

Communicating Knowledge: Pictures versus Words:

Knowledge can be represented in different ways in your mind: It can be stored as a mental picture, or in words, or abstract propositions. In this chapter, we focus on the difference between those kinds of knowledge representation. Of course, cognitive psychologists chiefly are interested in our internal, mental representations of what we know. However, before we turn to our internal representations, let's look at external representations, like books. A book communicates ideas through words and pictures. How do external representations in words differ from such representations in pictures? Some ideas are better and more easily represented in pictures, whereas others are better represented in words. For example, suppose someone asks you, "What is the shape of a chicken egg?" You may find drawing an egg easier than describing it. Many geometric shapes and concrete objects seem easier to represent in pictures rather than in words. However, what if someone asks you, "What is justice?" Describing such an abstract concept in words would already be very difficult, but doing so pictorially would be even harder. As Figure 7.3(a) and Figure 7.3(b) show, both pictures and words may be used to represent things and ideas, but neither form of representation actually retains all the characteristics of what is being represented. For example, neither the word cat nor the picture of the cat actually eats fish, meows, or purrs when petted. Both the word cat and the picture of this cat are distinctive representations of "catness." Each type of representation has distinctive characteristics. As you just observed, the picture is relatively analogous (i.e., similar) to the realworld object it represents. The picture shows concrete attributes, such as shape and relative size. These attributes are similar to the features and properties of the realworld object the picture represents. Even if you cover up a portion of the figure of the cat, what remains still looks like a part of a cat. Under typical circumstances, most aspects of the picture are grasped simultaneously; but you may scan the picture, zoom in for a closer look, or zoom out to see the big picture. Even when scanning or zooming, however, there are no arbitrary rules for looking at the picture—you may scan the picture from the left to the right, from the bottom to the top, or however it pleases you. In contrast, the word cat is a symbolic representation, meaning that the relationship between the word and what it represents is simply arbitrary. There is nothing inherently catlike about the word. If you had grown up in another country like Germany or France, the word "Katze" or the word "chat," respectively, would instead symbolize the concept of a cat to you. Suppose you cover up part of the word "cat." The remaining visible part no longer bears even a symbolic relationship to any part of a cat.

Pictures in Your Mind: Mental Imagery:

Imagery is the mental representation of things that are not currently seen or sensed by the sense organs (Moulton & Kosslyn, 2009; Thomas, 2003). In our minds we often have images for objects, events, and settings. For example, recall one of your first experiences on a college campus. What

were some of the sights, sounds, and smells you sensed at that time—cut grass, tall buildings, or tree-lined paths? You do not actually smell the grass and see the buildings, but you still can imagine them. Mental imagery even can represent things that you have never experienced. For example, imagine what it would be like to travel down the Amazon River. Mental images even may represent things that do not exist at all outside the mind of the person creating the image. Imagine how you would look if you had a third eye in the center of your forehead! Imagery may involve mental representations in any of the sensory modalities, such as hearing, smell, or taste. Imagine the sound of a fire alarm, your favorite song, or your nation's anthem. Now imagine the smell of a rose, of fried bacon, or of an onion. Finally, imagine the taste of a lemon, pickle, or your favorite candy. At least hypothetically, each form of mental representation is subject to investigation (e.g., Kurby et al., 2009; Palmieri et al., 2009; Pecenka & Keller, 2009). Nonetheless, most research on imagery in cognitive psychology has focused on visual imagery, such as representations of objects or settings that are not presently visible to the eyes. When students kept a diary of their mental images, the students reported many more visual images than auditory, smell, touch, or taste images (Kosslyn et al., 1990). Most of us are more aware of visual imagery than of other forms of imagery. We use visual images to solve problems and to answer questions involving objects (Kosslyn & Rabin, 1999; Kosslyn, Thompson & Ganis, 2006). Which is darker red—a cherry or an apple? How many windows are there in your house or apartment? How do you get from your home, apartment, or dormitory room to your first class of the day? How do you fit together the pieces of a puzzle or the component parts of an engine, a building, or a model? According to Kosslyn, to solve problems and answer questions such as these, we visualize the objects in question. In doing so, we mentally represent the images. Many psychologists outside of cognitive psychology are interested in applications of mental imagery to other fields in psychology. Such applications include using guided-imagery techniques for controlling pain and for strengthening immune responses and otherwise promoting health. With such techniques, you could imagine being at a beautiful beach and feeling very comfortable, letting your pain fade into the background. Or you could imagine the cells of your immune system successfully destroying all the bad bacteria in your body. Such techniques are also helpful in overcoming psychological problems, such as phobias and other anxiety disorders. Design engineers, biochemists, physicists, and many other scientists and technologists use imagery to think about various structures and processes and to solve problems in their chosen fields.

Dual-Code Theory: Images and Symbols:

According to dual-code theory, we use both pictorial and verbal codes for representing information (Paivio, 1969, 1971) in our minds. These two codes organize information into knowledge that can be acted on, stored somehow, and later retrieved for subsequent use. According to Paivio, mental images are analog codes. Analog codes resemble the objects they are representing. For example, trees and rivers might be represented by analog codes. Just as the movements of the hands on an analog clock are

analogous to the passage of time, the mental images we form in our minds are analogous to the physical stimuli we observe.

In contrast, our mental representations for words chiefly are represented in a symbolic code. A symbolic code is a form of knowledge representation that has been chosen arbitrarily to stand for something that does not perceptually resemble what is being represented. Just as a digital watch uses arbitrary symbols (typically, numerals) to represent the passage of time, our minds use arbitrary symbols (words and combinations of words) to represent many ideas. Sand can be used as well to represent the flow of time, as shown in the hourglass in Figure 7.4. A symbol may be anything that is arbitrarily designated to stand for something other than itself. For example, we recognize that the numeral "9" is a symbol for the concept of "nineness." It represents a quantity of nine of something. But nothing about the symbol in any way would suggest its meaning. We arbitrarily have designated this symbol to represent the concept. But "9" has meaning only because we use it to represent a deeper concept. Concepts like justice and peace are best represented symbolically. Paivio, consistent with his dual-code theory, noted that verbal information seems to be processed differently than pictorial information. For example, in one study, participants were shown both a rapid sequence of pictures and a sequence of words (Paivio, 1969). They then were asked to recall the words or the pictures in one of two ways. One way was at random, so that they recalled as many items as possible, regardless of the order in which the items were presented. The other way was in the correct sequence. Participants more easily recalled the pictures when they were allowed to do so in any order. But they more readily recalled the sequence in which the words were presented than the sequence for the pictures, which suggests the possibility of two different systems for recall of words versus pictures.

Storing Knowledge as Abstract Concepts: Propositional Theory:

Not everyone subscribes to the dual-code theory. Researchers have developed an alternative theory termed a conceptual-propositional theory, or propositional theory (Anderson & Bower, 1973; Pylyshyn, 1973, 1984; 2006). Propositional theory suggests that we do not store mental representations in the form of images or mere words. We may experience our mental representations as images, but these images are epiphenomena—secondary and derivative phenomena that occur as a result of other more basic cognitive processes. According to propositional theory, our mental representations (sometimes called "mentalese") more closely resemble the abstract form of a proposition. A proposition is the meaning underlying a particular relationship among concepts. Anderson and Bower have moved beyond their original conceptualization to a more complex model that encompasses multiple forms of mental representation. Others, such as Pylyshyn (2006), however, still hold to this position.

What Is a Proposition?:

How would a propositional representation work? Consider an example. To describe Figure 7.3(a), you could say, "The table is above the cat." You

also could say, "The cat is beneath the table." Both these statements indicate the same relationship as "Above the cat is the table." With a little extra work, you probably could come up with a dozen or more ways of verbally representing this relationship. Logicians have devised a shorthand means, called "predicate calculus," of expressing the underlying meaning of a relationship. It attempts to strip away the various superficial differences in the ways we describe the deeper meaning of a proposition: [Relationship between elements]([Subject element], [Object element]) The logical expression for the proposition underlying the relationship between the cat and the table is shown in Figure 7.3(c). This logical expression, of course, would need to be translated by the brain into a format suitable for its internal mental representation.

Using Propositions:

It is easy to see why the hypothetical construct of propositions is so widely accepted among cognitive psychologists. Propositions may be used to describe any kind of relationship. Examples of relationships include actions of one thing on another, attributes of a thing, positions of a thing, class membership of a thing, and so on, as shown in Table 7.1. In addition, any number of propositions may be combined to represent more complex relationships, images, or series of words. An example would be "The furry mouse bit the cat, which is now hiding under the table." The key idea is that the propositional form of mental representation is neither in words nor in images. Rather, it is in an abstract form representing the underlying meanings of knowledge. Thus, a proposition for a sentence would not retain the acoustic or visual properties of the words. Similarly, a proposition for a picture would not retain the exact perceptual form of the picture (Clark & Chase, 1972). According to the propositional view (Clark & Chase, 1972), both images [e.g., of the cat and the table in Figure 7.3(a)] and verbal statements [e.g., in Figure 7.3(b)] are mentally represented in terms of their deep meanings, and not as specific images or words. That is, they are represented as propositions. According to propositional theory, pictorial and verbal information are encoded and stored as propositions. Then, when we wish to retrieve the information from storage, the propositional representation is retrieved. From it, our minds re-create the verbal or the imaginal code relatively accurately. Some evidence suggests that these representations need not be exclusive. People seem to be able to employ both types of representations to increase their performance on cognitive tests (Talasli, 1990).

2.3 LANGUAGE AND LANGUAGE IN CONTEXT

2.3.1 Language:

Language is a system of communication that is governed by a system of rules (a grammar) and can express an infinite number of propositions. Language gives us the ability to communicate our intelligence to others by talking, reading, and writing. As the psychologist Steven Pinker puts it, language is the jewel in the crown of cognition (Pinker, 1994).

It is important to define language precisely and particularly to distinguish between language and communication. Although language is often used as a communication system, there are other communication systems that do not form true languages. For example, many bees use elaborate dances to tell other bees about a new found source of food. Although this dance communicates where the food is, it can only communicate that kind of message- the dance can't inform the bees about an interesting sight to see along the way to the food source. A natural language has two essential characteristics.

1) Regular and Productive:

It is regular (governed by a system of rules, called grammar), and it is productive, meaning that infinite combinations of things can be expressed in it.

2) Arbitrariness and Discreteness:

Other characteristics of human languages include arbitrariness (the lack of necessary resemblance between a word or sentence and what it refers to) and discreteness (the system can be subdivided into recognizable parts, for example- sentences into words (Hocket, 1960).

The Structure of Language:

When you have conversation, you first have to listen to the previous sounds the speaker directs at you. Different languages have different sounds (called phonemes).**Phoneme** is the smallest distinctive sound unit of a language. The study of the ways in which phonemes can be combined in any given language constitutes the study of phonology. Next you put the sounds together in some coherent way, identify the meaningful unit of the language, an aspect known as morphology. Word ending prefix, tense markers and the like are critical part of each sentence. Some of the **morphemes** (smallest unit that carry meaning in a given language)are words, and you also need to identify this and determine the role each word plays in sentence. To do so, you need to determine the syntax, or structure, of the sentence. A syntactically correct sentence does not by itself make for a good conversation.

The sentence must also mean something to the listener. Semantics is the branch of linguistics and psycholinguistics devotes to the study of meaning. Finally, for the conversation to work there must be some flow of given- and-take. Listeners must pay attention and make certain assumptions, and speakers must craft their contributions in ways that will make the listener's job feasible. This aspect of language, pragmatics, will conclude our discussion on the Structure of language. Keep in mind throughout that although the various aspects of language will be discussed separately, in actual conversation they must work together.

We will repeatedly bring forth the ideas of the different linguistic rules (such as phonological rules, syntactic rules) in this section. These rules make up the grammar of the language and, taken together, define the ways

language works. It is important that linguists and psychologist used the term grammar in the very restricted sense, here, meaning "the set of rules for language". In particular, grammatical in this context has nothing to do with the "rules" of "good English" such as "Don't use ain't" or "Use punctuation at the end of the statement." To a linguist or a psycholinguist, the sentence "I ain't going happily to it" is perfectly meaningful and "legal"-that is, it follows the "rules" of English that native speakers observe - and is therefore grammatical. (You understand it perfectly well, right?). Here grammar refers not to polite ways of speaking but to ways of speaking that form intelligible phrases or utterances recognizable as examples of language that a native speaker of the language might produce. Starting with the basic sound of speech, spoken language can be broken down into these elements: phonemes, syllables, morphemes, word, Phrase, and sentence. Apart from this there are many concepts in this topic. We would discuss all this concepts in details.

- **Phoneme:**

Speech sounds, or phonemes, are made by adjusting the vocal cords and moving the tongue, lips, and mouth in wonderfully precise ways to produce vibrations in the airflow from the lungs. While hundreds of speech sound can be distinguished on the basis of their frequency(the number of vibrations per second), their intensity (the energy in the vibrations) and their pattern of vibrations over time.

To illustrate phonemes, consider the k phoneme in the word key and cool. Say these words to yourself, and you will realize that the k sound is different in two words: simply notice the position of your lips when you are saying them and the "sharper" sound of the K phones in the word key here, they are two different phonemes, but either K sounds can be used in the word key without changing the meaning of the word; the same can be said for cool. English speakers do not notice the difference in these k sounds and, therefore, since they make up no difference in the meaning of the words and can be substituted for the one another, they can be grouped together as a single phoneme.

- **Morpheme:**

In a language, the smallest unit that carries meaning; may be a word or a part of a word (such as a prefix).Although syllables are the unit of speech perception, and some syllables have meanings, other language elements are the perceptual units carrying the meaning of speech. These elements, morphemes, are the smallest units of meaning in the speech perception. Consider the word distasteful. It is composed of three morphemes, each of which has meaning. The morphemes in this example are dis, taste, and ful. Dis means "negation" taste is a meaningful word, ful and means "quality". Thus, morphemes can be prefixes, words, or suffixes. Each is composed of syllables, of course, but what makes them morphemes is that they convey meaning. Morphemes are discovered by asking people to break words up into the smallest unit that have meaning for them.

- **Semantics:**

The set of rules by which we derive meaning from morphemes, words, and sentences in a given language; also, the study of meaning.

- **Syntax:**

The rules for combining words into grammatically sensible sentences in a given language.

- **Grammar:**

In language, a system of rules that enables us to communicate with and understand others. Words are combined by the rules of grammar into clauses, and clauses are formed into sentences. A clause consists of a verb and its associated nouns, adjectives, and so on. Evidence indicates that clauses, and not individual words or whole sentences, are the major units of perceived meaning in speech. When we hear a sentence with more than one clause, we tend to isolate the clauses, analysing the meaning of each (Bever, 1973).

