"Biological and cognitive psychology".

In Section 1 of this course you will cover these topics:

- How The Brain Gives Rise To The Mind
- Perception
- Attention

Topic : How The Brain Gives Rise To The Mind

Topic Objective:

At the end of this topic students will be able to:

- Explain cognitive psychology
- Understand the artificial intelligence
- Understand the action potentials
- Understand the limbic system
- Understand the placebo effects

Definition/Overview:

Brain: The brain is the center of the nervous system in animals. All vertebrates have a brain, and most invertebrates have either a brain or a collection of ganglia. Some animals such as jellyfish and starfish do not have a centralized brain, and instead have a decentralized nervous system, while sponges lack either a brain or a nervous system. In vertebrates, the brain is located in the head, protected by the skull and close to the primary sensory apparatus of vision, hearing, balance, taste, and smell.

From a philosophical point of view, it might be said that the most important function of the brain is to serve as the physical structure underlying the mind. From a biological point of view, though, the most important function is to generate behaviors that promote the welfare of an animal. Brains control behavior either by activating muscles, or by causing secretion of chemicals such as hormones. Not all behaviors require a brain. Even single-celled organisms may be capable of extracting information from the environment and acting in response to it. Sponges, which lack a central nervous system, are capable of coordinated body contractions and even locomotion. In vertebrates, the spinal cord by itself contains neural circuitry capable

of generating reflex responses as well as simple motor patterns such as swimming or walking. However, sophisticated control of behavior on the basis of complex sensory input requires the information-integrating capabilities of a centralized brain.

In spite of rapid scientific progress, the way that brains work remains in many respects a mystery. The operations of individual neurons and synapses are now understood in considerable detail, but the way they cooperate in groups of millions has been very difficult to decipher. Methods of observation such as EEG recording and functional brain imaging tell us that brain operations are highly organized, but these methods do not have high enough resolution to reveal the activity of individual neurons. Thus, even the most fundamental principles of neural computation may to a large extent remain for future investigators to discover.

Key Points:

1. Cognitive Psychology

Cognitive psychology is a branch of psychology that investigates internal mental processes such as problem solving, memory, and language. The school of thought arising from this approach is known as cognitivism. It had its foundations in the Gestalt psychology of Max Wertheimer, Wolfgang Khler, and Kurt Koffka, and in the work of Jean Piaget, who provided a theory of stages/phases that describe children's cognitive development. Cognitive psychologists are interested in how people understand, diagnose, and solve problems, concerning themselves with the mental processes which mediate between stimulus and response. Cognitive theory contends that solutions to problems take the form of algorithms rules that are not necessarily understood but promise a solution, or heuristics rules that are understood but that do not always guarantee solutions. In other instances, solutions may be found through insight, a sudden awareness of relationships.

2. Artificial Intelligence

Artificial intelligence is a field that involves an attempt to mimic human cognition in computers with artificial systems. Because computers must be programmed and cannot originate the processing of information on their own, it is remarkable that researchers can create systems that produce the same output as humans. Todays computers have applications

across a wide range of problem solving; from nuclear war to everyday problems such as balancing a checkbook. Innovations of artificial intelligence actually began quite some time ago with very rudimentary theories and functions.

Many ancient Greek myths involved uses of mechanical toys and models, which were constructed to mimic real human behavior. In the 13th century, talking heads or puppets were created for the pleasure of entertainment. More importantly, and more like modern-day computers and calculators, the invention of the printing press with moveable type was invented in the 15th century. Around the same time, clocks were being produced and later, even extended the craft with the inclusion of movable figurines that were set into motion with the hour. Their movements were to mimic human behavior.

During the 17th century, Pascal created the first mechanical calculator and Leibniz enhanced the machine to include multiplication and division. Although the 18th century was focused on the further creation of mechanical toys, Charles Babbage and colleague Ada Byron brought us the first rudimentary computer, which was actually the first programmablecalculator. The 20th century brought many publications of theories of artificial intelligence, with many prophesizing the future of a mechanized and computerized world. The 20th century also brought the first mention of the robot. During this time, researchers were beginning to ask if human and artificial intelligence were truly the same.

Alan Turing was one of the first to test whether artificial intelligence was as intelligent as human intelligence. His experiment was designed to discover whether a human could distinguish between the performance of a computer and a human. A human interrogator could ask a respondent either a computer or a human, whose identity was hidden any question he or she wished, and based on either the computers or the humans response, the interrogator had to decide if the answer was given by the computer or by the human. This answer was, and still is not easily solved. Variations of the Turing test continue to be formulated today, and arguments as to whether or not human intelligence is distinct linger on.

More recent programs dedicated to artificial intelligence involving the simulation of expertise have proven superior. However, several caveats must still be considered when evaluating the differences and similarities between human and artificial intelligence. First, we must consider the concept of serial versus parallel processing. Humans can efficiently handle the simultaneous processing of several different streams of information, known as parallel

processing. It is widely accepted that computers can only handle information instructions in a serial fashion one-at-a-time bits of information, no matter how rapid. However, more recent models that incorporate several networks can process more than one feed simultaneously. Second, some argue that although computers can process symbolic information, they lack intuition or insight; a problem-solving skill that may be distinctly human. Often, intuition or insight comes to us outside of awareness; we cannot explicitly detail how we encountered a solution to a problem, yet we arrive at it. Some argue that because computers need to be programmed for every possible step in a process, they cannot generate solutions that would be novel or intuitive. Can computers go beyond the information given, as humans can? New technologies are breaking the boundaries everyday, and perhaps human and artificial intelligence are becoming closer and closer to being indistinguishable.

3.Action Potentials

An action potential is what occurs as neurons, cells of the nervous system, pass information along throughout the body. Neurons are electrically charged, and change their charge as information is passed along. At rest, before information is passed through the neuron, the neuron has a negative charge inside the cell. This is because the cells membrane, or outer covering, has selective permeability. At rest, positively charged potassium ions K+ can flow freely from inside to outside of the cell, but negatively charged chloride Cl- and positively charged sodium Na+ ions have a harder time passing through. Negatively charged proteins inside the cell cannot exit or pass through the neurons membrane. At rest, there are more sodium ions outside the neuron and more potassium ions inside along with the more negative charge because of the stationary proteins. If a message comes along which is transmitted through a chemical called a neurotransmitter, this resting charge is changed. If the chemical is excitatory, depolarization occurs and the message is sent along, but if the chemical is inhibitory, then the message is not sent along hyperpolarization. Either way, the change in the charge of the neuron due to excitation would have to be strong enough to reach the neurons threshold, which is an individual, minimal level for excitation. The action potential follows an all-or-none law, where the neuron either fires sends the information along or it doesnt, and the strength of the firing is the same each time, as long as its threshold has been reached. It fires only if the stimulation causes enough sodium ions to enter the neuron.