- **Language Development:**

Childhood is the best time for language, no doubt about it. Young children, the younger the better, are good at it; it is child's play. It is a onetime gift to the species. (Lewis Thomas, The Fragile Species, 1992). Language development is a process starting early in human life. Anyone who has tried to master a second language as an adult knows the difficulty of language learning. And yet children learn languages easily and naturally. Children who are not exposed to language early in their lives will likely never learn one. Case studies, including Victor the "Wild Child, who was abandoned as a baby in France and not discovered until he was 12, and Genie, a child whose parents kept her locked in a closet from 18 months until 13 years of age, are (fortunately) two of the only known examples of these deprived children. Both of these children made some progress in socialization after they were rescued, but neither of them ever developed language (Rymer, 1993). This is also why it is important to determine quickly if a child is deaf and to begin immediately to communicate in sign language. Deaf children who are not exposed to sign language during their early years will likely never learn it (Mayberry, Lock, & Kazmi, 2002).

Milestones in Language development?:

Receptive Language:

Children's language development moves from simplicity to complexity. Infants start without language (infantis means "not speaking"). Yet by 4 months of age, babies can discriminate speech sounds (Stager & Werker, 1997). They can also read lips: They prefer to look at a face that matches a sound, so we know they can recognize that ah comes from wide open lips and from mouth with corners pulled back (Kuhl & Meltzoff, 1982). This

period marks the beginning of the development of babies' receptive language, their ability to comprehend speech – what is said to them or about them. At seven months and beyond, babies grow in their power to do what you and I find difficult when listening to an unfamiliar language: segmenting spoken sounds into individual words. Moreover, their adeptness at this task, as judged by their listening patterns, predicts their language abilities at ages 2 and 5 (Newman et al., 2006).

Productive Language:

Babies' productive language is their ability to produce words, matures after their receptive language.

Stages of Language Development:

There are mainly five stages of language development. We would discuss in details all the stages:

1) Babbles Stage:

Beginning at about 04 months. It consists of babbles, many speech sounds. Yet by 4 months of age, babies can discriminate speech sounds (Stager & Werker, 1997). Many of these spontaneously uttered sounds are consonant -vowel pairs formed by simply bunching the tongue in the front of the mouth or by opening or closing the lips.

Beginning at about 10 months, babbling changes and a trained ear can identify various sounds related to the household language. Without exposure to other languages, babies lose their ability to hear and produce sounds and tones found outside their native language. Babbling is not an imitation of adult speech - it includes sounds from various languages, including the one not spoken at home. Deaf infants who observe their deaf parents signing begin to babble more with their hands.

2) One-word stage:

Beginning at about 12 months. The stage in speech development, during which a child speaks mostly in single words. They have already learnt that sounds carry meanings. They now begin to use sounds - usually only one recognizable syllable such as ma or da. But family members quickly learn to understand. Across the world, baby's first words are often nouns that label objects or people. This one-word stage may equal a sentence.

3) Two-word, telegraphic speech:

At about 18 months, children's words learning explodes from about a word per week to a word per day. By their second birthday, most have entered the two-word stage. They start uttering two-word sentences in telegraphic speech: Like the old-fashioned telegrams (TERMS ACCEPTED. SEND MONEY), this early form of speech contains mostly nouns and verbs (Want juice). Alsolike telegrams, it follows rules of syntax; the words are in a sensible order. English-speaking children typically place adjectives before nouns—big doggy rather than doggy big.

4) Language develops rapidly into complete sentences:

Once children move out of the two-word stage, they quickly begin uttering longer phrases (Fromkin & Rodman, 1983). If they get a late start on learning a particular language, for example after receiving a cochlear implant or being an international adoptee, their language development still proceeds through the same sequence, although usually at a faster pace (Ertmer et al., 2007; Snedeker et al., 2007). By early elementary school, children understand complex sentences and begin to enjoy the humour conveyed by double meanings: "You never starve in the desert because of all the sand-which-is there."

Table 10.1.: Summary of Language development

Sr. No.	Month (Approximate)	Stage
1	4	Babbles many speech sounds
2	10	Babbling resembles household language.
3	12	One-word stage.
4	24	Two-word, telegraphic speech.
5	24+	Language develops rapidly into complete sentences.

Explaining Language Development:

Noam Chomsky argued that all languages do share some basic elements which he called universal grammar. For example, all human languages have nouns, verbs and adjectives as grammatical building blocks. Chomsky believed that we human beings are born with a built-in predisposition to learn grammar rules, that is why preschoolers pick up language so readily and use grammar so well. It happens naturally. But no matter what language we learn, we start speaking it mostly in nouns rather than in verbs and adjectives.

Further, research shows that 7 month olds can learn simple sentence structures. In an experiment, after repeatedly hearing syllable sequences that follow one rule, infants listened to syllables in a different sequence. They could detect the difference between two patterns later on. This suggested that babies come with a built in readiness to learn grammatical rules.

Childhood seems to represent critical(sensitive) period for mastering certain aspects of language before the language learning window closes. People who learn a second language as adults usually speak it with the accent of their native language and have difficulty in mastering the second language. The window on language learning closes gradually in early childhood. By about age 7, those who have not been exposed to either a spoken or a signed language gradually lose their ability to master any language.

Language communication:

A language is said to communicate when others understand the meaning of our sentences, and we, in turn, understand their communications, of course, this is not limited to language. We convey much information to others nonverbally by gesture. When we speak one of the thousands of languages of the world, we draw on our underlining knowledge of the rules governing the use of language. This knowledge about language, or linguistic competence, as it is called, is used automatically and almost effortlessly to generate and comprehend meaningful speech. Linguistic competence seems to be universal human species-typical ability.

2.3.2 Language in context:

Living in a silent world:

The discussion so far has been about the use of vocal speech symbols, or verbal language, in thinking. Can other language system be used as tools of thought? Studies of the deaf provide an approach to this question. Deaf children with little verbal language ability score in the normal range on standardized tests of cognitive performance (Vernon, 1967), and their cognitive and thinking abilities develop relatively normally (Furth, 1971). Such findings have been interpreted as indicating that language plays little or no role in the thinking or cognitive development of the deaf. But many of the deaf are taught sign language, and, even if they are not explicitly taught such language, it has been found that deaf children will develop their own (Goldin& Feldman, 1977). This may indicate that there is an innate human program for language be it verbal or gestural.

The standard visual-gestural sign languages learned by the deaf have many features in common with auditory languages. For example, just as the auditory-vocal languages use combinations of small number of basic sounds, or phonemes, as they are called to generate meaningful language, so, too, do the visual-gestural languages of the deaf make use of a relatively small number of basic movement combinations for communication. Thus, from combinations of the basic gestures, an infinity of ideas can be expressed in the visual-gestural languages. Some studies suggest that deaf children who know sign language are better at a variety of cognitive and thinking tasks than are those without this language (Vornon & Koh, 1971; Stuckless & Birch, 1966).Thus, those deaf people whose verbal languages skills are minimal seem to have a nonverbal language tool of thought.

The challenge of life without hearing may be greatest for children. Unable to communicate in customary ways, signing playmates find it difficult to coordinate their play with speaking playmates. Their school achievement may suffer because academic subjects are rooted in spoken languages. Adolescents may feel socially excluded with a resulting low self-confidence.

Do other species have language?:

Language is considered to be a very complex form of communication that occurs among the human race. It is a set of verbal and non-verbal conventions that humans use to express their ideas and wants. Humans use words while talking to express their needs and wants and they cry, slouch and make faces when they want to express feelings. Animals, or in other words non-humans also show signs of communication such as a dog wagging its tail when excited or a bird singing a song to attract the opposite sex. However, do animals have their language? Researchers say that animals or non-humans, do not have a true language like humans. However, they do communicate with each other through sounds and gestures. Animals have a number of in-born qualities they use to signal their feelings, but these are not like the formed words we see in the human language. Human children show these same forms of communication as babies when crying and gesturing. But they slowly learn the words of the language and use this as form of communication.

If human children were separated at birth away from humans they would not learn the words of the language and would not be able to communicate with other humans. They would resort to sounds and gestures as their primary form of communication. However, in the animal kingdom if they are reared alone from birth they are still able to behave and communicate in the same way as other species of their kind.

So what about animals such as dogs that understand commands or birds that can "talk"? Dogs can be trained to follow certain commands such as 'sit', 'come' and 'roll over', but does this mean they understand language and therefore can use it as well? Dogs are known to be experts at reading their owners intentions and that they do not respond to actual words but the tone in which it is said. So if you say "bad dog" in a cheerful tone, the dog will wag its tail. If you say "good dog" in a harsh tone, the dog will put his tail in between his legs. Birds that are in captivity are known to be able to "talk"- it is believed that it does not mean anything to them and they are merely copying sounds they hear. There is no doubt that animals communicate with each other to one degree or another in response to different stimuli such as hunger or fear. Human language is creative and consists of unique characteristics that give us the ability to engage in abstract and analytical ways.

THINKING AND LANGUAGE:

Philip Dale very correctly said that thinking is more than language and language is more than thinking, but thinking and language are related and in this topic we will describe some of the ways in which they are related.

Every day we use language in our thinking. For many people, much of the time, a good deal of thinking involves the use of word symbols and the rules of grammar to join the words into phrases and sentences. The words, their meanings and rules for joining them together are stored in our

semantic long term memories. When we think with language, we draw on this store of information to use language as tool of thought.

Some theories take a more extreme view of the role language in thinking; they claim that language can actually determine the thoughts we are capable of having. But this linguistic relativity hypothesis, as it is called, has been under increasing attack in recent years.

Because so much thinking involves language, the idea arose in psychology that thinking was actually a kind of inner speech, a kind of "talking to yourself under your breath." According to this idea, people make small movement of the vocal apparatus when they think and carry on their thinking by talking to themselves. A number of experiments have indicated that movements of the vocal apparatus may indeed accompany thought, but other experiments have made it clear that such movements are not necessary for thinking (Smith et al., 1947). In one heroic experiment, the subject, a physician, was completely paralyzed by means of a drug. He literally could not move a muscle, and his breathing was done for him by an iron lung. The paralyzing drug, however, did not affect the way his brain worked; it merely acted on the drug, the subject was given certain verbal problems to solve; he could not answer, of course, because the muscles necessary for speaking were paralyzed. There is no way to be certain that, thinking while under the influence of the drug, but all indications are that he was unable to do so because after the paralysis was removed by a counteracting drug, he clearly remembered what had taken place while he was drugged and promptly gave the answer to problems.

Language influences thinking:

There are at least 5,000 living languages in the world about 140 of them are spoken by a million or more people. Is a particular language merely a convenient set of symbols for the communication of our thoughts? According to the linguist Benjamin L. Whorf, the answer is no. Whorf argued that the higher levels of thinking require language and that the characteristics of particular language actually shape the way that users of the language think about things. There are two ideas here. One is that thinking requires language, the other has come to be called the **linguistic relativity hypothesis**. Most of the interest has focused on this hypothesis. In its strongest form, it says that the particular language people used determines how they see the world.

Whorf based his hypothesis on studies of North American Indian languages, but his hypothesis is said to hold for all languages. He found many differences between these languages and European ones and argued that such differences predispose their users to think in different ways. For example, the grammar of a language dictates how people describe changes in the environment. Since the basic unit of English grammar are nouns and verbs, English-speaking people commonly think in terms of "things" and "actions" Whorf found that people using other languages do not necessarily divide situation up this way. Furthermore, all languages have some words for which no equivalents can be found in any other language.

The German word weltanschauungsfor instance, means something like "a general world view, or a general philosophy of the world". There is no word with this precise meaning in English. In addition, languages categorize events in various ways. Eskimos are said to use some four different words for snow, while English has only one. According to the linguistic relatively hypothesis. Eskimos can think about snow with greater precision than English speaking can people and have different conception of what snow is, the Hopi language has single word for all flying objects their than birds. The hypothesis states that Hopi speakers thinks differently about flying objects than do speakers of languages that do not categorize the world in this way. The Hanno people of the Philippine, islands are said to have names for 92 varieties of rice, but all 92 varieties are, for the English speaker, simply rice(Con, 1954 cited in brown, 1965).

The linguistic relativity hypothesis is controversial. Many linguistic have argued that the hypothesis is circular Whorf found that languages differ in their grammar and in the concepts they can express from the hypothesized that thinking must also differ among the users of this different languages. However, the differences in the thinking are themselves assessed by the way of the language is used. What is hidden are ways of assessing conceptions of the word independently of language. The few experiments that have attempted this have had inconclusive results. Perhaps it is not so much a matter of what can be thought about by users of a language as it is of how easy it is to think about certain things. English-speaking thinkers can think about the concept of the "world view" even if they do not have a convenient word for it. English speakers can think about different kinds of snow, even have to use more words to describe it.

More recently, interest has shifted away from relativity to universals in thinking perhaps the basic thought processes in thinking are similar, even though languages differ widely. Colour perception provides an example of the possible universality of thinking despite the different ways in which different languages designate colours. It has been found that certain "focal" colours-a maximum of 11-are chosen from a colour chart by speakers of widely differing languages. Furthermore, it has been shown that thinking can be influenced by these focal colours even when the language does not have names for them. This is contrary to what might be expected from the linguistic relativity hypothesis. For example, Eleanor Rrosch has done experiments with the Dani people of the New Guinea. The Dani have only "black" and mola for "white". The Dani subjects in these experiments studies a colour chart arbitrary names were assigned to eight of the focal colours and eight of the non-focal colours on the chart. The Dani learn the names assigned to the focal colours more rapidly and remembered them better than they did those given to the other colors. Thus even though the Dani do not have names for the focal colors in their language, their thinking is influenced by them.

Thinking in images:

To a large degree, the availability of the symbols that we use in thinking are often words and language, and therefore thinking and language are closely related. A language makes available hundreds of thousands of potential language symbols is what makes human thinking so much more sophisticated than the thinking of other animals. Although language is a powerful tool in human thought, as when we "talk to ourselves" internally, images are another important type of symbol used in thinking.

People vary remarkable in how much they use images in their thinking. A few report that they almost never use mental pictures, so they must be doing their thinking with words, or verbally; others that most of their thinking is done in image form. When we use images to think, they are not usually complete "pictures in the head". They are usually incomplete. Consider the imagery you use, if you use it at all, in solving the following problems (Huttenlocher, 1973). Imagine that you are standing on a certain street corner in a section of a city you know well. How would you walk or drive from this point to some other part of the city?

Here is another problem in which you might use imagery: from where on earth could you walk first 1 mile south, then 1 mile east, then 1 mile north, and end up exactly where you began? Did you use imagery in trying to solve this problem? If so, what was your imagery like?

When solving problems like these, most people report that their images are incomplete. To solve the first problem, people usually make a visual map, but it is a strange one. Although it shows turns, the lines connecting the turns are of no particular length. In solving the second problem (the answer is the north pole), people imagine a globe- but not the whole globe, only the polar region. Such problem-solving images contain only a few details- say, of sidewalks, roads, buildings, or color-although some people may imagine snow when they think of the north pole. In general, the images are abstractions of certain features from previous experience.

The incomplete, abstract images most of us use in thinking seem to be constructed from elements stored in long term memory. The constructive process involved in imagery has been studied by means of experiment in which people were asked to form images of various sizes. For example, an elephant might be imaged as the size of a mouse, or mouse imaged as the size of an elephant. Variations of this sort in the sizes of images indicate that images are constructions. Even more interesting, however, are studies indicating that the ease with which information is found in an image depends on the size (and other aspects) of the image constructed (Kosslyn, 1983).

Differences among Languages:

Why are there so many different languages around the world? And how does using any language in general and using a particular language influence human thought? As you know, different languages comprise different lexicons. They also use different syntactical structures. These

differences often reflect variations in the physical and cultural environments in which the languages arose and developed. For example, in terms of lexicon, the Garo of Burma distinguish among many kinds of rice, which is understandable because they are a rice-growing culture. Nomadic Arabs have more than 20 words for camels. These peoples clearly conceptualize rice and camels more specifically and in more complex ways than do people outside their cultural groups. As a result of these linguistic differences, do the Garo think about rice differently than we do? And do the Arabs think about camels differently than we do? Consider the way we discuss computers. We differentiate between many aspects of computers, including whether the computer is a desktop or a laptop, a PC or a Mac, or uses Linux or Windows as an operating system.

A person from a culture that does not have access to computers would not require so many words or distinctions to describe these machines. We expect, however, specific performance and features for a given computer based on these distinctions. Clearly, we think about computers in a way that is different than that of people who have never encountered a computer. The syntactical structures of languages differ, too. Almost all languages permit some way in which to communicate actions, agents of actions, and objects of actions (Gerrig & Banaji, 1994). What differs across languages is the order of subject, verb, and object in a typical declarative sentence. Also differing is the range of grammatical inflections and other markings that speakers are obliged to include as key elements of a sentence. For example, in describing past actions in English, we indicate whether an action took place in the past by changing (inflecting) the verb form. For example, walk changes to walked in the past tense. In Spanish and German, the verb also must indicate whether the agent of action was singular or plural and whether it is being referred to in the first, second, or third person. In Turkish, the verb form must additionally indicate whether the action was witnessed or experienced directly by the speaker or was noted only indirectly. Do these differences and other differences in obligatory syntactical structures influence—or perhaps even constrain—the users of these languages to think about things differently because of the language they use while thinking? We will have a closer look at these questions in the next two sections, in which we explore the concepts of linguistic relativity and linguistic universals.

Bilingualism—An Advantage or Disadvantage?:

Does bilingualism make thinking in any one language more difficult, or does it enhance thought processes? The data are somewhat contradictory. Different participant populations, different methodologies, different language groups, and different experimenter biases may have contributed to the inconsistency in the literature. Consider what happens when bilinguals are balanced bilinguals, who are roughly equally fluent in both languages, and when they come from middle-class backgrounds. In these instances, positive effects of bilingualism tend to be found. Executive functions, which are located primarily in the prefrontal cortex and include abilities such as to shift between tasks or ignore distracters, are enhanced in bilingual individuals. Even the onset of dementia in bilinguals may be

delayed by as much as four years (Andreou & Karapetsas, 2004; Bialystok & Craik, 2010; Bialystok et al., 2007). But negative effects may result as well. Bilingual speakers tend to have smaller vocabularies and their access to lexical items in memory is slower (Bialystok, 2001b; Bialystok & Craik, 2010).

What might be the causes of this difference? Let us distinguish between what might be called additive versus subtractive bilingualism (Cummins, 1976). In additive bilingualism, a second language is acquired in addition to a relatively well-developed first language. In subtractive bilingualism, elements of a second language replace elements of the first language. It appears that the additive form results in increased thinking ability. In contrast, the subtractive form results in decreased thinking ability (Cummins, 1976). In particular, there may be something of a threshold effect. Individuals may need to be at a certain relatively high level of competence in both languages for a positive effect of bilingualism. Classroom teachers often discourage bilingualism in children (Sook Lee & Oxelson, 2006). Either through letters requesting only English be spoken at home, or through subtle attitudes and methods, many teachers actually encourage subtractive bilingualism (Sook Lee & Oxelson, 2006). Additionally, children from backgrounds with lower socioeconomic status (SES) may be more likely to be subtractive bilinguals than are children from the middle SES. Their SES may be a factor in their being hurt rather than helped by their bilingualism. Researchers also distinguish between simultaneous bilingualism, which occurs when a child learns two languages from birth, and sequential bilingualism, which occurs when an individual first learns one language and then another (Bhatia & Ritchie, 1999). Either form of language learning can contribute to fluency. It depends on the particular circumstances in which the languages are learned (Pearson et al., 1997). It is known, however, that infants begin babbling at roughly the same age. This happens regardless of whether they consistently are exposed to one or two languages (Oller et al., 1997). In the United States, many people make a big deal of bilingualism, perhaps because relatively few Americans born in the United States of non-immigrant parents learn a second language to a high degree of fluency. In other cultures, however, the learning of multiple languages is taken for granted. For example, in parts of India, people routinely may learn as many as four languages (Khubchandani, 1997). In Flemish-speaking Belgium, many people learn at least some French, English, and/or German. Often, they learn one or more of these other languages to a high degree of fluency.

Language in a Social Context:

The study of the social context of language is a relatively new area of linguistic research. One aspect of context is the investigation of pragmatics, the study of how people use language. It includes sociolinguistics and other aspects of the social context of language. Under most circumstances, you change your use of language in response to contextual cues without giving these changes much thought. Similarly, you usually unselfconsciously change your language patterns to fit

different contexts. For example, in speaking with a conversational partner, you seek to establish common ground, or a shared basis for engaging in a conversation (Clark & Brennan, 1991). When we are with people who share background, knowledge, motives, or goals, establishing common ground is likely to be easy and scarcely noticeable. When little is shared, however, such common ground may be hard to find. Gestures and vocal inflections, which are forms of nonverbal communication, can help establish common ground. One aspect of nonverbal communication is personal space—the distance between people in a conversation or other interaction that is considered comfortable for members of a given culture. Proxemics is the study of interpersonal distance or its opposite, proximity. It concerns itself with relative distancing and the positioning of you and your fellow conversants. In the United States, 2.45 feet to 2.72 feet are considered about right.

In Mexico, the adequate distance ranges from 1.65 to 2.14 feet, whereas in Costa Rica it is between 1.22 and 1.32 feet (Baxter, 1970). Scandinavians expect more distance. Middle Easterners, southern Europeans, and South Americans expect less (Sommer, 1969; Watson, 1970). When on our own familiar turf, we take our cultural views of personal space for granted. Only when we come into contact with people from other cultures do we notice these differences. For example, when the author was visiting Venezuela, he noticed his cultural expectations coming into conflict with the expectations of those around him. He often found himself in a comical dance: He would back off from the person with whom he was speaking; meanwhile, that person was trying to move closer. Within a given culture, greater proximity generally indicates one or more of three things. First, the people see themselves in a close relationship. Second, the people are participating in a social situation that permits violation of the bubble of personal space, such as close dancing. Third, the "violator" of the bubble is dominating the interaction. Even within our own culture, there are differences in the amount of personal space that is expected. For instance, when two colleagues are interacting, the personal space is much smaller than when an employee and supervisor are interacting. When two women are talking, they stand closer together than when two men are talking (Dean, Willis, & Hewitt, 1975; Hall, 1966). Does interpersonal distance also play a role in virtual-reality environments?

When virtual worlds are created, a lot of factors matter in determining how believable the virtual worlds are. How people dress, how the streets look, and what sounds are in the background all facilitate or make it harder for people to immerse themselves in that environment. For example, when you visit a virtual place located in Latin America, you expect to see people who look Latin American. To create lifelike simulations, it also matters how people behave during interpersonal interactions. How close do they stand together, how often do they look at each other, and how long do they keep that gaze? Computational models are being developed to simulate the behavior of people from different cultures (Jan et al., 2007). Violations of personal space, even in virtual environments, cause discomfort (Wilcox et al., 2006). When given the option, people whose personal space is violated

in a virtual environment will move away (Bailenson et al., 2003). Physical space is also maintained in video conferencing (Grayson & Coventry, 1998). These findings on proxemics indicate the importance of interpersonal space in all interactions. They also indicate that proxemics is important, even when one or more of the people are not physically present.

Gender and Language:

Within our own culture, do men and women speak a different language? Gender differences have been found in the content of what we say. Young girls are more likely to ask for help than are young boys (Thompson, 1999). Older adolescent and young adult males prefer to talk about political views, sources of personal pride, and what they like about the other person. In contrast, females in this age group prefer to talk about feelings toward parents, close friends, classes, and their fears (Rubin et al., 1980). Also, in general, women seem to disclose more about themselves than do men (Morton, 1978). Conversations between men and women are sometimes regarded as crosscultural communication (Tannen, 1986, 1990, 1994). Young girls and boys learn conversational communication in essentially separate cultural environments through their same-sex friendships. As men and women, we then carry over the conversational styles we have learned in childhood into our adult conversations.

Tannen has suggested that male–female differences in conversational style largely center on differing understandings of the goals of conversation. These cultural differences result in contrasting styles of communication. These in turn can lead to misunderstandings and even break-ups as each partner somewhat unsuccessfully tries to understand the other. Men see the world as a hierarchical social order in which the purpose of communication is to negotiate for the upper hand, to preserve independence, and to avoid failure (Tannen, 1990, 1994). Each man strives to one-up the other and to "win" the contest. Women, in contrast, seek to establish a connection between the two participants, to give support and confirmation to others, and to reach consensus through communication. To reach their conversational goals, women use conversational strategies that minimize differences, establish equity, and avoid any appearances of superiority on the part of one or another conversant. Women also affirm the importance of and the commitment to the relationship. They handle differences of opinion by negotiating to reach a consensus that promotes the connection and ensures that both parties at least feel that their wishes have been considered. They do so even if they are not entirely satisfied with the consensual decision. Men enjoy connections and rapport. But because men have been raised in a gender culture in which status plays an important role, other goals take precedence in conversations.

Tannen has suggested that men seek to assert their independence from their conversational partners. In this way, they indicate clearly their lack of acquiescence to the demands of others, which would indicate lack of power. Men also prefer to inform (thereby indicating the higher status conferred by authority) rather than to consult (indicating subordinate

status) with their conversational partners. The male partner in a close relationship thus may end up informing his partner of their plans. In contrast, the female partner expects to be consulted on their plans. When men and women engage in cross-gender communications, their crossed purposes often result in miscommunication because each partner misinterprets the other's intentions. Tannen has suggested that men and women need to become more aware of their cross-cultural styles and traditions. In this way, they may at least be less likely to misinterpret one another's conversational interactions. They are also both more likely to achieve their individual aims, the aims of the relationship, and the aims of the other people and institutions affected by their relationship. Such awareness is important not only in conversations between men and women. It is also important in conversations among family members in general (Tannen, 2001). Tannen may be right. But at present, converging operations are needed, in addition to Tannen's sociolinguistic case-based approach, to pin down the validity and generality of her interesting findings. Gender differences in the written use of language have also been observed (Argamon et al., 2003). For example, a study that analyzed more than 14,000 text files from 70 separate studies found that women used more words that were related to psychological and social processes, whereas men related more to object properties and impersonal topics (Newman et al., 2008). These findings are not conclusive. A study examining blogs noted that the type of blog, more than the gender of the author, dictated the writing style (Herring & Paolillo, 2006). Thus far we have discussed the social and cognitive contexts for language. Language use interacts with, but does not completely determine, the nature of thought.

2.4 NEUROPSYCHOLOGICAL BASIS OF MEMORY AND LANGUAGE

2.4.1 Neuropsychological basis of Memory:

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 nondeclarative 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.

Nondeclarative memory is expressed through performance rather than recollection. The unconscious status of nondeclarative 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.

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 McGaugh (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.

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.

Fig.8.1

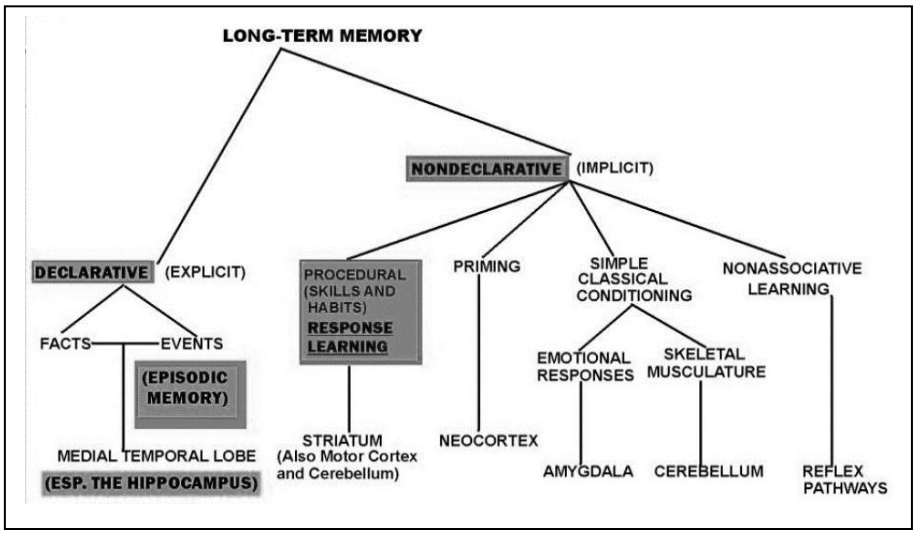
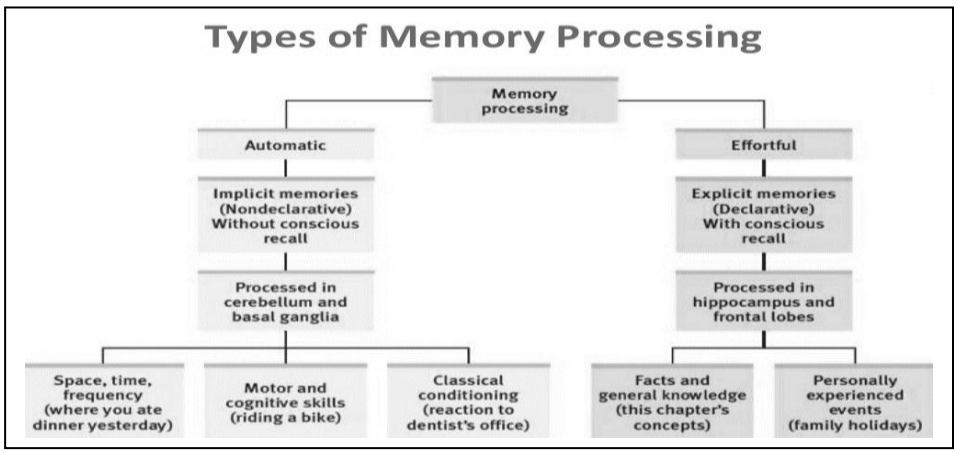


Fig.8.2



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)

2.4.2 Neuropsychological basis language:

The brain and language:

We process complex language information with amazing speed is an understatement. Caplan (1994), reported, for example, that people typically recognize spoken words after about 125 milliseconds (about one eight of a second) that is, while the word is still being spoken. Normal word production, estimated over a number of studies, requires us to search through a mental "dictionary" of about 20,000 items, and we do so at the rate of three words per second.