Lets assume that an excitatory neurotransmitter has been passed to a neuron, and the neurons threshold has been reached. During this process of depolarization, positively charged sodium

ions rush into the neuron. This temporarily changes the charge of the cell from being more negative to more positive and signals the sending of the neurotransmitter along to the next adjacent neuron. Next, potassium ions rush out, which restores the charge of the neuron repolarization. This process is a chain-reaction of sorts, as it occurs up and down the length of the neurons membrane. This process is also known as the sodium-potassium pump. There is a short period where the neuron cannot respond to incoming signals about 2 ms, and this is called the refractory period because the neuron needs time to restore back to its originally, negatively charged resting state.

Hyperpolarization occurs when the incoming signal is inhibitory and causes the inside of the neuron to become even more negatively charged, and thus prohibiting the action potential from occurring and the message being passed through the neurotransmitter toward the next neuron.

Action potentials occur all throughout the body in billions of neurons in order to send information from the external world to the internal world and back again. Action potentials are critical for the functioning of the nervous system.

4. The Limbic System

The limbic system, which was once believed to only regulate emotion, includes structures that serve many other functions. Generally speaking, the limbic system commands cognitions and behaviors necessary for human survival, which include controlling emotion and emotional responses, mood, motivation, pain and pleasure sensations, and some aspects of memory. The limbic system is also responsible for two behaviors exhibited by all mammals; the caring and nursing of females towards their offspring, and playful mood. And although the expression of emotion may differ by culture, it appears that some emotions are universal, including happiness, anger, fear, surprise, sadness, and disgust.

Several theories have been postulated that explain how we experience emotion. The James-Lange theory of emotion stated that an emotion-invoking stimulus first elicits a bodys physiological response to the arousal, which then in turn leads to a cognitive appraisal of emotion. Later theories by Cannon-Bard implied that physiological responses are accompanied by ones emotional experience, simultaneously. Finally, Schacter proposed a two-factor theory, which stated that a stimulus causes physiological arousal and our creation

of a cognitive label for the arousal e.g., I am afraid, which in turn elicits the expression of emotion. Debate continues as to whether or not physiological responses precede cognition and whether cognition precedes emotion, however, it appears that the ability of any theory to explain the experience of emotion depends on the complexity of the emotional response, which varies by type of emotion and individual.

Once again, the limbic system is not just about emotion; there are many structures that may be considered part of the limbic system that contribute to the various functions necessary for our survival. The biggest contributing structures include: the amygdala, hippocampus, thalamus, fornix, hypothalamus, cingulate gyrus, prefrontal lobe, and portions of the brainstem. The amygdala is known as the emotional hub of the brain. It mediates and controls affective activities in the brain including fear and aggression, and is also related to the expression of mood. The hippocampus is involved in the formation of new memories; specifically part of the process of transforming information from short-term to long-term memory. Emotional memories are recalled better. The thalamusis known as the relay station of the brain, and along with the fornix is involved in connecting impulses and pathways between the various structures of the limbic system. The hypothalamus is responsible for motivation of behavior, especially primordial behaviors necessary for survival i.e., sex drive, hunger, thirst. The cingulate gyrus coordinates smells and sights with past emotion-laden memories. Recent research shows the cingulate to also participate in the emotional reaction to pain and aggressive behavior. The prefrontal lobe, though involved in many cognitive functions, integrates the experience of emotion and emotional expression. It communicates in a bidirectional fashion with many other structures of the limbic system. Finally, several structures located in the brainstem including the ventral tegmental area, reticular formation, and locus coeruleus are involved in regulating circadian rhythm, alerting mechanisms, and pleasurable sensations similar to what is experienced as an orgasm. Altogether, these many structures of the limbic system contribute to our daily functioning and survival, including the human experience of emotion.

5. Placebo Effects

The placebo effect, which is known to be a part of much psychological and clinical research, is known as a physiological, cognitive, or behavioral response to an inert substance. Theories state that because individuals believe to be part of a treatment, even if they are given none or are part of an inactive condition, they often elicit a change in response. This change can be

favorable; for example, a decrease in pain with a placebo thought to be a pain reducer. This change can also be unfavorable also known as a nocebo; for example, complaints of negative side-effects thought to be due to a placebo. For placebos to work, they must be as identical to treatment conditions as possible. Patients or participants must believe they are receiving an effective treatment. However, placebo effects even occur when individuals know they are, or have a chance of, receiving a placebo.

The goal in clinical research is for the true treatment to have greater effects than the placebo treatment. What is also necessary in clinical research is to have a double-blind procedure accompany placebo trials. Double-blind refers to the fact that neither the patient nor the doctor, or researcher, know who or what condition is receiving the true treatment and which is receiving the placebo. Obviously, expectancy effects are what, in part, allows placebo effects to occur, and reducing expectancy in all parties of research would minimize the effects of confounds. It becomes difficult to separate the effects of placebos from true changes in response. Other confounding factors include spontaneous improvement or deterioration, natural fluctuation in symptomology, suggestibility and expectancy effects, and the good subject bias. The good subject bias refers to research participants wanting to impress their doctors or researchers by doing what is good, or expected and being a good subject. If they know a treatment is supposed to have a given effect, patients or participants want to be seen as good or typical, and often claim that a treatment is working, even if it is not. Many adults have learned the appropriate response to medical intervention.

Thus, cognitive effects on our health and behavior are strong, and in fact, can be stronger than any biological method of treatment. Newer models of research are seeking to identify indicators that may help predict strength of placebo effects in individuals, such as personality traits and behavioral factors

Topic : Perception

Topic Objective:

At the end of this topic students will be able to:

- Explain the overview of perception
- Understand the color versus black and white light and dark vision
- Understand the color different types of agnosia

- Understand the color figure or ground parsing
- Understand the color cues for depth perception

Definition/Overview:

Perception: In psychology and the cognitive sciences, perception is the process of attaining awareness or understanding of sensory information. It is a task far more complex than was imagined in the 1950s and 1960s, when it was predicted that building perceiving machines would take about a decade, a goal which is still very far from realizable. The word perception comes from yje weird Latins word perception, percepio, , meaning "receiving, collecting, action of taking possession, apprehension with the mind or senses."

What one perceives is a result of interplays between past experiences, ones culture and the interpretation of the perceived. If the percept does not have support in any of these perceptual bases it is unlikely to rise above perceptual threshold.

Perception gives rise to two types of consciousness; phenomenal and psychological. The difference everybody can demonstrate to himself/herself by simple opening and closing his/her eyes. Phenomenal consciousness is full of rich sensations that are hardly present when eyes are closed. Psychological consciousness is well researched and measured. It occurs half a second after a stimulus starts. If a weak stimulus lasts less, it is unlikely to be perceived. The capacity of psychological consciousness is also well measured. Depending on methods used the capacity ranges between seven and forty symbols or percepts at one time.

There are two basic theories of perception: Passive Perception (PP) and Active Perception (PA). The passive perception (conceived by Ren Descartes) is addressed in this article and could be surmised as the following sequence of events: surrounding → input (senses) → processing (brain) → output (re-action). Although still supported by mainstream philosophers, psychologists and neurologists, this theory is nowadays losing momentum. The theory of active perception has emerged from extensive research of sensory illusions, most notably the works of Richard L. Gregory. This theory is increasingly gaining experimental support and could be surmised as dynamic relationship between description (in the brain) ↔ senses ↔ surrounding.

Perception is one of the oldest fields in psychology. The oldest quantitative law in psychology is the Weber-Fechner law, which quantifies the relationship between the intensity of physical stimuli and their perceptual effects. It was the study of perception that gave rise to the Gestalt school of psychology, with its emphasis on holistic approach.

Key Points:

1. Overview

In the case of visual perception, some people can actually see the percept shift in their mind's eye. Others, who are not picture thinkers, may not necessarily perceive the 'shape-shifting' as their world changes. The 'esemplastic' nature has been shown by experiment: an ambiguous image has multiple interpretations on the perceptual level.

Just as one object can give rise to multiple percepts, so an object may fail to give rise to any percept at all: if the percept has no grounding in a person's experience, the person may literally not perceive it.

The processes of perception routinely alter what humans see. When people view something with a preconceived idea about it, they tend to take those preconceived ideas and see them whether or not they are there. This problem stems from the fact that humans are unable to understand new information, without the inherent bias of their previous knowledge. The extent of a persons knowledge creates their reality as much as the truth, because the human mind can only contemplate that which it has been exposed to. When objects are viewed without understanding, the mind will try to reach for something that it already recognizes, in order to process what it is viewing. That which most closely relates to the unfamiliar from our past experiences, makes up what we see when we look at things that we dont comprehend.

This confusing ambiguity of perception is exploited in human technologies such as camouflage, and also in biological mimicry, for example by Peacock butterflies, whose wings bear eye markings that birds respond to as though they were the eyes of a dangerous predator. Perceptual ambiguity is not restricted to vision. For example, recent touch perception research (Robles-De-La-Torre & Hayward 2001) found that kinesthesia-based haptic perception strongly relies on the forces experienced during touch. This makes it possible to

produce illusory touch percepts (see also the MIT Technology Review article The Cutting Edge of Haptics).

Cognitive theories of perception assume there is a poverty of stimulus. This (with reference to perception) is the claim that sensations are, by themselves, unable to provide a unique description of the world. Sensations require 'enriching', which is the role of the mental model. A different type of theory is the perceptual ecology approach of James J. Gibson. Gibson rejected the assumption of a poverty of stimulus by rejecting the notion that perception is based in sensations. Instead, he investigated what information is actually presented to the perceptual systems. He (and the psychologists who work within this paradigm) detailed how the world could be specified to a mobile, exploring organism via the lawful projection of information about the world into energy arrays. Specification is a 1:1 mapping of some aspect of the world into a perceptual array; given such a mapping, no enrichment is required and perception is direct.

2. Color versus Black and White Light and Dark Vision

Specialized cells in the eye that are responsible for vision are called photoreceptors. There are two different types of photoreceptors: rods and cones. Rodsprocess light and dark and are part of non-color perception, while cones are involved in color perception. Together, they allow us to visually perceive objects in our environment.

The retina, which lines the back of the eye, contains the rod and cone photoreceptors. At the center of the retina, the fovea, where visual acuity is best, there are more cones than rods. In the periphery of the retina, there are more rods than cones. This makes sense given that we can perceive color more clearly at the center of our vision and less so in our visual periphery. However, more of the retina is taken up by rods than cones, even though we can see more clearly with cones. This is because we use our rods for very important survival mechanisms, such as seeing in the dark and edge detection. Though the rods provide less visual acuity, the sensitivity of rods increases as we adapt to the dark. And, because edges are perceived as contrasts in light and dark, rods are ultimately responsible for helping us detect edges.

In color perception, there are three wavelengths of light that we perceive as distinct colors; red, blue, and green. All other colors that we perceive are a mixture of these three wavelengths. In all actuality, because color is merely a reflection of light, both rods and cones

have the capacity to respond to color of different wavelengths. Cones respond best to high wavelengths of yellows, reds, and oranges. Rods respond best to lower wavelengths of blues and greens. Perhaps you have noticed that in the dark or low level light, you may be able to perceive some dark hues of bluish or greenish colors.

Individuals with various types of color perception deficiencies may not be able to perceive all or any of the three color wavelengths. Monochromatismis a rare form of colorblindness, where no cones are functioning essentially none of the three wavelengths are effectively perceived. Individuals with monochromatism essentially rely on rods for perception and only perceive objects in shades of light and dark: white, gray, and black. Dichromatism involves partial perception of the three wavelengths. There are three subtypes: protanopia, deuteranopia, and tritanopia, which occur more often in males because a majority of these abnormalities are located on the X chromosome. Protanopes and deuteranopes are similar in that they do not perceive red color wavelengths, while tritanopes do not perceive blues or yellows. These abnormalities have to do with cone sensitivity to light. Another type of color deficiency is cerebral achromotopsia, which occurs due to cerebral damage. Research with these populations suggests that color perception is a distributed process that not only calls upon the physiology of the eye, but also parts of the cerebral cortex.

3. Different Types of Agnosia

Agnosia involves the loss of ability to recognize objects in the environment. This loss of ability does not involve damage to sensory organs, but deficits in attention, recognition, or integration of information. There are three general categories of agnosia: visual agnosias which involve the inability to recognize visual objects, auditory agnosias which involve the inability to recognize sounds, and somatosensory agnosias which involve the inability to recognize objects using the tactile sense. Here, we will focus on visual agnosias, as the text spends substantial time on visual perception.

Visual agnosia is the inability to recognize visual objects despite intact physiology of the visual system vision. Three criteria usually have to be met in order to be diagnosed with visual agnosia; difficulty recognizing a variety of visually presented objects, normal recognition of objects when relying on verbal descriptions or perception from another sense besides vision, and elementary visual perception intact, sufficient enough to copy draw an

object. Visual agnosia involves damage to the left occipital, parietal and/or temporal lobe. Often this damage is a result of stroke, dementia, poisoning, or other neurological disorder.

There are several types of visual agnosia. Object agnosia is the inability to recognize, and thus name, objects. Individuals can describe the features of objects, but are unable to name them or recognize them based on those features. In converse, form agnosia involves the perception of only parts or features of an object, but not the whole thing. Similarly, those with simultagnosia can only recognize objects one at a time in a visual scene have difficulty integrating more than one object at once. For instance, individuals may see one tree at a time, but not the whole forest.

One unique form of agnosia is called Prosopagnosia. Prosopagnosia is the inability to recognize familiar faces, perhaps even ones own face. Individuals can pick out generic features of a face, but cannot make distinctive meaning of the collective features ones individual face. Prosopagnosia may also involve the inability to discriminate between members of a category who share similar features i.e., an expert bird watcher with prosopagnosia may not be able to differentiate between 2 species of birds.