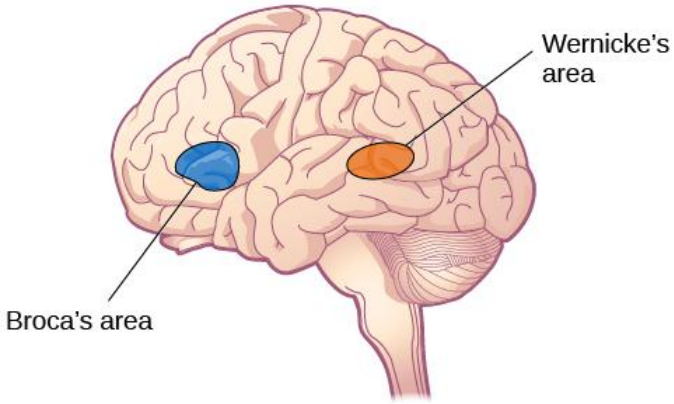
Obviously, the brain architecture to support this rapid and complex cognitive processing must be sophisticated indeed. Neuropsychologists have been trying to understand what the underlying brain structures involved with language are, where they are located, and how they operate. In this topic, we will see two important language disorders which are related to brain and language.

Adults whose hearing becomes impaired later in life also face challenges. When older people with hearing loss must expend efforts to hear words, they have less remaining cognitive capacity available to remember and comprehend them. It has been found that people with hearing loss, especially those not wearing hearing aid, have reported feeling sadder, being less socially engaged and more often experiencing others' irritation. They may also experience a sort of shyness. Henry Kisor (1990) very aptly said, "we can be self-effacing and diffident to the point of invisibility. Sometimes this tendency can be crippling. I must fight it all the time". Helen Keller, both deaf and blind, also noted that "Blindness cuts people off from things. Deafness cuts people off from people".

Broca's Aphasia:

Interest in localizing language function in the brain dates back at least to the 1800s, when a French physician with interests in anthropology and ethnography, Pierre Paul Broca, read a paper in 1861 at the meeting of the society Anthropologist in Paris. The paper reported on a patient, nicknamed "Tan" because he had lost the ability to speak any word save for tan. Shortly after the patient died, his brain was examined and found to have a lesion in the left frontal lobe. The very next day, Broca reported this exciting (for science, not for the patient or his family, probably) finding (Posner &Raichle, 1994). The area of the brain, henceforth known as Broca's area, is shown in the figure 10.7.A. It is also called expressive aphasia. A Broca's aphasia appeared to leave language reception and processing undisturbed. In 1865, Broca reported that after damage to an area of the left frontal lobe a person would struggle to speak words while still being able to sing familiar songs and comprehend speech.

Brain structure involved with languages.



Wernicke's Aphasia:

About 13 years later, in 1874, a German neurologist Carl Wernicke identified another brain area that, if damaged by a small lesion (often result of a stroke), left patients with extreme difficulty in comprehending (but not producing) spoken language (Posner & Raichle, 1994). (Not surprisingly, this area has come to be called Wernicke's area, and it is also shown in figure 10.7.A. It is also called receptive aphasia. People could

speak words and sentences (although the language was often gibberish). Damage to Wernicke's area also disrupts understanding.

But today, Functional MRI scan shows that different neural networks are activated by nouns and verbs, or objects and actions, by different vowels and by reading stories of visual vs. motor experiences. It was also found that jokes that play on meaning are processed in a different area of the brain than jokes that play on the words. The main point is that in processing language, the brain operates by dividing its mental functions – speaking, perceiving, thinking, remembering into sub functions. Localized trauma that destroys one of these neural work teams may cause people to lose just one aspect of processing.

2.5 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?

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3

THINKING AND INTELLIGENCE

Unit Structure

3.1 PROBLEM SOLVING AND CREATIVITY

3.1.1 Problem Solving:

In general, a problem can be any conflict or difference between one situation and another situation we wish to produce our goal. In trying to reach the goal of problem solution, we use information available to us from long term memory and from our here-and-now perception of the problem situation before we process this information according to rules that tells us what we can and cannot do. In other words, many instances of problem solving can be considered a form of rule-guided, motivated information processing (Newell & Simon, 1972).

Problem Solving Strategies:

Many of the rules used in solving problems concern the changes that are permissible in going from one situation to another. Four major types of such rules are algorithm, heuristics, trial and error and insight.

1) Algorithm:

An algorithm is a set of rules which, if followed correctly, will guarantee a solution to a problem. For instance, if you are given two numbers to multiply, you immediately start thinking of all the rules for multiplication you have learned and you apply these algorithm to the problem. If you follow the rules correctly, you will solve the problem. Algorithm is a step-by-step procedure that guarantees a solution. But it can be laborious and frustrating experience.

2) Heuristics:

Heuristic are simpler thinking strategies, usually based on our past experience with problems, that are likely to lead to a solution but do not guarantee success. One common strategy, or heuristic, is to break the problem down into smaller sub problems, each a little closer to the end goal.

3) Trial and Error:

This is the most commonly used method in problem solving. It is used when a person does not have any well thought out strategy for solving a problem or when he is incapable of thinking about his problem systematically. In other words, he does not know about the rules to help him solve the problem. He goes on trying one thing after another till somehow the problem gets solved by chance – an abrupt, true seeming and often satisfying solution. Insight strikes suddenly with no prior sense of 'getting warmer' or feeling close to a solution.

Mechanical solutions also involve solving by rote or a learned set of rules. Many problems in life can be solved by merely applying certain rules mechanically. If the rules are applied correctly the solution is sure to be found. Many problems in everyday life and in school and college situations involve mechanical application of the facts or knowledge that we have acquired. The strategy involving use of algorithms and heuristics is representatives of this method.

4) Insight:

This is another important method of solving a problem. For some problems, solutions occur suddenly. Insight occurs when the problem solver suddenly 'sees' the relations involved in a task and is immediately able to solve the problem. It was Kohler who first suggested that learning takes place by insight. An instance of insight is found in the example of Archimedes who ran naked out of his bathtub, shouting 'Eureka', when he found an answer to a problem that had troubled him for a long time. Most creative problems are solved through insight. When human beings solve the problem through insight they experience a good feeling called as 'aha' experience. Thus, insight occurs when the learner 'suddenly sees' the solution involved in a task and is immediately able to solve the problem. When he suddenly gets the solution, he is said to have got insight.

Obstacles in Problem Solving:

Problem solving is not an easy task, it is filled with considerable difficulties or obstacles that are involved in the process of problem solving. Some problems are difficult to solve as compared to others. Human beings commit errors or have limitations that come in the way of solving problems. The three most common barriers to solving a problem are as follows:

1. Functional Fixedness
2. Mental Set
3. Confirmation bias.
4. Using incomplete or incorrect representations
5. Lack of Problem specific knowledge or expertise

We will discuss each of these briefly.

1. Functional Fixedness:

Functional Fixedness means that the functions or uses we assign to objects tend to remain fixed or stable. Functional fixedness is a cognitive bias that that limits a person to using an object only in the way it is traditionally used. Karl Duncker defined functional fixedness as being a "mental block against using an object in a new way that is required to solve a problem." This "block" then limits that ability of an individual to use the components given to them to make a specific item, as they cannot move past the original intention of the object. When people develop functional fixedness, they recognize tools only for their obvious function. For example, an object is regarded as having only one fixed function. The problem-solver cannot alter his or her mental set to see that the tool may have multiple uses. To overcome functional fixedness, we need to think flexibly about other ways that objects can be used. To overcome functional fixedness, we have to realize that an object designed for one particular function can also serve another function. The history of technology offers numerous examples of overcoming functional fixedness. For instance, the steam engine was used for a century to pump water out of mines before an inventor realized that it could be used as a source of locomotive power (Gellatly, 1986).

2. Mental Set:

Mental set is a tendency to adopt a certain framework, strategy or procedure or more generally, to see things in certain ways instead of others. Mental set is analogous to perceptual set, the tendency to perceive an object or pattern in a certain way on the basis of your immediate perceptual experience. Mental set is one type of functional fixedness. Mental set directs the thinking process to solving problems in the same way. When problem solvers have mental set, they keep trying the same solution they have used in previous problems, even though the problem could be approached via other, easier ways. Mental sets involve a kind of mindless rigidity that blocks effective problem solving (Langer, 1989).A mental set often works against us in our everyday experiences too. A number of research studies have been carried out to study how mental set effects problem-solving behavior. The three major studies using different problems are as follows: i)Luchin's study using water Jar problem. ii) Nine-dot problem iii) Six match stick problem. Luchin (1942) in one of the earliest studies on mental set demonstrated that 75 percent of the

students were blind to easy solution and continued to solve the problem in the same fashion as they did in the practice problem.

3. Confirmation bias:

Confirmation bias is one of the barriers to logical thinking. Confirmation bias refers to a type of selective thinking whereby one tends to notice and to look for what confirms one's beliefs, and to ignore, not look for, or undervalue the relevance of what contradicts one's beliefs. Confirmation bias is a phenomenon wherein decision makers have been shown to actively seek out and assign more weight to evidence that confirms their hypothesis, and ignore or under weigh evidence that could disconfirm their hypothesis. Confirmation bias is one of the hurdles in objective evaluation of a theory. In this a researcher overemphasizes data supporting the theories they favour and tend to ignore or downplay data which are inconsistent with their views.

4. Using incomplete or incorrect representations:

Irrelevant information hinders problem solving as it slows the process down, can cause confusion or misunderstandings.

5. Lack of Problem Specific Knowledge or Expertise:

If we don't have problem specific knowledge or expertise, we can't solve problem. Even if we are going to solve problem it can create difficulties in solving problem.

3.1.2 Creativity:

One important debate in understanding the variations in creativity has been the relationship of creativity with intelligence. Let us take an example of two students in a class. Savita is regarded by her teacher as an excellent student. She does her work on time, scores the highest grades in her class, listens to instructions with care, grasps quickly, reproduces accurately but she rarely comes out with ideas which are her own. Rima is another student who is just average in her studies and has not achieved high grades consistently. She prefers to learn on her own. She improvises new ways of helping her mother at home and comes up with new ways of doing her work and assignment. The former is considered to be more intelligent and the latter as more creative. Thus, a person who has the ability to learn faster and reproduced accurately may be considered intelligent more than creative unless she/he devises new ways of learning and doing.

Terman, in the 1920s, found that persons with IQ were not necessarily creative. At the same time, creative ideas could come from persons who did not have a very high IQ. Other researchers have shown that not even one of those identified as gifted, followed up throughout their adult life, had become well-known for creativity in some field. Researchers have also found that both high and low level of creativity can be found in highly intelligent children and also children of average intelligence. The same

person, thus, can be creative as well as intelligent but it is not necessary that intelligent ones, in the conventional sense, must be creative. Intelligence, therefore, by itself does not ensure creativity.

Researchers have found that the relationship between creativity and intelligence is positive. All creative acts require some minimum ability to acquire knowledge and capacity to comprehend, retain and retrieve. Creative writers, for example, need facility in dealing with language. The artist must understand the effect that will be produced by a particular technique of painting, a scientist must be able to reason and so on. Hence, a certain level of intelligence is required for creativity but beyond that intelligence dose not correlate well with creativity. It can be concluded that creativity can take many forms and blends. Some may have more of intellectual attributes, others may have more of attributes associated with creativity. Yet there is more to creativity than what intelligence tests reveal. Intelligence tests require convergent thinking while creativity tests require divergent thinking. Injury to certain areas of the frontal lobes can leave reading, writing and arithmetic skills intact but destroy imagination. Sternberg et.al. have identified 5 components of creativity-

1. Expertise: A well-developed base of knowledge- furnishes the ideas, images and phrases we use as mental building blocks. The more blocks we have, the more chances we have to combine them in novel way.

2. Imaginative Thinking Skill: It provides the ability to see things in a novel way, to recognize patterns, and to make connections. Having mastered a problem's basic elements, we redefine or explore it in a new way.

3. A Venturesome Personality: A venturesome personality seeks new experiences, tolerates ambiguity and risk, and perseveres in overcoming obstacles. For example, Wiles said he labored in near-isolation from the mathematics community partly to stay focused and avoid distractions.

4. Intrinsic Motivation: Intrinsic motivation is being driven more by interest, satisfaction and challenge than by external pressures. Creative people focus less on extrinsic motivators such as meeting deadlines, impressing people, or making money – than on the pleasure and stimulation of the work itself. When Newton was asked how he solved such difficult problems, he said by thinking about them all the time.

5. A Creative Environment: Sparks, supports, and refines creative ideas. After studying the careers of 2026 famous scientists and inventors, Dean keith Simonton (1992) concluded that most of these men were mentored, challenged and supported by their colleagues. Many had the emotional intelligence needed to network effectively with peers. Creativity -fostering environments support innovation, team building and communication. They also support contemplation.

3.2 THINKING, DECISION MAKING AND REASONING

3.2.1 Thinking:

Most of our waking hours, and even when we are asleep and dreaming, we are thinking. It is hard not to think. As you read these words you are thinking, and even if you stop thinking about what you are reading, your thoughts wander off to something else-perhaps to what you are going to do tomorrow- you will still be thinking. What do we do when we think? Loosely speaking, we might say that we mentally, or cognitively, process information. There are different definitions of thinking. We would discuss in briefly.

Thinking consists of the cognitive rearrangement and manipulation of both information from the environment and the symbols stored in long-term memory. From another viewpoint, thinking is the form of information processing that goes on during the period between a stimulus event and the response to it.

In other words, thinking is the set of cognitive processes that mediate, or go between, stimuli and responses. To illustrate, suppose you are trying to make a decision about buying a new mobile. The seller presents several mobiles in your price range (the stimuli), and you eventually purchase one of them (the response). Before making the response, however, you consider the advantages and the disadvantages of the several mobiles; you process the information you have about them. Your thinking about the mobiles - thus mediates between the mobiles as stimuli and your eventual response of buying one of them.

The general definition of thinking given above encompasses many different varieties of thought. For instance, some thinking is highly private and may use symbols with very personal meanings. This kind of thinking is called as autistic thinking; dreams are an example of autistic thinking. Other thinking is aimed at solving problems or creating something new; this is called directed thinking. Directed thinking is the kind you were engaged in when you solved (or tried to solve) the problem.

How people think?:

One of the most complex and highest forms of human behaviour is thinking. The topic of thinking came within the purview of psychology only in the 1960s with the growth of cognitive psychology. Behaviorists were not in favour of the study of thinking as according to them thinking was covert in nature and not empirically observable. Thinking is closely related to learning, memory, intelligence, decision making and language development. We would discuss these topics in this as well as the next unit.

Thinking or Cognition:

The terms thinking and cognition are often used synonymously. There is considerable difference between them. The term cognition is much broader in scope as compared to thinking. According to one definition, thinking is a symbolic mediation or a symbolic bridge that fills the gaps

between a situation and the response we make to it. According to Watson, 'thinking' is 'sub-vocal speech'. Thinking is also defined as "mental activity that goes on in the brain when a person is processing information such as organizing it, understanding it, and communicating it to others." Thinking is not only verbal in nature but also involves the use of mental images or mental representation. The three most important elements involved in thinking are mental images (also called as mental imagery), concepts and prototypes.

Concepts:

Concepts are an important class of language symbols used in thinking. A concept is a symbolic construction representing some common and general features of object or events. Some natural, or basic, concepts are easily acquired and appear in thinking early in life. Other concepts are acquired by discriminative learning by seeing examples of the concept in different context, and by definition. There are different types of concepts. We would discuss these in detail.

1) Superordinate Concept:

It is the most general type of a concept, such as "bird" or "vegetable" or "fruit".

2) Basic level Type:

A basic level type of concept is one around which other similar concepts are organised, such as Mango or apple or watermelon, as there can be many different types of mangos such as alphonso, dusseri, badami, payri, langda, etc.

3) Subordinate Concept:

It is the most specific type of a concept. Such as "Crackle Cadbury chocolate" or the name of your dog or a "Kashmiri apple", etc.

4) Formal Concept:

Formal concepts refer to those concepts which have a strict definition. These concepts are defined by specific rules or features and are very rigid. Formal concepts are generally taught in schools and colleges as a part of academic activity.

5) Natural Concept:

Natural concepts are those concepts which people form as a result of their experiences in the real world. Unlike formal concepts, natural concepts are not well defined. Is tomato a vegetable of fruit? Is duck a mammal or a bird? What about whale, is it a fish or a mammal? We form concepts about these as a result of our experiences in the outside world. Natural concepts help us to understand our surrounding in a less structured and rigid manner.

Becoming a human being involves the attainment of concepts: much human thinking uses them. It is therefore of some practical value to discovery what helps or hinders concept attainment. One factor in concept attainment is transfer. A second factor is the degree to which the common elements are isolated, grouped, or otherwise made conspicuous. This may be called as distinctiveness. A third factor is ability to manipulate the materials involved in the concept. Rearranged, rewarding, or reorganized materials containing the common properties helps people to discover the concept. Another factor is the instructional set people have. Finally, people usually learn concept faster if they have all the relevant information available at the same time, instead of being given only a piece of information at a time.

Mental Imagery:

Mental imagery is also called as visual imagery or imagery and is an important component of human thought or cognition. Mental imagery refers to the representations that stand for objects or events and have a picture-like quality. Mental imagery is used by most people in their everyday life. Considerable degree of research on mental imagery has been done by Allan Paivio, Kosslyn and others.

Research studies by Kosslyn and his colleagues (1990)have shown that most of our imagery is visual. They did some pioneering studies on mental rotation of visual images. Kosslyn also found that when we form a mental image our experience seems much like seeing something in our mind. It seems a lot like vision. When we form a mental image we seem to be able to manipulate them and we seem to be solving problems some times by means of manipulating them. Mental images can be quite detailed but they tend to be less detailed than actual perception. Kosslyn's research has demonstrated the following with respect to imagery and size.

- People take longer to make judgements about the characteristics of small mental images than of the large mental images.
- It takes longer time to travel a large mental distance than when images are different.

Research shows that visual imagery is a powerful strategyfor enhancing memory. Research has also shown that memory is most effective when the items must be recalled are shown interacting with each other (Begg 1982).

Prototypes:

Prototype is another important element of thinking. It can be defined as an example of a concept that closely matches the defining characteristics of a concept. Prototypes can be defined as mental models of the typical qualities of members of some group or category. Concepts simplify our thinking. We can't think of life without concepts. Without concepts, we would need a different name for every person, vents, objects and ideas. For example, suppose we ask a child to "throw a ball", a child will not understand if he has no concept of ball or throw. So we can say that

concepts such as ball gives us much information with little cognitive efforts.

Prototypes can be defined as mental frame- work for e.g., we have prototypes for Indian political leaders, certain film stars, criminals, etc. Prototypes describe the truly typical member of such categories. The prototypical model helps us to compare new persons we meet in order to determine if they do or do not fit into the category. When they fit quite well, we can readily place them in various categories. When they do not, the situation is more puzzling. For example, suppose you meet a young woman who told you that she reads books as a hobby, likes to do social work and who was dressed in simple clothes. When you discovered that she was a film actress you would probably be surprised. The reason is simple: she does not seem to fit well with the prototype of film actress that you have built up through past experience. Prototypes also exert important effects on social thought and social behaviour. The prototype for objects and events varies from culture to culture and from region to region. For e.g., In an Indian family it is customary to touch the feet of elders. However, such a custom does not exist in many other cultures. Similarly, prototype of fruits or drink varies from region to region depending upon what fruit or drink is commonly available in a given region or culture. For e.g., someone who lives in a tropical area will have a different prototype for fruit as compared to one who stays in Northern Hemisphere. For e.g., someone who grew up in an area where there are many coconut trees, for e.g., Kerala might think of coconut as the most typical fruit as compared to a person who comes from Kashmir where apples are found in plenty. It has also been noted that people who are familiar or have knowledge about given objects and events will have a different prototype about these objects and events as compared to persons who are not knowledgeable or lack information about such objects and events. Thus, many factors influence the development and formation of prototypes. Some common factors are as follows:

- Geographical Region
- Culture
- Information and Knowledge
- Experience

One’s thinking is considerably influenced by the prototype that one develops or holds. They also aid in the process of problem solving and decision making. Eleanor Rosch (1973) has done considerable research work with respect to prototypes. The prototype approach has had an important impact on cognitive psychology and other related disciplines.

3.2.2 Decision Making and Reasoning:

Decision-making is a kind of problem solving in which a person must choose among several alternatives. In choosing among alternatives that

involve certain amounts of risk, we are often guided by heuristic rules. There are two types of heuristics.

1) Availability Heuristics

2) Representative Heuristics

We would discuss each of these heuristics briefly.

1) Availability Heuristics:

Availability heuristics is a mental shortcut that helps us make a decision based on how easy it is to bring something to mind. In other words, we often rely on how easy it is to think of examples when making a decision or judgment. For instance, in 2011, what percentage of crimes do you suppose involved violence? Most people are likely to guess a high percentage because of all the violent crimes - murder, rape, robbery, and assault - that are highlighted on the news. Yet the FBI reported that violent crimes made up less than 12% of all crimes in the United States in 2011. So, anything that makes information 'pop up' into mind- its vividness, recency or distinctiveness can make it seem common place. We often fear the wrong things. For example, we fear flying because we play in our head some air disaster.

2) Representative Heuristics:

A mental shortcut that helps us make a decision by comparing information to our mental prototypes. For example, if someone was to describe an older woman as warm and caring with a great love of children, most of us would assume that the older woman is a grandmother. She fits our mental representation of a grandmother, so we automatically classify her into that category.

These rules include judging on the basis of representativeness, using the available information to decide which outcome is more likely, and using adjustment to arrive at an estimate of the probability of a certain outcome. Each of these heuristics introduces bias into the decision-making process.

Heuristics are simple decision-making rules we often use to make inferences or draw conclusions quickly and easily. Heuristics are strategies, usually based on our past experiences with problems, that are likely to lead to a solution but do not guarantee success. We make use of many mental heuristics in our effort to think about and use social information. Two most important heuristics approaches in solving a problem are as follows:

1) The Means-Ends Analysis

2) The Analogy Approach.

1) The Means-Ends Analysis:

It is a problem solving strategy in which the solver compares the goal to the current state, and then chooses a step to reduce maximally the difference between them. In other words this strategy involves figuring out the "ends" you want and then figuring out the "means" you will use to reach those ends. The means-ends analysis concentrates the problem solver's attention on the difference between the current problem state and the goal state. Very often, it so happens that in order to reach a goal state certain preconditions have to be fulfilled. These preconditions constitute sub goals. Through the creation of sub goals, the task is broken down into manageable steps, which help us to reach a final goal state. Newell and Simon developed a computer program called General Problem Solver or GPS, which is a program whose basic strategy is means-ends analysis.

2) The Analogy Approach:

In an analogy, we use a solution to an earlier problem to help with a new one. Analogies pervade human thinking. Whenever we try to solve a new problem by referring to a known, familiar problem, we are using an analogy (Halpern et al.,1990).

Bad Decisions:

a) Overconfidence: Sometimes our judgments and decisions go wrong simply because we are more confident than correct. In many tasks, people tend to overestimate their performance. For example, many overconfident students expect to finish preparing for exam ahead of schedule. In fact, the preparation takes more time than what they predict. Similarly, many people do not realize that there can be a potential for error in their thinking and believe that they will have more money next year and merrily take loans and later on find it difficult to pay back as they may not get as much pay raise as they expected.

However, overconfidence has an adaptive value. Research studies have shown that people who make mistakes in judgment due to overconfidence live more happily. They make tough decisions more easily, and they seem to be more credible than others. The wisdom to know when we know a thing and when we don't know is born from experience.

b) Belief Perseverance: Just like we have problem of overconfidence, we also have problem of belief perseverance - our tendency to cling to our beliefs in the face of contrary evidence. Belief perseverance often leads to social conflicts. The more we come to appreciate why our beliefs might be true, the more tightly we cling to them. For example, once we have explained to ourselves why we believe a child is 'gifted' or has a 'learning disability', we tend to ignore evidence undermining our beliefs. Once beliefs form and get justified, it takes more compelling evidence to change them than it did to create them.

To control this tendency, a simple trick is to consider the opposite. When people are asked to imagine and ponder over opposite findings, they become much less biased in their evaluation of the evidence.

c) The Effects of Framing: Framing refers to the way we present an issue, sways our decisions and judgments. For example, imagine that two different surgeons are explaining a surgery risk to a patient. One surgeon says that 10% people die during this surgery, while the other surgeon says that 90% people survive this surgery. The information is same but the effect will be different. Patients report that risk seems greater when they are told that 10% people die during this surgery.

Framing can be a powerful persuasion tool. If rightly framed arguments are presented, it can persuade people to make decisions that could benefit them or society as a whole.

3.3 HUMAN INTELLIGENCE: ORGANIZATION OF KNOWLEDGE IN THE MIND

Introduction: What Is Intelligence?:

In this unit, we will discuss numerous topics related to intelligence such as determinants of intelligence and is intelligence one general ability or several specific abilities. We will also be discussing neurological measurement of intelligence, mental retardation and giftedness. We would discuss in detail about the origins of intelligence testing and different ways to assess intelligence. After this, we would briefly discuss modern tests of mental abilities such as Binet Mental Ability Test, Stanford Binet and The Wechsler Tests. It should be remembered that Intelligence is one of the most important and unique ability that human beings possess. The term intelligence was popularized by Sir Francis Galton, Alfred Binet and others. Intelligence refers to the cognitive ability of an individual to learn from experience, to reason well, and to cope with the demands of daily living. Some important concepts and topics related to intelligence such as emotional intelligence, Intelligence and creativity, the nature v/s nurture controversy and the bell curve would also be discussed in brief. Towards the end of the unit we would study principles of test construction.

Intelligence is a key construct employed to know how individuals differ from one another. It also provides an understanding of how people adapt their behaviour according to the environment they live in. In this chapter, we would learn about intelligence in its various forms.

Definition:

Psychological notion of intelligence is quite different from the common notion of intelligence. If you watch an intelligent person, you are likely to see in her/him with attributes like mental alertness, ready wit, quickness in learning and ability to understand relationships. Intelligence is not a quality like height or weight, which has the same meaning for everyone around the globe. People assign the term intelligence to the qualities that enable success in their own time and in their own culture. There are different definitions of intelligence given by different psychologist, some of which are given below.

- Alfred Binet was one of the first psychologist who worked on intelligence. According to him, Intelligence is the ability to judge well, understand well and reason well (Alfred Binet, 1973).
- According to Wechsler, Intelligence is the global and aggregate capacity of an individual to act purposefully, to think rationally and to deal effectively with his/her environment. (Wechsler, 1950).
- Other psychologists such as Gardner and Sternberg have defined intelligence as well. Intelligent individual not only adapt to their environment but also actively modifies or shapes it (Gardner & Sternberg).

In simple words, intelligence is synthesis of one's abilities. Binet assumes intelligence as a general capacity for comprehension and reasoning that manifests itself in various ways, another psychologist, Charles Spearman, proposed that all individuals possess a general intelligence factor in varying amounts. In contrast to Spearman. Louis Thurstone felt that intelligence could be broken down into a number of primary abilities. Rejecting all these theories, Guilford states that many aspects of intelligence tends to be ignored when items are lumped together to form tests.

Important Concepts in Intelligence:

Individual Differences in Intelligence:

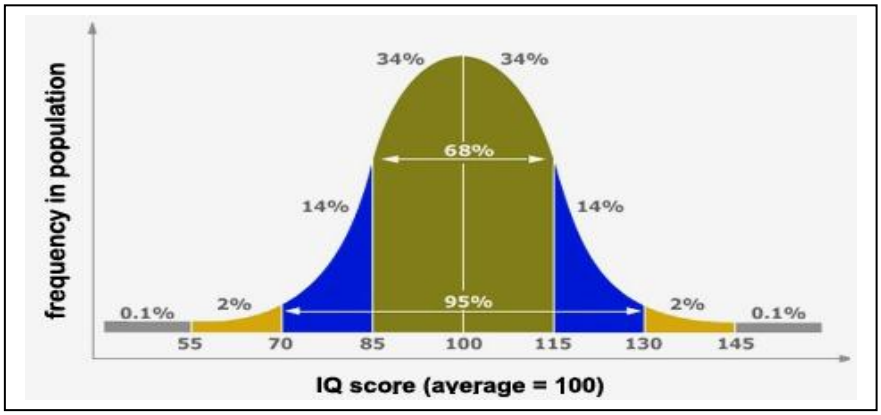
It is often said that no two individuals are exact duplicates; they differ from each other in some way or the other. Hence the job of the psychologist is to identify and understand this uniqueness in individuals. Such a similarity or difference between persons reveals individual differences. It happens in our day-to-day life when we see people around us. A question comes to mind; how and why people appear similar or different to each other? For example, when we think about their physical appearance, we often ask ourselves why some people have dark or fair complexion, why some people are tall and some are short, why some are thin and why some are very fat. When we think about their psychological characteristics we often come across people who are very talkative or less talkative, some laugh too much whereas others take much time even to smile and some are very friendly whereas some prefer to be alone. In psychology, these are called individual differences referring to the extent and kind of variations or similarities among people on some of the important psychological aspects such as intelligence.

When we speak Individual differences in terms of intelligence, individual difference occur due to interaction of genetic and environmental factors. We inherit certain characteristics from our parents through genetic codes. The phenotype or the expressed forms of our characteristics depend on contributions of the socio-cultural environment. This is the reason why we are not exactly like our parents and our parents not exactly like our grandparents. We do share similarities with our parents in respect of many physical attributes like height, colour of eyes, shape of nose etc. We also

inherit certain cognitive, emotional and other characteristics from our parents like intellectual competence, love for sport, creativity etc. However, our own characteristics develop largely by the support from the environment in which we live.