Agnostic alexia involves the inability to recognize and thus read text. This is different from dyslexia, which involves issues not related to agnosia, such as difficulty with phonetics. Another type of agnosia is color agnosia. Individuals with color agnosia cannot discriminate between colors, and thus label them name them as being different. There is no damage to the cones photoreceptors for color in the visual system or brightness discrimination ability. Finally, topographical agnosia involves the inability to rely on visual cues to navigate in ones environment. Although individuals may have memory of common locations, such as the home or workplace, because they cannot recognize the objects around them, they often bump into furniture and other environmental landmarks.

Thus, it is often said that agnosia involves not only problems in object recognition, but also difficulty in making meaning of objects, because of the failure to recognize. This can often be a source of frustration given that the senses themselves are intact. Individuals often feel like they know the name of given objects, and can describe them, but yet cannot fully recognize them. There is no known cure for the agnosias, but treatments may involve training individuals to recognize objects with other senses unaffected by agnosia.

4. Figure or Ground Parsing

Part of the challenge to our visual system is separating objects in our environment, namely figure from ground. Figure/ground parsing allows us to perceive what object/s is at the center, or the focus in our visual field and what is simply in the background ground. We assume that the figure, the focus of our attention, stands out from the ground or background. There are several heuristics, or rules of thumb, that assist us in parsing figure from ground.

First, we assume that the object in the forefront has object-like qualities. This means that the figure of our attention has distinct features. In addition, the figure would likely be more meaningful than the background, which would explain why it would be at the center of our attention. We also assume that the figure is in front of the ground, and thus closer to us. If there are shared edges between the figure and ground which is highly likely in any two-dimensional representation, we assume that the edges belong to the figure and that the ground continues behind it. Likewise, we assume the figure has symmetrical edges, whereas the background may not. Objects in our natural environment often have symmetrical edges and features.

The figure is often lighter in color, as it would be shading or occluding the background behind it. Though we assume that the figure is large because it is closer to us using the relative size cue for depth, we recognize that the figure is probably smaller than the overall background and takes up less space. It is reasonable to conclude that a background could be quite vast. Finally, we assume that the figure would most often appear in a horizontal or vertical orientation, since that is what most often occurs in our natural environment.

The ground, in converse, should be of unformed material, with symmetrical edges less likely. The ground should contain more dense grain, which may be shadowed by distance and occluders. Finally, the ground would be less distinctive and its features would not pop-out, as the figures features may.

We tend to rely on bistable perception, where even if figure and ground were ambiguous, we could only perceive one as figure and one as ground at once both cannot be figure and both cannot be ground. We assume that the edges separating figure from ground only belong to one object, which is the most parsimonious and natural explanation. We assume that the background continues behind the object at the forefront. The idea that two contours would

line up perfectly is highly unlikely. Thus, these heuristics serve us well in segregating figure from ground.

5. Cues for Depth Perception

Depth perception is important for survival in order to estimate distance and size of objects in our environment. Perceiving depth relies on several different types of cues; oculomotor cues based on our ability to sense the position of our eyes and tension in eye muscles, monocular cues visual cues from one eye, and binocular cues visual cues from both eyes.

Oculomotor cues come from convergencebetween the two eyes and accommodationfrom each eye. We sense the directed inward and outward movement of the eyes, focusing towards an object ahead. Our two eyes converge or cross as we focus on very nearby objects and diverge as objects get farther away. We also perceive the musculature of the eyes bend the shape of the lens covering of each eye when we focus on objects at various distances. The lens flattens and muscles release for objects at a far distance, while the lens curves and tightens muscles as we view objects nearby.

Monocular cues for depth include accommodation of a single eye as detailed above, several pictoral cues, and some movement-produced cues. Pictoral cues for depth allow us to perceive three dimensions from two dimensions, since we are only relying on depth perception from one eye. These are cues that are often used in art, to allow the viewer to experience an environment in three dimensions. Pictoral cues include: the linear perspective and the vanishing point, occlusion, relative height, relative size, theatmospheric perspective, texture gradients, and shadows. The linear perspective shows the convergence of lines that are parallel with increasing distance, until the two lines meet at a vanishing point along a horizon. We often see this in edges of a road, which we know to be parallel, that converge towards the horizon. Occlusion shows us that objects that are in front of, or occlude, objects behind it are closer to us than those that are partially covered or hidden occluded. This cue does not provide absolute distances of objects in our visual field, but distances relative to one another and oneself. Relative heighttells us that objects that are higher up along our visual field are farther away while objects that are closer are lower along our visual field. Similarly,relative size tells us that objects that are closer are larger, while objects that are farther away are smaller with absolute size being held equal. For instance, we know that the

person walking down the street three blocks ahead of us are not half the size of the person two feet in front of us.

The atmospheric perspective causes us to perceive distant objects with less clarity because we perceive them through air full of small particles of dust, dirt, water droplets and other airborne particles. Thus, we perceive less detail in distant objects. Likewise, the texture gradient shows that objects get more densely packed with distance. Elements that are equally spaced apart appear closer together and packed as they get farther away, such as tiles on a floor. Shadows also increase with distance, making color appear less vivid and detail grainier. Objects that are closer are less shadowed, because they are in the forefront and are not occluded but are instead occluding and casting shadows on objects that are farther away.

Finally, movement-based cues, including the motion parallax and deletion/accretion, allow us to perceive depth. The motion parallax shows us that objects in motion that are nearby fly past us rapidly, while objects at a distance pass by much more slowly. Objects that are closer take less time to travel across our retina, while objects that are far away move at a much slower pace. As we move, objects become covered deletion and uncovered accretion. Backgrounds are covered up and then uncovered, either by moving objects or a moving observer. These are cues for depth that need only one eye to perceive.

Binocular cues, which rely on perception from both eyes, includebinocular disparity and stereopsis. Because each eye is separated by space, each eye sees a slightly different picture, even if both eyes are focused on the same thing. This is called binocular disparity. Each eye doesnt see something completely different, but rather an overlap of two images. The distance between that overlap is a cue for depth. The closer the two images each eye sees, the farther the object is. The greater the difference between the two images, the closer the object is. You can test this out simply by putting your finger out in the air in front of you and view with each eye separately, at different distances.

Stereopsis is the blending of these two images, so we perceive in three dimensions and integrate the differences between the two images each eye sees. Similar to stereo, referring to the combined auditory input each ear receives simultaneously, stereopsis is necessary for coherent vision as we move through our environment. However, because so many monocular cues are available, individuals with damage in vision to one eye can still perceive depth and function properly.

Topic : Attention

Topic Objective:

At the end of this topic students will be able to:

- Understand the Divided Attention
- Understand the Automaticity
- Understand the Signal Detection Theory: Attention Mechanisms
- Understand the Artificial Attention Deficit hyperactivity Disorder

Definition/Overview:

Attention: Attention is the cognitive process of selectively concentrating on one aspect of the environment while ignoring other things. Examples include listening carefully to what someone is saying while ignoring other conversations in a room (the cocktail party effect) or listening to a cell phone conversation while driving a car. Sometimes attention shifts to matters unrelated to the external environment, a phenomenon referred to as mind-wandering or "spontaneous thought". Attention is one of the most intensely studied topics within psychology and cognitive neuroscience.

Key Points:

1. Artificial Attention Deficit hyperactivity Disorder

Attention deficit hyperactivity disorder ADHD is an attentional deficit that usually manifests in children in their preschool or early school years, but continues into adulthood. It is characterized by inattention, hyperactivity, and impulsivity. Causes of ADHD include mostly biological or genetic effects. There exists a heritability rate of up to 25% in families and an even higher concordance rate for identical twins. Neurological evidence points to the involvement of the frontal lobe which is responsible for higher order thinking, organization, and problem solving and other important structures of the brain including the cerebrum, cerebellum, basal ganglia, corpus callosum, as well as abnormal inhibited levels of dopamine DA in the brain, a neurotransmitter that is responsible for concentration, attention, movement, the experience of pleasure, and inhibition. Other causes may include environmental agents such as prenatal exposure to teratogens smoking, alcoholic consumption and lead

consumption. A smaller percentage of studies have correlated the overconsumption of food additives and sugar and brain injury with ADHD, but these causes are less likely.

Diagnosis for ADHD is difficult because children at a young age are often naturally hyperactive and have short attention spans. The hyperactive child that cannot sit still is easier to diagnosis than the silent daydreamer who doesnt pay attention, however, hyperactivity may or may not be part of the diagnosis. Often, early diagnosis is warranted if the childs inattention, hyperactivity, and/or impulsivity significantly impairs school performance, social relationships, and functioning at home for a period of at least 6 months. According to the Diagnostic and Statistical Manual of Mental Disorders DSM-IV, children with ADHD usually fit one of three subtypes: the hyperactive-impulsive type, inattentive type, or combined type all 3 criteria.

Hyperactivity is characterized by constant agitation or motion. Children often squirm or fidget in their restlessness. Adults may conceal this restlessness, but nonetheless feel it internally. Impulsivity is characterized by the inability to monitor actions or behaviors before engaging in them. Blurting out verbalizations, displaying dramatic emotions, and engaging in inappropriate behaviors without constraint are common. These individuals rely on immediate gratification and cannot wait for delayed reinforcement. Adults with ADHD also have problems with spontaneity and impulsivity.

Inattention is less overtly observable. Children have a difficult time keeping on task and often cannot sustain attention on one task for longer than several minutes unless it is a task they truly enjoy. They often report getting bored with things very easily and fail to complete tasks at hand. Adults, too, often begin several tasks without completing any. Likewise, concentration is difficult and frustration ensues. Individuals are often easily distracted and commit many errors in their work due to problems following instructions carefully and completely, or simply incompletion and lack of following through with their work. Again, these individuals do not exhibit the outward defiant behavior, but rather appear lethargic or spaced-out.

In general, these behaviors must be excessive, pervasive, and long-term. Often diagnosis goes unnoticed until the child begins manifesting problems at school and it is the teacher that calls for concern. However, other times, parents witness these problems at home prior to entering school. The earlier the detection, the greater the likelihood of success for treatment.

Treatments for ADHD may include stimulant medications that target dopamine mechanisms. Antidepressants may also work to boost DA levels in the brain. Other treatments include behavioral therapy, social skills training, extra educational support, support groups, and parental skills training. Because ADHD is a disorder that often continues into adulthood, treatments are usually long-term, but have proven to be effective. Depending on the individuals symptomology, treatment can be tailored to improve the inattention, hyperactivity, and/or impulsivity of ADHD.

2. Signal Detection Theory: Attention Mechanisms

Signal detection theory began as an experimental design to explain the detection attention to a stimulus as presented. Various top-down cognitive influences affect our attention to and detection of a stimulus. Also, noise other, sometimes uncontrollable factors can interfere with our perception of a stimulus. For instance, it may become difficult to detect your cell phone ringing if an ambulance siren is ringing outside your house. And in fact, we may think that we hear our cell phone ringing if we are anxiously awaiting a call, even if it isnt. Signal detection techniques were created to measure how well an individual can detect a stimulus often embedded in noise. This method has ecological validity given that in the real world, we often need to discriminate desired, attended information from background distraction.

There are four types of responses that are measured in signal detection paradigms. These include hits, false alarms, misses, and correct rejections. Hits represent when a stimulus is correctly detected picking up your cell phone when it rings.False alarms represent incorrectly detecting a stimulus when it is not present thinking you hear your phone ringing when it is an ambulance siren outside instead. Misses represent the lack of detection of a stimulus when it is present not hearing your phone ring because the ambulance siren is too loud. Finally, correct rejections represent when you correctly do not detect a stimulus not picking up your phone when it is not ringing.

In signal detection theory, a statistical parameter called d′or d prime is calculated which represents the proportion of detection between noise and stimulus in addition to noise conditions. It accounts for guessing, or false alarms as a result of noise. Again, how well we perceive and detect stimuli out there in our environment is a function of background noise. Sometimes we incorrectly guess about the detection of stimuli in our environment, and this theory accounts for that. Many experimental methods in cognition now often incorporate

estimates for guessing, along with hits and misses. Signal detection paradigms are useful in that they can be used in many different types of experimental studies.

3. Automaticity

Automaticity is the ability to engage in a task outside of awareness or limitation of resources. It involves very little to no effort and once initiated, can proceed without monitoring by the cognitive system. Automaticity develops through prolonged practice and involves a shift in brain usage of resources less.

Explicit and conscious control attends to the task. With repeated exposure and practice on the task, these steps proceed implicitly, with little or no conscious control needed. Procedural memory allows you to recognize the familiar task. For instance, when you first learned to drive a car you had to look at each gear, follow through with the steps of releasing the brake and putting your foot on the gas, watch your hands on the steering wheel, as well as remember your driving route. Once driving a car became well-practiced, you didnt have to think about how to drive; you now can drive while thinking about other things, changing the radio station, and perhaps even eating!

It should also be noted that automaticity may be unwanted, as exemplified by the Stroop Task. Here, we automatically process the meaning of words, even if we are trying not to. Other times, what seems like habit can interfere with something we are trying to learn that is similar, but new. Proactive interference, where past memories that have become well learned such as procedural tasks intrude in trying to learn new information, can occur. For instance, if the lightswitch for your childhood bedroom of 18 years was on the left-hand side, you probably walked in and out, switched it on and off without even looking. Now, you move to a new apartment, where the bedroom lightswitch is on the right-hand side. You probably often find intrusions; reaching for the left because that was where your old lightswitch was, and having to relearn the new location. This may take some time, because the automaticity associated with the left-hand side lightswitch was well-learned. What we describe as habits can intrude because they have become automatic.