Extremes of Intelligence: Retardation and Giftedness:

Figure: Normal Distribution Curve of Intelligence: Bell Curve



The results of studies assessing the measurement of intelligence show that IQ is distributed in the population in the form of a normal distribution curve, which the pattern of scores is usually observed in a variable that clusters around its average. In a normal distribution, the bulk of the scores fall toward the middle, with many fewer scores falling at the extremes. The normal distribution of intelligence (Figure11.2. Distribution of IQ Scores in the General Population") shows that on IQ tests, as well as on most other measures, the majority of people cluster around the average (in this case, where IQ = 100), and fewer are either very smart or very dull. Because the standard deviation of an IQ test is about 15, this means that about 2% of people score above an IQ of 130 (often considered the threshold for giftedness), and about the same percentage score below an IQ of 70 (often being considered the threshold for mental retardation).

The normal distribution of IQ scores in the general population shows that most people have about average intelligence, while very few have extremely high or extremely low intelligence.

- **Retardation:**

One cause of mental retardation is Down syndrome, a chromosomal disorder leading to mental retardation caused by the presence of all or part of an extra 21st chromosome. The incidence of Down syndrome is estimated at 1 per 800 to 1,000 births, although its prevalence rises sharply in those born to older mothers. People with Down syndrome typically exhibit a distinctive pattern of physical features, including a flat nose, upwardly slanted eyes, a protruding tongue, and a short neck.

Societal attitudes toward individuals with mental retardation have changed over the past decades. We no longer use terms such as mad, idiot to describe these people, although these were the official psychological terms used to describe degrees of retardation in the past. Laws such as the

Person with Disabilities Act (PWD) have made it illegal to discriminate on the basis of mental and physical disability, and there has been a trend to bring the mentally retarded out of institutions and into our workplaces and schools.

- **Giftedness:**

Having extremely high IQ is clearly less of a problem than having extremely low IQ, but there may also be challenges to being particularly smart. It is often assumed that schoolchildren who are labeled as gifted may have adjustment problems that make it more difficult for them to create social relationships. To study gifted children, Lewis Terman and his colleagues (Terman & Oden, 1959) selected about 1,500 high school students who scored in the top 1% on the Stanford-Binet and similar IQ tests (i.e., who had IQs of about 135 or higher), and tracked them for more than seven decades (the children became known as the termites and are still being studied today). This study found, first, that these students were not unhealthy or poorly adjusted but rather were above average in physical health and were taller and heavier than individuals in the general population. The students also had above average social relationships for instance, being less likely to divorce than the average person (Seagoe, 1975).

As you might expect based on our discussion of intelligence, kids who are gifted have higher scores on general intelligence (g). But there are also different types of giftedness. Some children are particularly good at math or science, some at automobile repair or carpentry, some at music or art, some at sports or leadership, and so on. There is a lively debate among scholars about whether it is appropriate or beneficial to label some children as gifted and talented in school and to provide them with accelerated special classes and other programs that are not available to everyone. Although doing so may help the gifted kids (Colangelo & Assouline, 2009), it also may isolate them from their peers and make such provisions unavailable to those who are not classified as gifted. There is IQ classification given by Wechsler for understanding of IQ range. Classification of IQ range is given below.

Sr. No.	IQ Range	IQ Classification
1	130 and Above	Very Superior
2	120-129	Superior
3	110-119	Above Average Intelligence
4	90-109	Average Intelligence
5	80-89	Below Average Intelligence
6	70-79	Borderline Intelligence
7	55-69	Mild Mental Retardation
8	40-54	Moderate Mental Retardation
9	25-39	Very Superior
10	24 and Below	Superior

Figure A: Classification of Intelligent Quotient by Wechsler

Nature v/s Nurture Controversy:

Intelligence has both genetic and environmental causes, and these have been systematically studied through a large number of twin and adoption studies (Neisser et al., 1996; Plomin, DeFries, Craig, & McGuffin, 2003). These studies have found that between 40% and 80% of the variability in IQ is due to genetics, meaning that overall genetics plays a bigger role than does environment in creating IQ differences among individuals (Plomin & Spinath, 2004). The IQs of identical twins correlate very highly (r = .86), much higher than do the scores of fraternal twins who are less genetically similar (r = .60). And the correlations between the IQs of parents and their biological children (r = .42) is significantly greater than the correlation between parents and adopted children (r = .19). The role of genetics gets stronger as children get older. The intelligence of very young children (less than 3 years old) does not predict adult intelligence, but by age 7 it does, and IQ scores remain very stable in adulthood (Deary, Whiteman, Starr, Whalley, & Fox, 2004).

But there is also evidence for the role of nurture, indicating that individuals are not born with fixed, unchangeable levels of intelligence. Twins raised together in the same home have more similar IQs than do twins who are raised in different homes, and fraternal twins have more similar IQs than do non-twin siblings, which is likely due to the fact that they are treated more similarly than are siblings. The fact that intelligence becomes more stable as we get older provides evidence that early environmental experiences matter more than later ones. Environmental factors also explain a greater proportion of the variance in intelligence for children from lower-class households than they do for children from upper-class households (Turkheimer, Haley, Waldron, D'Onofrio, & Gottesman, 2003). This is because most upper-class households tend to provide a safe, nutritious, and supporting environment for children, whereas these factors are more variable in lower-class households.

Social and economic deprivation can adversely affect IQ. Children from households in poverty have lower IQs than do children from households with more resources even when other factors such as education, race, and parenting are controlled (Brooks-Gunn & Duncan, 1997). Poverty may lead to diets that are under-nourishing or lacking in appropriate vitamins, and poor children may also be more likely to be exposed to toxins such as lead in drinking water, dust, or paint chips (Bellinger & Needleman, 2003). Both of these factors can slow brain development and reduce intelligence. If impoverished environments can harm intelligence, we might wonder whether enriched environments can improve it. Government-funded after-school programs such as Head Start are designed to help children learn. Research has found that attending such programs may increase intelligence for a short time, but these increases rarely last after the programs end (McLoyd, 1998; Perkins & Grotzer, 1997). Intelligence is improved by education; the number of years a person has spent in school correlates at about r = .6 with IQ (Ceci, 1991).

It is important to remember that the relative roles of nature and nurture can never be completely separated. A child who has higher than average intelligence will be treated differently than a child who has lower than average intelligence, and these differences in behaviors will likely amplify initial differences. This means that modest genetic differences can be multiplied into big differences over time.

The Bell Curve:

Richard Herrinstein and Charles Murray in 1994 published an important book called as "The Bell Curve" which has become highly controversial and had made certain conclusion concerning intelligence, race and genetics. According to Herrenstein and Wilson (1994) intelligence is an important asset in a modern society. The demand for intelligence in modern society has created two groups in society. One group consists of highly intelligent individuals who hold good jobs and earn more. Due to their high intelligence, they are paid more and they progress economically as well as socially. On the other hand, are individuals, who, because of their low intelligence, hold low status jobs and are paid less. Consequently, their economic and social status is also low. Thus, according to Herrenstein and Murray (1994) one's intelligence determines one's occupational success and one's social status. Its central point is that intelligence is a better predictor of many factors including financial income, job performance, unwed pregnancy, and crime than parents' Socioeconomic or education level. Also, the book argued that those with high intelligence, which it called the "cognitive elite", are becoming separated from the general population of those with average and below-average intelligence and that this was a dangerous social trend.

Thus, in The Bell Curve, Herrnstein and Murray set out to prove that American society was becoming increasingly meritocratic, in the sense that wealth and other positive social outcomes were being distributed more and more according to people's intelligence and less and less according to their social backgrounds.

The Bell Curve has become highly controversial. The Bell Curve is not a scientific work. It was not written by experts, and it has a specific political agenda. According to experts the book has many statistical errors and ignored the effects of environment and culture in determining his/her success in life.

Theory of Multiple Intelligence:

According to American psychologist Howard Gardner (1983) we do not have one underlying general intelligence, but instead have multiple intelligences. The nine types of intelligence identified by Howard Gardner are as follows:

- **Linguistic Intelligence:** Children with this kind of intelligence enjoy writing, reading, telling stories or doing crossword puzzles. Linguistic intelligence involves aptitude with speech and language and is exemplified by poet T. S. Eliot.

- **Logical-Mathematical Intelligence:** Children with lots of logical intelligence are interested in patterns, categories and relationships. They are drawn to arithmetic problems, strategy games and experiments. Physicist Albert Einstein is a good example of this intelligence.

- **Spatial Intelligence:** It is used to perceive visual and spatial information and to conceptualize the world in tasks like navigation and in art. Painter Pablo Picasso represents a person of high spatial intelligence.

- **Musical intelligence:** It is the ability to perform and appreciate music, is represented by composer A. R. Rahman and Rahul Dev Burman (R.D. Burman).

- **Bodily-kinaesthetic intelligence:** It is the ability to use one's body or portions of it in various activities, such as dancing, athletics, acting, surgery, and magic. Martha Graham, the famous dancer and choreographer, is a good example of bodily-kinaesthetic intelligence. It is the type of ability shown by the gifted athletes, dancers or super surgeons who have great control over their body, hand and finger movements.

- **Interpersonal intelligence:** It involves understanding others and acting on that understanding. It is the type of ability shown by those who can easily infer other people's mood, temperaments, or intentions and motivations.

- **Intrapersonal intelligence:** It is the ability to understand one's self and is typified by the leader Mohandas Gandhi. It is the ability shown by someone who has great insight into his/her own feelings and emotions.

- **Naturalist Intelligence**: the ability to recognize and classify plants, animals, and minerals. Naturalist Charles Darwin is an example of this intelligence. Naturalistic Intelligence is defined as the ability to observe and/or interact with diverse species in nature. The type of ability shown by biologists or environmentalist

- **Existentialist:** It is the ability to see the "big picture of the human world by asking questions about life, death and the ultimate reality of human existence.

Emotional intelligence:

Most psychologists have considered intelligence a cognitive ability, people also use their emotions to help them solve problems and relate effectively to others. Emotional intelligence refers to the ability to accurately identify, assess, and understand emotions, as well as to effectively control one's own emotions (Feldman-Barrett & Salovey, 2002; Mayer, Salovey, & Caruso, 2000).

This concept was first introduced by Salovey and Mayer. According to them, Intelligence is the ability to monitor one's own and others emotions, to discriminate among emotions and to use the information to guide one's thinking and actions. The idea of emotional intelligence is seen in Howard Gardner's interpersonal intelligence (the capacity to understand the emotions, intentions, motivations, and desires of other people) and intrapersonal intelligence (the capacity to understand oneself, including one's emotions).

Emotional Quotient (EQ):

Emotional Quotient (EQ) is used to express emotional intelligence in the same way as Intelligent Quotient (IQ) is used to express intelligence. Emotional Quotient (EQ) is a ratio concept and is a score of emotional intelligence obtained by dividing chronological age by emotional age and multiplying by 100. The formula of Emotional Quotient (IQ) is given below.

Emotional Quotient (EQ) = Emotional Age/ Chronological Age* 100

Emotional intelligence is a set of skills that underlie accurate appraisal, expression and regulation of emotions. It is the feeling side of intelligence. A good IQ and scholastic record is not enough to be successful in life. You may find many people who are academically talented but are unsuccessful in their own life. They experience problems in their life, workplace and interpersonal relationships. What do they lack? Some psychologists believe that the source of their difficulty may be lack of emotional intelligence. In simple words, emotional intelligence refers to the ability to process emotional information accurately and efficiently. There are some characteristics of emotional intelligent person. Person who are high on emotional intelligence who possess following characteristics.

Characteristics of Emotional Intelligent Person:

- Perceive and be sensitive to your feelings and emotions.
- Perceive and be sensitive to various types of emotions in others by noting their body language, voice, tone and facial expressions.
- Relate your emotions to your thoughts so that you take them into account while solving problems and taking decisions.
- Understand the powerful influence of the nature and intensity of your emotions.
- Control and regulate your emotions and their expressions while dealing with self and others.

Daniel Goleman, an American author and journalist, popularized the concept in his book Emotional Intelligence (1995). He expanded the concept to include general social competence. The importance of emotional intelligence has been very well brought out in the following words by Daniel Goleman "Emotional Intelligence is a master aptitude, a

capacity that profoundly affects all other abilities, either facilitating or interfering with them. According to Daniel Goleman the term encompasses has following five characteristics and abilities:

1) **Self-Awareness**: Knowing your emotions, recognizing feelings as they occur, and discriminating between them.

2) **Mood Management**: Handling feelings so they're relevant to the current situation and you react appropriately.

3) **Self-Motivation**: Gathering up your feelings and directing yourself towards a goal, despite self-doubt, inertia, and impulsiveness.

4) **Empathy**: Recognizing feelings in others and tuning into their verbal and nonverbal cues.

5) **Managing relationships**: Handling interpersonal interaction, conflict resolution, and negotiations.

Thus, emotional intelligence is not same as self-esteem and optimism. Rather emotionally intelligent people are both social and self-aware. Those scoring high on managing emotions enjoy higher-quality interactions with friends (Lopes et.al.2004). They avoid being hijacked by overwhelming depression, anxiety or anger. Being sensitive to emotional cues, they know what to say to soothe a grieving friend, encourage a colleague and manage conflict.

Emotional intelligence is less a matter of conscious efforts and more of one's unconscious processing of emotional information. (Fiori,2009). Across many studies in many countries, those scoring high on emotional intelligence showed somewhat better job performance. They could also delay gratification in pursuit of long-term rewards, rather than being overtaken by immediate impulses. They were emotionally in tune with others and therefore often succeeded in career, marriage and parenting.

3.4 NEUROPSYCHOLOGICAL BASIS OF EXECUTIVE FUNCTIONS

3.4.1 Social Determinants & Biological Determinants of Intelligence:

There are two basic factors which influence the human intelligence. These two factors are biological and social. The heredity-environment issue, debated in regard to many aspects of human behaviour, has focused most intensely on the area of intelligence. Few experts doubt that there is some genetic basis for intelligence, but opinion differ as to the relative contribution of heredity and environment.

Most of the evidence bearing on the inheritance of the intelligence comes from studies correlating IQs between person of various degree of genetic relationship. The average correlation between the IQs of parents and their natural children is 50; between parents and their adopted children the correlation is about 25. Identical twins, because they develop from a single

egg. Share precisely the same heredity; the correlation between their IQs very high –about 90. The IQs of fraternal twins (who are genetically no more alike than ordinary siblings, since they develop from separate eggs) correlated higher, .75, than those of fraternal twins reared together.

Note that being reared in the same home situation tends to increase IQ similarity, even for individual who are unrelated. Although adopted children resemble their natural parents on the basis of their natural parent's ability (Skodak and Skeels, 1949).