4. Divided Attention

Divided attention involves engaging in multiple tasks simultaneously, and thus having to divide attention between each. There are several factors that affect the ease with which we can engage in multiple tasks: task similarity, task difficulty, and practice.

Studies show that the more similar two tasks are, the harder it will be to engage in each simultaneously. If tasks engage different sensory modalities, it becomes easier to perform than if cognitive resources are competing. For instance, listening to the radio while reading a book two verbal tasks would be more difficult than listening to the radio while drawing a picture one verbal and one spatial task.

The more difficult a task, the more attentional resources are required. The more difficult both tasks in a dual-task paradigm are, the even greater the difficulty becomes. However, different tasks have different levels of difficulty for different people. And, this effect interacts with practice because the more practiced a given task is, the less difficult it becomes.

Practice, including automatization, is another factor that affects the ease of divided attention. The more automatic a task has become, the fewer resources are required to engage in that task, and thus, the greater the resources left over to be utilized by the other task. And, if two tasks have become well-rehearsed together, the more automatic the combining of those two tasks becomes. Thus practice improves dual-task performance, and can sometimes even be superior to performing either task alone.

Several theories of divided attention have been proposed. Central capacity models of divided attention argue that there exists a central capacity of resources, having to be shared among multiple activities. Each task has separate levels of demands. Other theories believe that more than just size of demand determines the efficacy of dual-task performance. Bottleneck theories, as described in the text, show that each task must be filtered through the cognitive system by attention, and that essentially only one can proceed through at a time. Once initiated, both tasks can run simultaneously. Finally, a third theory proposes that we have multiple resources, or three stages of processing, which provide different pools of resources to pull attention from. It acknowledges central processing as one of three resources, in addition to an encoding and a responding resource, or stage. These three pools leave more room for dual-task processing. However, the one final theory that incorporates many aspects

of divided attention is biased competition or integrated competition theory. These competition theories see attention as a form of competition between multiple inputs. The input receiving the greatest proportion of resources because it is more difficult, for instance, would be the task that is most greatly processed. Bias can come from exogenous or endogenous stimuli. And, this competition can be between input from different sensory modalities and between different brain regions. These competing effects occur simultaneously and again, could be affected by both bottom-up and top-down influences.

In Section 2 of this course you will cover these topics:

- Representation And Knowledge In Long-Term Memory
- Encoding And Retrieval From Long-Term Memory
- Working Memory

Topic : Representation And Knowledge In Long-Term Memory

Topic Objective:

At the end of this topic students will be able to:

- Understand the knowledge
- Understand the schema is.
- Understand the analogue representations in mental imagery
- Understand the mental rotation
- Understand the schemas
- Understand the association areas of the brain
- Understand the roles of knowledge in cognition

Definition/Overview:

Knowledge: Knowledge is defined (Oxford English Dictionary) variously as (i) expertise, and skills acquired by a person through experience or education; the theoretical or practical understanding of a subject, (ii) what is known in a particular field or in total; facts and information or (iii) awareness or familiarity gained by experience of a fact or situation. Philosophical debates in general start with Plato's formulation of knowledge as "justified true

belief". There is however no single agreed definition of knowledge presently, nor any prospect of one, and there remain numerous competing theories.

Knowledge acquisition involves complex cognitive processes: perception, learning, communication, association and reasoning. The term knowledge is also used to mean the confident understanding of a subject with the ability to use it for a specific purpose if appropriate.

Key Points:

1. Knowledge

The knowledge is a matter of on-going debate among philosophers in the field of epistemology. The classical definition, described but not ultimately endorsed by, Plato, has it that in order for there to be knowledge at least three criteria must be fulfilled; that in order to count as knowledge, a statement must be justified, true, and believed. Some claim that these conditions are not sufficient, as Gettier case examples allegedly demonstrate. There are a number of alternatives proposed, including Robert Nozick's arguments for a requirement that knowledge 'tracks the truth' and Simon Blackburn's additional requirement that we do not want to say that those who meet any of these conditions 'through a defect, flaw, or failure' have knowledge. Richard Kirkham suggests that our definition of knowledge requires that the believer's evidence is such that it logically necessitates the truth of the believ.

1.1 Reliable Knowledge

In An Introduction to Logic and Scientific Method (1934), Morris R. Cohen and Ernest Nagel reviewed the pursuit of truth as determined by logical considerations. They reviewed ways of eliminating doubt and arriving at stable beliefs or reliable knowledge, such as

The method of authority

The method of intuition

The methods of experimental inquiry:

- Types of invariant relations

- The experimental method in general
- The method of agreement
- The method of difference
- The joint method of agreement and difference
- The method of concomitant variation
- The doctrine of the uniformity of nature
- The plurality of causes

Their final conclusion was, "Scientific method we declare as the most assured technique man has yet devised for controlling the flux of things and establishing stable beliefs." In an essay entitled "Inductive Method and Scientific Discovery," Marcello Pera said, "In the first place, the scientific method is a procedure, a general strategy that indicates an ordered sequence of moves (or steps) which the scientist has to make (or go through) in order to reach the goal of his research." (In On Scientific Discovery, edited by Grmek, Cohen, and Cimino [1977], published in the Boston Studies in the Philosophy of Science Series.) The scientific method is not a method directly applied, but rather a guide to the mental activity stages of originating, refining, extending, and applying knowledge. It is subject neutral and flexible in use; it is thus suitable for all domains.

Statements about truth must be viewed skeptically. Rather than state something as "true," the following phrase should be used: "On the evidence available today the balance of probability favors the view that..." .

1.2 Communicating knowledge

Symbolic representations can be used to indicate meaning and can be thought of as a dynamic process. Hence the transfer of the symbolic representation can be viewed as one ascription process whereby knowledge can be transferred. Other forms of communication include imitation, narrative exchange along with a range of other methods. There is no complete theory of knowledge transfer or communication.

While many would agree that one of the most universal and significant tools for the transfer of knowledge is writing (of many kinds), argument over the usefulness of the written word exists however, with some scholars skeptical of its impact on societies. In his novel Technopoly Neil Postman demonstrates the argument against the use of writing through an excerpt from Plato's work Phaedrus (Postman, Neil (1992) Technopoly, Vintage, New York, pp 73). In this excerpt the scholar Socrates recounts the story of Thamus, the Egyptian king and Theuth the inventor of the written word. In this story, Theuth presents his new invention "writing" to King Thamus, telling Thamus that his new invention "will improve both the wisdom and memory of the Egyptians" (Postman, Neil (1992) Technopoly, Vintage, New York, pp 74). King Thamus is skeptical of this new invention and rejects it as a tool of recollection rather than retained knowledge. He argues that the written word will infect the Egyptian people with fake knowledge as they will be able to attain facts and stories from an external source and will no longer be forced to mentally retain large quantities of knowledge themselves (Postman, Neil (1992) Technopoly, Vintage, New York ,pp 74).

Andrew Robinson also highlights, in his work The Origins of Writing, the possibility for writing to be used to spread false information and there for the ability of the written word to decrease social knowledge (Robinson, Andrew (2003) The Origins of Writing in Crowley and Heyer (eds) Communication in History: Technology, Culture, Society, Boston pp 34). People are often internalizing new information which they perceive to be knowledge but are in reality fill their minds with false knowledge.

1.3 Situated knowledge

Situated knowledge is knowledge specific to a particular situation. Imagine two very similar breeds of mushroom, which grow on either side of a mountain, one nutritious, one poisonous. Relying on knowledge from one side of an ecological boundary, after crossing to the other, may lead to starving rather than eating perfectly healthy food near at hand, or to poisoning oneself by mistake.

Some methods of generating knowledge, such as trial and error, or learning from experience, tend to create highly situational knowledge. One of the main benefits of the scientific method is that the theories it generates are much less situational than

knowledge gained by other methods. Situational knowledge is often embedded in language, culture, or traditions.

Knowledge generated through experience is called knowledge "a posteriori", meaning afterwards. The pure existence of a term like "a posteriori" means this also has a counterpart. In this case that is knowledge "a priori", meaning before. The knowledge prior to any experience means that there are certain "assumptions" that one takes for granted. For example if one is being told about a chair it is clear to him that the chair is in space, that it is 3D. This knowledge is not knowledge that one can "forget", even someone suffering from amnesia experiences the world in 3D. See also: A priori and a posteriori.

1.4 Partial knowledge

One discipline of epistemology focuses on partial knowledge. In most realistic cases, it is not possible to have an exhaustive understanding of an information domain, so then we have to live with the fact that our knowledge is always not complete, that is, partial. Most real problems have to be solved by taking advantage of a partial understanding of the problem context and problem data. That is very different from the typical simple math problems that we solve at school, where all data are given and we have a perfect understanding of formulas necessary to solve them.

2. Analogue Representations in Mental Imagery

Mental imagery is the ability to see something in your minds eye. We are able to visualize and imagine what something looks like without directly perceiving it; we can envision objects and places in our heads. What is remarkable is that the pictures we see in our mental imagery actually resembles what is out there in real-life. Mental images are analogue analogous to the real world representations.

There exists a functional equivalence between what we see in the environment and how we produce mental images. Size, distance, and other physical aspects of objects are all generally preserved and proportional in imagery. As mentioned in the text, studies have shown that relative size holds true in mental imagery. For instance, if you were to mentally image a goose standing next to a fly, both would not be the same size. In your mental image, the

goose would be much bigger. And, if you were asked to visualize the characteristics of the goose say its legs, it would be easier and quicker for you to visualize, than to visualize the gooses legs if the goose were standing next to an elephant instead. This is because the goose would be much bigger in the visual field of your mental image in the first example, and much smaller standing beside the elephant in the second example. In the first example, the gooses legs were at front and center and fairly large, but in the second example, your visual field had to be much larger to accommodate the elephant, and so you would have to zoom in to the tiny gooses legs. Thus, objects in our mental images are scaled to size.

Distance is also preserved. If you were to visualize yourself taking a walk from your bedroom to your bathroom which is located right next to your bedroom, this would take less time than it would for you to visualize yourself walking from your bedroom to the basement down two flights of steps. Likewise, in your house, your bedroom is to the left of the bathroom and to the right of your brothers room. These rooms would be located in the same spatial arrangement in your mental image of your house. Mental images are like cognitive maps of the environment, again analogue in preserving distance and spatial location. The layout of a visual scene in your head should be representative
of the same objects in your environment. How do you think you can walk around your house in the dark, which so many of us do from time to time? You have built a mental map.

3. Mental Rotation

We are remarkably good at visualizing objects in our heads, and these representations are similar, or analogue to what we see in the real-world. We are also able to spatially manipulate the images in our heads; which is known as mental rotation. The theory behind both experiments is the same. It takes time to move objects through space, and the same goes for the movement of mental images.

The first experiments using mental rotation had objects made of blocks. A pair of two objects was shown, and research participants had to decide if the two objects were the same that one could be rotated to match the other, or different the objects could not be rotated into congruence. The results showed that when an object could be rotated into congruence, the larger the angular disparity between the two objects the more one of the two objects had to be rotated into congruence, the longer it took participants to respond. The smaller the angular difference between the two objects, the quicker participants were to respond. So, for instance,

if you were asked to imagine rotating a pair of scissors 180 degrees, it would take you longer than to imagine rotating them only 90 degrees.

We can rotate objects in three dimensions as well as two dimensions. Children as well as adults are capable of mental rotation, although studies often show that men perform better than women on tests of mental rotation. With training and experience, both men and women, boys and girls can improve their mental rotation performance. Mental rotation is practically important because it is often used in many aspects of our functioning; from envisioning what clothes put together in an outfit might look like, to arthroscopic surgery. Mental rotation is one of the most important mental representations we are capable of producing.

4. Schemas

Schemas are structured representations that capture information about a situation or event; stored knowledge about how the world works. We make inferences, decisions, and form new representations based on existing schemata.

Schemas are interconnected concepts, organized by relationships between objects. They serve as representations in memory that contain more than just category information, but the understanding of the events that surround them. They are based on experience, and thus expectations. For instance, our schemata tell us what to expect once weve stopped driving at a stop light. We have schemata that tell us how babies behave. We have schemata for what manners are appropriate at the dinner table. But because schemata are based on experience, even schemata based on similar concepts most likely differ between individuals. For instance, your schema for what your familys Thanksgiving dinner is like is probably different than the student sitting next to you in class.

Scripts are one type of schema. Scripts define the specific sequences of events related to a particular schema. Scripts tell us what to do when we pull up to a stop light first you let off the gas and slow down, then put your foot on the brake, , what to do when a babys crying first pick up the baby, then gently rock the baby, and how to eat our food politely in front of guests which forks to use, how to place our napkin on our lap. Together, scripts and schemas in memory inform us about what to think and how to behave in given situations at least those similar to what weve encountered before. We rely on schemata in our everyday lives.

5. Association Areas of the Brain

The association areas are regions of the cortex outer layer of the brain that integrate sensory incoming from the senses and motor reaction information. The association areas in the human brain take up roughly 75% of the entire cortex. The association areas of the cortex are very important, and yet damage to them shows no specific impairment. Instead, impairment is rather generalized, yet severe, with many lesion cases demonstrating the inability to speak or act purposefully. This is because the association areas of the cortex are vital to the integration of so many different sensory experiences and our motor responses to them. Thus, association areas also form the basis for thought and perception.

The association areas encompass all portions of the cortex except the primary somatosensory cortex, the primary motor cortex both bordering the parietal lobes, and the primary visual cortex in the occipital lobe. The association areas can be broken down into three segments; the prefrontal association area, the limbic association area, and the parieto-occipito-temporal association area. The prefrontal association area part of the frontal lobe is involved in complex cognitive functions such as goal-planning, attention and social behavior and motor planning. The limbic association area covering part of the frontal and temporal lobes is involved in emotion, motivation, and memory. The parieto-occipito-temporal association area covering parts of the parietal, occipital, and temporal lobes, as the name suggests is involved in integrating somatosensory, visual, and auditory information.