Racial Differences:

After discussing generic contribution to intelligence, it is obvious that there are racial differences in intelligence. Because of the recent issue on the question of whether blacks are innately less intelligent than whites. In view of the heated controversy centered on this issue and its significance for social policy, it is important that we examine the available evidence. On standard intelligence tests black Americans, as a group, score 10 to 15 IQ points lower than while Americans, as a group. This fact is not a debate but revolves around how to interpret the difference. Some possible explanations should be apparent from what we have already said about the nature of IQ tests and the influence of environmental factor on tested intelligence. For example, most intelligence have been standardized on white populations. Since black and whites generally grow up in quite different environments and have different experiences, the contents of such tests may not be appropriate for blacks. And a black child may react differently to being tested (particularly if he or she is being tested by a white examiner) than a white child. Thus, the whole issue of estimating black intelligence is complicated by the questions of whether the tests are appropriate and whether the data obtained by white testers represent an unbiased measure of IQ.

3.4.2 Is intelligence neurologically Measurable?:

Using today's neuroscience tools, we might link differences in people's intelligence test performance to dissimilarities in the heart of smarts—the brain? Might we anticipate a future brain test of intelligence?

More recent studies that directly measure brain volume using MRI scans do reveal correlations of about +.33 between brain size (adjusted for body size) and intelligence score (Carey, 2007; McDaniel, 2005). Moreover, as adult's age, brain size and nonverbal intelligence test scores fall in concert (Bigler et al., 1995). One review of 37 brain-imaging studies revealed associations between intelligence and brain size and activity in specific areas, especially within the frontal and parietal lobes (Jung & Haier, 2007). Sandra Witelson would not have been surprised. With the brains of 91 Canadians as a comparison base, Witelson and her colleagues (1999) seized an opportunity to study Einstein's brain. Although not notably heavier or larger in total size than the typical Canadian's brain, Einstein's brain was 15 percent larger in the parietal lobe's lower region—which just happens to be a center for processing mathematical and spatial

information. Certain other areas were a tad smaller than average. With different mental functions competing for the brain's real estate, these observations may offer a clue to why Einstein, like some other great physicists such as Richard Feynman and Edward Teller, was slow in learning to talk (Pinker, 1999).

If intelligence does modestly correlate with brain size, the cause could be differing genes, nutrition, environmental stimulation, some combination of these, or perhaps something else. Recall from earlier chapters that experience alters the brain. Rats raised in a stimulating rather than deprived environment develop thicker, heavier cortexes. And learning leaves detectable traces in the brain's neural connections. "Intelligence is due to the development of neural connections in response to the environment," notes University of Sydney psychologist Dennis Garlick (2003).Postmortem brain analyses reveal that highly educated people die with more synapses—17 percent more in one study—than their less-educated counterparts (Orlovskaya et al., 1999). This does not tell us whether people grow synapses with education, or people with more synapses seek more education, or both. But other evidence suggests that highly intelligent people differ in their neural plasticity—their ability during childhood and adolescence to adapt and grow neural connections in responseto their environment (Garlick, 2002, 2003).

The neurological approach to understanding is currently in its heyday. Will this new research reduce what we now call the g factor to simple measures of underlying brain activity? Or are these efforts totally wrongheaded because what we call intelligence is not a single general trait but several culturally adaptive skills? The controversies surrounding the nature of intelligence are a long way from resolution.

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4

PSYCHOLOGY OF EMOTIONS

Unit Structure

4.1 INTRODUCTION

Emotions are responsible for the finest inhuman achievement and for the worst in history. They are the source of pleasure as well as sorrow in our life. Negative and long lasting emotions can make us sick. So, what are emotions? Emotions are our body's adaptive response. They exist to give us support for our survival. When we are faced with a challenge, emotions focus our attention and energize our actions. (Cyders & Smith,2008).Emotions are a mix of bodily arousal (heart pounding), expressive behaviors (quickened pace) and conscious experience, including thoughts and feelings (panic, fear, joy). (Mayers D.G.,2013)

Historical as well as current research has been trying to find answer to two questions.

1. Whether bodily arousal comes before or after we emotional feelings?

2. How do thinking (cognition) and feelings interact?

4.2 Theories of Emotions

4.2.1 Historical Emotion Theories:

1) A. James Large Theory: Arousal Comes Before Emotion:

Common sense suggests that first we experience a feeling and then consequently comes our action, e.g., we cry because we are sad, tremble because we are scared. But James-Lange theory proposes exactly opposite of that and states that feeling comes as a consequence of our action, e.g., we feel sorry because we cry.

In other words, James and Lange would say, "I feel sorry because I cry, I feel afraid because I tremble". If a person sees a bear while walking along in the woods, James and Lange would suggest that the person would tremble and then realize that, because they are trembling, they are afraid. He further stated that without the bodily states following on the perception, the latter would be purely cognitive in form, pale, colorless, destitute of emotional warmth. We might then see the bear, and judge it best to run, receive the insult and deem it right to strike, but we should not actually feel afraid or angry.

2) The Cannon-Bard Theory:

Cannon disagreed with James-Lange Theory and stated that people who show different emotions may have the same physiological state, e.g., cry when happy and sad. The body's responses such as heart rate, perspiration and body temperature are often too similar and too slow to cause different emotions, which erupt very quickly, e.g., does racing heart signal fear, anger or love? Physiological arousal may occur without the experience of an emotion, e.g., exercise increases heart rate no emotional significance. Cannon - Bard explained that our bodily responses and experienced emotions occur separately but simultaneously, e.g., The emotion triggering stimulus travels to sympathetic nervous system, causing body's arousal. *At the same time*, it travels to brain's cortex, causing awareness of emotion. So, my pounding heart did not cause my feeling of fear, nor did my feeling of fear cause my pounding of heart.

However, Cannon-Bard's theory has been criticized by those doing research on spinal cord injuries. It was reported by them that patients with high spinal cord injury (those who could feel nothing below neck) reported changes in their emotions' intensity. Patients reported that the intensity of experienced emotion such as anger has come down drastically. One patient reported that "Anger just doesn't have the heat to it that it used to…" But other emotions that are expressed mostly in body above the neck were felt more intensely, e.g., these patients reported increase in weeping, lumps in the throat and getting choked up when saying good-bye, worshipping or watching an emotional movie. This indicates that our bodily responses feed our experienced emotions.

4.2.2 Cognition Can Define Emotion: Schachter and Singer's Two Factor Theory:

Schachter and Singer maintain that we don't automatically know when we are happy, angry, or jealous. Instead, we label our emotions by considering situational cues. Our physical reactions and thoughts together create emotions. So, there are two factors – physical arousal and cognitive appraisal. They also talked about **spillover effect**. some element in the situation (e.g., you have come home after a rigorous exercise) must trigger a general, nonspecific arousal marked by increased heart rate, tightening of the stomach, and rapid breathing. At that time, you get the good news that you have got the job that you wanted for a long time. You will feel more excited because of lingering arousal from the exercise. You would not have felt the same intensity of excitement if you had just woken up from sleep.

To show this spillover effect, they conducted an experiment in which volunteered were told that experiment was about the effects of a vitamin called Suproxin. After volunteers consented they were injected with epinephrine or a placebo. Epinephrine triggers a feeling of arousal and generally increases blood pressure, heart rate, and respiration. Thus, the men who received the epinephrine were more physiologically aroused than those who received the placebo. Schachter and Singer reasoned that once the epinephrine's effects take place, participants would begin to search for the cause of their arousal and their reaction would depend on the available situational cues. After administering injection, all participants were asked to wait in a waiting room, where another person (actually an accomplice of the experimenters) was already present. This accomplice acted either euphoric or irritated.

Before going into the waiting room some of the epinephrine injected participants were told that there are some common side effects of the drug - they might feel flushed, their hands might shake, and their hearts might pound. The other subjects, in contrast, were given no information at all about the effects of the drug. Once the effect of epinephrine kicked in, people who were told beforehand that the drug would arouse them felt no emotion and assumed that the drug was causing their hands to shake and their heart to pound and those who weren't told about the drug's effects, interpreted their arousal as an emotion. As Schachter and Singer had predicted, the physiologically aroused subjects who hadn't been told about the drug's side-effects responded with motions that matched the confederate's actions. If they were aroused and hadn't been expecting the arousal, then they felt happy when the other person, i.e., confederate, was happy, but angry when the other person was angry. Forewarned subjects and unaroused subjects who received a placebo did not display any pronounced emotion. This finding that arousal state can be experienced as one emotion or the other depending on how we label it has been replicated in many other studies, indicating that arousal fuels emotions, cognition channels it.

4.2.3 Cognition May Not Precede Emotion: Zajonc, LeDoux and Lazarus' Theory:

Zajonc believed that some of our emotional reactions involve no deliberate thinking. He that our emotional responses follow two different brain pathways. Some emotions such as hatred and love travel a "high-road" while other emotions such as simple likes, dislikes and fears take "low road". This low road is like shortcut that enables our emotional response before our intellect interferes.

Lazarus said that our brains process vast amount of information without our conscious awareness and that some emotional responses do not require conscious thinking. Much of our emotional life operates via the automatic, speedy low road. However, we still need to appraise a situation to determine what we are reacting to. This appraisal may be effortless and we may not be conscious of it. In other words, he said that emotions arise when we appraise an event as harmless or dangerous, whether we truly know it is or not, e.g., we appraise the sound of the rustling bushes as the presence of danger. Later on we might realize that it was just the wind. So, some emotional responses-especially simple likes, dislikes and fears involve no conscious thinking, e.g., we may fear a snake and our emotion may not change in spite of knowing that snake is harmless. However, studies have shown that highly emotional people are intense partly because of their interpretations and although the emotional low road functions automatically, the thinking high road allows us to retake some control over our emotional life.

4.3 BIOLOGICAL BASIS OF HUMAN EMOTIONS

Different emotions do not have sharply distinct biological signatures and they do not engage very distinctly different brain regions. For example, insula, a neural center deep inside the brain gets activated when we experience different social emotions such as lust, pride and disgust. It gets activated with taste, smell or even thought of some disgusting food or even if we feel moral disgust over a cheating case. However, researchers have identified some subtle physiological distinctions and brain patterns for different emotions,

We can say that we cannot differentiate in emotions on the basis of heart rate, breathing and perspiration, but different emotions have different facial expressions and brain activity.

4.3.1 Emotions and the Autonomic Nervous System:

By now, we know that autonomic nervous system helps in moving our various bodily organs into action when the need arises and parasympathetic nervous system helps in calming down our bodily reactions. For example, when we are faced with a challenging or exhilarating situation, our adrenal glands secrete stress hormones, our liver releases more sugar in the blood stream to provide more energy and respiration rate goes up to provide more oxygen. The digestion slows

down to divert more blood from internal organs to muscles and if you are wounded, the blood clots more quickly to stop the bleeding. The pupil in the eyes dilates so that more light comes in and you can see better. The perspiration increases to cool your stirred-up body, etc. This kind of bodily response is beneficial for better performance to meet the challenges. Moderate arousal is needed to give better performance. For example, can you imagine P.T. Usha winning a race if she was not moderately aroused/tense (or was sleeping) just before the race started. However, having too much arousal/ tension or having too little arousal/ tension before an important activity will not enhance the performance. One should not be too relaxed or too tense before the important activity.

On the other hand, when the situation comes back to normal and is no more challenging, the parasympathetic gradually calms down the body and stress hormones slowly dissipate from the blood stream.

4.3.2 The Physiology of Emotions:

Different emotions neither have very distinct biological reactions nor do they originate from specific distinct brain regions. For example, the insula in the brain is activated when we experience various social emotions such as lust, pride and disgust. It does not matter that these feelings may originate from different sources. For example, the feeling of disgust may originate from taste of disgusting food, smell of disgusting food or just a thought of some disgusting food or it may originate from watching a disgusting news of corruption practiced by politicians.

However, studies have shown that even though biological reactions and brain regions for different emotions appear to be similar, there are emotions such as sexual arousal, fear, anger, and disgust that are felt differently by the people and they appear to be different to other people. Researchers have identified some subtle brain pattern differences and physiological differences for different emotions. For example, the finger temperature and hormone secretion related with fear and rage differ. Heart rate increases in fear and joy but both feelings stimulate different facial muscles. While experiencing fear, your eye brow muscles get tensed up and while experiencing joy, your cheeks and under your eyes pull into smile.

Some emotions also differ in their brain circuits. People show more activity in amygdala when they are watching fearful faces rather than angry faces. Experience of negative emotions such as disgust activates right side prefrontal cortex rather than left side one. People with depression and negative personality in general also show more right frontal activity. People with positive personalities, that is people who are alert, enthusiastic, energized and persistently goal oriented, show more activity in the left frontal lobe than in the right frontal lobe.

Thus, we can say that we can't easily differentiate emotions on the basis of bodily reactions such as heart rate, breathing and perspiration. But facial expressions and brain activity can differ with emotions.

4.3.3 Gender, Emotion and Nonverbal Behavior:

Studies have proved that women are better at reading emotional cues than men, even if they are exposed to very little behavior of the other person, e.g., they can detect whether a male-female couple is a genuine romantic couple or just pretending one(Barnes & Sternberg, 1989).Women's nonverbal sensitivity is due to their greater emotional literacy and they more emotionally responsive. For example, in an experiment on emotional literacy, when men were asked how will they feel saying good bye to a friend, they simply said, "I will feel bad", while women said "It will be bittersweet; I'll feel both happy and sad".(Barrett et.al., 2000). A study of people from 26 cultures found that women reported themselves as more open to feelings than men. (Costa et.al. 2001). This clearly indicates that women are more emotional than men. However, generally, people tend to attribute women's reactions to their emotions while men's reactions to their circumstances, except for the feeling of anger. Anger is considered as more masculine emotion. Surveys showed that women are more likely to describe themselves as empathic. Their heart rate goes up and they are more likely to cry when they see someone in distress.

4.4 MEASUREMENT OF EMOTIONS

4.4.1 Detecting Emotions in Others:

To determine other people's emotions we read their bodies, listen to their voice tones and study their faces. Psychologists wondered whether non-verbal language differs according to our culture and can our expressions influence our experienced emotions. For example, in western culture, a firm handshake conveys an outgoing, expressive personality. A gaze, an averted glance or a stare indicates intimacy, submission or dominance. In a study, male-female pairs who were total strangers to each other, were asked to gaze intently at each other for two minutes. They reported feeling a tingle of attraction towards each other.

Most of us read nonverbal cues well. We are especially good at detecting nonverbal threats. In a crowd of faces, a single angry face is identified much faster than a single happy face. Experience can also sensitize us to particular emotions, e.g., viewing a series of faces depicting anger to fear, physically abused children were much quicker to spot the signals of anger than non-abused children. Hard to control facial muscles reveal signs of emotions that a person may be trying to hide, e.g., eyebrows raised and pulled together signal fear. Our brains are very good detectors of subtle expressions. Seeing a face for just 0.1 seconds also enabled people to judge attractiveness or trustworthiness of a person (Willis & Todorov,2006). It is rightly said that first impression occurs at lightning speed. Despite our brain's emotion detecting skills, it is difficult to detect deceiving expressions. The behavioral differences between liars and truth-

tellers are too minute for most people to detect. However, some people are much better emotion detectors (especially introverts) than others. It is difficult to detect emotions from written communication because it does not have gestures, facial features and voice tones to help detection of emotions. Electronic communication also provides very poor quality nonverbal cues. That is why, people often use emoticons.

Lie Detection:

It is a common practice for researchers and crime detectors to use lie detector- polygraph to detect the lies. The question arises how effective and reliable is polygraph in detecting lies. The polygraph works on the principle that certain emotion-linked bodily changes, such as changes in breathing, cardiovascular activity and perspiration changes take place when a person tells a lie, even if that person can control his facial expressions. The tester/examiner asks questions to the testee and observes these bodily changes taking place in the testee while answering the questions. The tester starts questioning with certain question that may make any person nervous and polygraph will show signs of arousal. These are called control questions. For example, a tester may ask in last 10 years have you taken anything that does not belong to you? The arousal level shown on a polygraph, in response to these control questions serves as the base line. Then the tester will ask the critical questions, e.g., have you stolen anything from your previous employer? The arousal level shown on polygraph in response to this question will indicate whether the person is telling the truth or lying. For example, if the arousal level while answering the critical question is weaker than the base line arousal determined before, then we can say that person is telling the truth. On the other hand, if the arousal shown in response to critical question is more than base line arousal that means the person is telling the lie.

4.4.2 Culture and Emotional Expression:

Studies have shown that there are universal facial expressions for basic emotions across different cultures. Facial muscles speak a universal language. In entire world, children cry when in distress and smile when they are happy. Even people blind from birth, naturally show the common facial expressions linked with emotions such as joy, sadness, fear and anger. Musical expressions also cut across cultures. In all cultures, fast paced music seems to be happy one and slow music is considered as sad one.

Charles Darwin said that in prehistoric times, before our ancestors communicated through words, they communicated threats, greetings and submission through facial expressions. Their shared expressions help in their survival. Emotional expressions help in our survival in other ways also, e.g., surprise raises the eyebrows and widens the eyes so that we can take in more information. However, it is observed that people are more accurate in judging emotions from their own culture, and there are cultural differences in how much emotion will be expressed. For example, in

western culture, people openly show their emotions while in Asian cultures, people tend to have less visible display of their emotions.

4.4.3 The Effects of facial Expression:

Studies indicate that expressions not only communicate emotions, they also amplify and regulate them. People report feeling more fear than any other emotion, when made to construct a fearful expression. It is said smile warmly on the outside and you will feel better on the inside. So, your face feeds your feelings. In an experiment, depressed patients felt better after getting Botox injections that paralyze the frowning muscles. Similarly, it is reported that people see ambiguous behaviors differently depending on which finger they move up and down while reading a story. If they read the story, while moving an extended middle finger, the story behaviors seemed more hostile. If read with a thumb up, they seemed more positive.

4.5 EMOTIONAL DEVELOPMENT AND REGULATION

4.5.1 The Need To Belong: Introduction:

Aristotle wrote that all human beings are social animals. Even if people have all resources and amenities to live life comfortably, but no social contact with other human beings, they will choose not to live. They will prefer to live with others, even if it means to live with limited resources. We all have a need to affiliate with others, even to become strongly attached to certain others in long lasting close relationships. Alfred Adler called it an "urge to community". The question arises why do we have such strong desire to affiliate with others. Psychologists believe that need to belong is beneficial for human beings.

Aiding in Survival:

Evolutionary psychologists explained that social bonds increased the survival rate of our ancestors who were living in forests and caves. Survival was enhanced by cooperation. In solo combat, our ancestors could not fight back other animals who were much stronger than them. Similarly, to get food by hunting, fishing or by just collecting from plants, our ancestors realized that it is better to hunt in team and share the spoils rather than try to hunt individually. Travelling in group gave every one of them protection from predators and enemies.

Psychologists believe that all human beings have a strong instinct to propagate their genes in next generation. As adults, those who formed attachments were more likely to reproduce (have children) and to co-nurture their offspring to maturity. By keeping children close to their caregivers, attachments served as a powerful survival impulse. Those who felt a need to belong survived and reproduced more successfully. So being social is there in our genes.

Good Health:

Studies have shown that people who feel supported by close relationships are the ones who live longer with better health and at a lower risk of psychological disorder than those who do not have social support, e.g. It was observed that married people are less at risk for depression, suicide and early death. Social isolation puts us at the risk of declining mental and physical health.

Wanting to Belong:

Most people report close, satisfying relationships with family, friends, or romantic partners is the first and foremost requirement for their happiness and meaning in life. (Berscheid, 1985) Studies show that money does not make a person happy, rich and satisfying close relationship do. A person may be very rich and yet unhappy and lonely. When our need to belong is satisfied in balance with psychological needs of autonomy (having a sense of personal control) and competence, we experience a deep sense of well-being. (Deci & Ryan (2002). When we feel included, accepted and loved by those who are important to us, our self-esteem goes up. Therefore, most of our actions are aimed at increasing our social acceptance. To avoid rejection, we generally **conform to** group norms and try to make favorable impressions.

The need to belong influences our need to define who we are. We express our identity in terms of faithful relationships and loving families. We proudly say that I belong to so and so family. However, our need to define who we are can be expressed in negative way also. For example, we may become part of teen gangs, we may become part of ethnic rivalries (our identity as Hindu, Muslim, or Sikh, etc.) and fanatic nationalism.

Sustaining Relationships:

It is well known that generally familiarity produces liking. Think of it. In a new class or conducted vacation trips, initially, we are indifferent to other students/participants, who are total strangers for us, but by the end of the course/ vacation trip, parting ways and breaking social bonds becomes a distressing experience and we promise to keep in touch with each other. These friendships with at least some of them becomes lifelong.

Our strong desire to maintain relationships with others, no matter how bad or abusive, are due to our fear of being alone. Studies on abusive relationships have shown that people prefer to stay in abusive relationships and suffer emotional and physical abuse rather than face the pain of being alone. People suffer emotional trauma even when bad relationship breaks down. After separations, people have feelings of loneliness and anger. Sometime they have strange desire to be near the former partner even if the relationship with former partner was not good.

Children who move through a series of foster homes or through repeated family relocations, with repeated disruptions of budding attachments, may have difficulty in forming deep attachments in later life. (Oishi &

Shimmack, 2011). It has been observed that children reared in institutions have no sense of belonging to anyone, or children locked away at home under extreme neglect become pathetic beings – withdrawn, frightened and speechless.

Life's best moments occur when close relationships begin, e.g., when new friendship develops, we fall in love or when a new baby is born in the family. The worst moments of life take place when close relationship comes to an end. When some situation threatens, or dissolves our social ties, we experience extreme anxiety, loneliness, jealousy or guilt. When a person loses a life partner, he or she feels that life has become empty and meaningless. For immigrants and refugees moving alone to new places, the stress and loneliness can lead to depression for them. But if the feeling of acceptance and connection increases, then our self-esteem, positive feelings and desire to help others instead of hurting others also increases.

The Pain of Ostracism:

This social exclusion is called ostracism. For centuries together, humans have controlled social behavior by using the punishing effect of severe ostracism. In extreme form, it can be in the form of exile, imprisonment or solitary confinement. In milder form, it can be being excluded, ignored or shunned by your friends, being given a silent treatment by not talking to you, by avoiding you or averting his/her eyes in your presence or even making fun of you behind your back. Williams & Zadro (2001) stated that being shunned – given the cold shoulder or the silent treatment, with others' eyes avoiding yours- threatens one's need to belong. This is the meanest thing you can do to someone, especially when you know that the other person can't fight back. Even just being linguistic outsider among people speaking a different language that you can't speak or understand must have made you feel excluded.

People often respond to social ostracism with depressed moods. In the beginning, they try to restore their acceptance and if they don't succeed, they go into withdrawal. People lose their self-esteem and their weight drops. Experiencing cyber-ostracism is equal to experiencing real pain. Ostracism (in the form of being ignored in a chat room or email going unanswered) even by strangers or by a despised out group takes its toll on the victim. It activates the same area of brain that is activated in response to physical pain. (Williams et.al.,2006).

When people experience rejection, and cannot rectify the situation they seek new friends or gain stress relief by strengthening their religious faith. They may turn nasty, may indulge in self- defeating behaviors, may underperform on given tasks, may not empathize with others and are more likely to behave aggressively, especially towards those who had excluded them.

Social networking:

Since social relationships are essential for leading a healthy life, it is but natural for us to see how the progress of communication technology has

significantly impacted satisfaction of our need to have social contacts. Technology has changed the way we connect with others and communicate. Texting, e-chatting and e-mailing has replaced phone talking. With social networking being pervasive in all aspects of our life it is important for us to see how it impacts us.

The Social Effects of Social Networking:

As electronic communication becomes part of new normal, researchers are exploring how these changes affect our relationships. The question asked by psychologists is**"Are Social Networking Sites Making Us More Or Less Socially Isolated?"**Research has reported that when online communication in chat rooms and during social games was mostly between strangers in the internet's early years, adolescents and adults who spent more time online spent less time with friends, and their offline relationships in real world suffered.

Bonetti et.al.(2010) reported that lonely people tend to spend greater than average time online. Social networkers are less likely to know their real-world neighbors, and compared to non-internet users, are 64% less likely to rely on neighbors for help either for themselves or for their family members.

However, social networking has its own **advantages** also. The internet is diversifying our social networks. It is possible to connect with likeminded people having similar interest from all over the world. Geographical boundaries are broken. To a large extent, social taboos are also broken. Despite the decrease in neighborliness, social networking is mostly strengthening our connections with people we already know. For example, we form groups on Facebook and WhatsApp. If Facebook page helps you to connect with friends, stay in touch with extended family, or find support in facing challenges, then you are not alone.

Another phenomenon noticed on social networking sites is that people disclose personal information to perfect strangers or for the whole world to see that in normal circumstances they will not like to disclose in real life. This observation brought another important question to psychologists – **Does Electronic Communication Stimulate Healthy Self-Disclosure?**

Mental health experts point out that confiding in others can be a healthy way of coping with day to day challenges. Very often we find that people pour out their woes on social networking site. For example, it was reported in TOI, dated 16th May 2017, that a film producer of Marathi films posted his suicide note on Facebook before committing suicide. This is not isolated news. Before that also, media has reported many such incidents. The question arises why people disclose their distress on social networking sites rather than talking to somebody in their vicinity. There can be many reasons for it such as:

1. People may not have any close friends to whom they can communicate face to face about their problems.

2. While disclosing our distress face to face, we are not sure how the other person is going to react. We are vulnerable and self-conscious. It makes us feel weak and hits our self-esteem. On the other hand, while communicating electronically rather than face-to-face, we often are less focused on others' reactions, feel less self-conscious and thus feel less inhibited. We become more willing to share our joys, worries and vulnerabilities. Sometimes, this disinhibition can take an extreme form. For example, people indulge in sexting, teens send nude photos of themselves to their internet friends, youth are "cyber-bullied" or trolling takes place, hate groups post messages promoting bigotry or crimes.

3. Self-disclosure can also help to deepen friendships. Even if our friendship with internet friends gets stronger, we crave to meet them face to face. This is because nature has designed us for face to face communication, which appears to be better predictor of life satisfaction. Texting and e-mailing are rewarding but having face to face conversation with friends and family is more enjoyable.

There are all sorts of people in virtual world just as they are in real world. Some people are honest, loving good human beings and some are cheats, criminals/ predators. Psychologists wondered whether people reveal their true selves on internet. So the next question is –**Do Social Networking Profiles and Posts Reflect People's Actual Personalities?**

Beck et.al. (2010) found that ratings based on Facebook profiles were much closer to the participants' actual personalities than to their ideal personalities. This indicated that generally social networks reveal people's real personalities. In another study, it was found that people who seemed most likable on their Facebook page also seemed most likable in face to face meetings also. This also indicates that Facebook profile reflects real personality of the person.

It has been observed that most of the people using social networking sites are mainly talking about themselves. It is always about me, my life, my family, my thoughts, my experiences etc. So, another question that intrigued psychologists was - **Does Social Networking Promote Narcissism?**

Narcissistic people are self – focused, self- promoting and have an unusual sense of self – importance. They like to be the center of attention. Such people on Facebook compare the number of friends they have, the number of likes they get from others, compared to their other friends. They are very active on social media. Just to feel the pleasure of having maximum number of friends, they collect more superficial friends. They post more staged, glamorous photos of themselves just to get more likes. Anyone who visits their Facebook page can judge that they are narcissists. So, social media is not just a platform for all narcissists to gather there, but it also satisfies their narcissistic tendencies

Maintaining Balance and Focus:

The question arises how to maintain balance between our real world and the virtual world. Some of the suggestions offered by experts are as follows:

1. **Monitor your time:** Keep a diary and see whether the way you use your time reflects your priorities. Check whether the time spent on internet is interfering with your academic and work performance and whether it is eating your time with friends and family.

2. **Monitor your Feelings:** Check how you feel when you are not online. If you feel anxious and restless, if you keep thinking about social networking sites all the time even when you are in class or at work, then you are getting addicted to social networking sites and you need help.

3. **"Hide" your more distracting online friends:** Before posting anything on your social networking sites, ask yourself, is it something that I would like to read if somebody else had posted it?

4. **Try turning off your handheld devices(mobiles) or leaving them elsewhere:** Cognitive psychologists point out that we cannot pay full attention to two things at a time. When you do two things at once, you don't do either of them as well as when you do them one at a time. So while studying, resist the temptation to check your social networking sites like WhatsApp/Facebook. Disable sound alerts and pop-ups.

5. **Try going on Internet "Fast":** That means decide to go off internet for five hours/ten hours or one day.

6. **Recharge your focus with a natural walk:** Research has shown that walking in a quiet garden or in a forest recharges people's capacity for focused attention rather than walking in a busy street.

4.6 SUMMARY

In this unit, we have touched upon three learning items - need to belong, emotions and happiness.

In need to belong, we looked at the definition and usefulness of need to belong. We also discussed how ostracism is painful for anybody and in social networking topic we discussed how technology has impacted our social communications. We also looked at the ways and means of maintaining a balance between real world and internet world.

In emotions we first talked about its definition, and we discussed four historical theories of emotion to see the link between cognition and emotions. The James Lange theory proposed that first comes bodily response and then we label emotions based on those bodily responses. Cannon-Bard's theory argued that emotions and autonomic responses occur simultaneously but separately. One is not the cause of the other. The

individual's appraisal of the emotion producing situation largely determines the emotions.

Schachter and Singer believed that to experience emotions, we must consciously interpret and label them. Zajonc, LeDoux and Lazarus noted that we have many emotional reactions without interference of intellect. Many emotions occur without our being aware of them. Then we discussed the physiology of emotions and how emotions can be detected by others. We also dwelled upon how gender and culture can influence the expression of emotions, and how facial expression can influence the actual experience of emotions.

4.7 QUESTIONS

1. Explain the usefulness of need to belong and pain of ostracism.
2. What is social networking and how can we maintain balance between real world and virtual world.
3. Define emotion and discuss various theories of emotion.
4. How can we detect emotions in others and what role is played by gender and culture in detecting emotions?

Write a short note on.

a. Effects of social networking

b. Maintaining balance between real world and virtual world

c. Cannon-Bard theory of emotion

d. Schachter & Singer's theory of Emotion

4.8 REFERENCES

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