The association areas, in their broad expansion of the brain, are involved in most of our daily activities and are thus, very important to our survival. They are spread out across the cortex and are involved across a wide range of behaviors to insure that if one portion is injured, we can still function properly.

6. Roles of Knowledge in Cognition

Knowledge is often thought of as constituting particular bodies of facts, techniques, and procedures that cultures develop, such as knowledge of baseball statistics, knowledge of the guitar, knowledge of how to order a meal in a restaurant.

Knowledge, in its most inclusive sense, and the sense in which the term is used in cognitive psychology, is information about the world that is stored in memory, ranging from the

everyday to the formal. It is essential for the competent functioning of most mental processes, not only in memory, language, and thought, but also in perception and attention. Without knowledge, any mental process would stumble into ineffectiveness.

7. Schema

A schema (pl. schemata), in psychology and cognitive science, is a mental structure that represents some aspect of the world. This learning theory views organized knowledge as an elaborate network of abstract mental structures which represent one's understanding of the world. Schema theory was developed by R. C. Anderson, a respected educational psychologist . The term schema was first used by Jean Piaget in 1926, so it was not an entirely new concept. Anderson, however, expanded the meaning. People use schemata to organize current knowledge and provide a framework for future understanding. Examples of schemata include Rubric (academic), stereotypes, social roles, scripts, worldviews, and archetypes.

7.1 A collective investment scheme

A collective investment scheme is a way of investing money with other people to participate in a wider range of investments than those feasible for most individual investors, and to share the costs of doing so.

Terminology varies with country but collective investment schemes are often referred to as investment funds, managed funds, mutual funds or simply funds (note: mutual fund has a specific meaning in the US). Around the world large markets have developed around collective investment and these account for a substantial portion of all trading on major stock exchanges.

Collective investments are promoted with a wide range of investment aims either targeting specific geographic regions (e.g. Emerging Europe) or specified themes (e.g. Technology). Depending on the country there is normally a bias towards the domestic market to reflect national self-interest as perceived by policy makers, familiarity and the lack of currency risk. Funds are often selected on the basis of these specified investment aims, their past investment performance and other factors such as fees

7.2 Constitution and terminology

Collective investment schemes may be formed under company law, by legal trust or by statute. The nature of the scheme and its limitations are often linked to its constitutional nature and the associated tax rules for the type of structure within a given jurisdiction.

Topic : Encoding And Retrieval From Long-Term Memory

Topic Objective:

At the end of this topic students will be able to:

- Understand the long-term memory,
- Understand the nature of long-term memory
- Understand the episodic memory: source and flashbulb memories
- Understand the forgetting: infantile amnesia
- Understand the explicit and implicit types of long-term memory
- Understand the learning theories
- Understand the long term memory
- Understand the processing theory

Definition/Overview:

Long-term Memory: Long-term memory (LTM) is memory that can last as little as a few days or as long as decades. It differs structurally and functionally from working memory or short-term memory, which ostensibly stores items for only around 20 seconds. Biologically, short-term memory is a temporary potentiation of neural connections that can become long-term memory through the process of rehearsal and meaningful association. Much is not known about the underlying biological mechanisms of long-term memory, but the process of long-term potentiation, which involves a physical change in the structure of neurons, has been proposed as the mechanism by which short-term memories move into long-term storage. Notably, the time scale involved at each level of memory processing remains under investigation.

As long-term memory is subject to fading in the natural forgetting process, several recalls/retrievals of memory may be needed for long-term memories to last for years, dependent also on the depth of processing. Individual retrievals can take place in increasing intervals in accordance with the principle of spaced repetition. This can happen quite naturally through reflection or deliberate recall (a.k.a. recapitulation or recollection), often dependent on the perceived importance of the material.

Key Points:

1. Understating Long Term Memory

The brain stores long term information by growing additional synapses between neurons. Since the brain has approximately 1015 synapses, one can argue that brain has a maximum capacity of about 100 TByte, possibly more if one synapse can store more than 1 bit of information. By no means do humans store that much information. Experiments in the mid 1980s showed that humans can store only 1-2 bits/second in their long term memory. The cumulative amount of data stored in the brain over a 70 year lifetime is therefore only in the order of 125 MByte.

1.1 Disorders of memory

Minor everyday slips and lapses of memory are fairly commonplace, and may increase naturally with age, when ill, or when under stress (Reason J.). Some women may experience more memory lapses following the onset of the menopause. More serious problems with memory generally occur due to traumatic brain injury or neurodegenerative disease:

1.2 Everyday memory problems

The everyday experience of memory problems is the problem of failed recall, forgetting. The tip-of-the-tongue phenomenon is particularly frustrating because the person trying to remember feels that the memory is available. Failing to remember something in the situation in which it would have been useful leads to regret.

1.3 Traumatic brain injury

The majority of findings about memory have been the result of studies that lesioned specific brain regions in rats or primates, but some of the most important work has been the result of accidental or inadvertent brain trauma. The most famous case in memory studies is the case study of HM, who had parts of his hippocampus, parahippocampal cortices, and surrounding tissue removed in an attempt to cure his

epilepsy. His subsequent total anterograde amnesia and partial retrograde amnesia provided the first evidence for the localization of memory function, and further clarified the differences between declarative and procedural memory.

1.4 Neurodegenerative diseases

Many neurodegenerative diseases can cause memory loss. Some of the most prevalent (and consequently, most intensely researched) include Alzheimer's Disease, Dementia, Huntington's Disease, Multiple Sclerosis, and Parkinson's Disease. None act specifically on memory; instead memory loss is often a casualty of generalized neuronal deterioration. Currently, these illnesses are irreversible, but research into stem cells, psychopharmacology, and genetic engineering hold much promise.

2. Learning Theories

Part of memory involves learning, which reflects a relatively permanent change in thinking or behavior due to experience. If information is learned, it was attended to, and it is now stored in memory. There are two basic theories in learning: classical and operant conditioning.

Classical conditioning, initially experimented by Pavlov and his dogs, involves making associations between stimuli. These associations either occur naturally or have to be learned conditioned. A stimulus that elicits a naturally occurring response is called an unconditioned stimulus, and the response is called an unconditioned response. For instance, as Pavlov showed, dogs naturally salivate to meat. Meat is the unconditioned stimulus and drooling is the unconditioned response. There are also stimuli out there that do not elicit such an unconditioned response, and so have to be learned. For instance, a ringing bell would not naturally elicit drooling. But over time, if we pair the bell with the meat, the dog would drool to both. Thus, the ringing bell becomes the conditioned stimulus; one learns that it is paired with an unconditioned stimulus. Over time, after many pairings of the unconditioned stimulus and the conditioned stimulus, if only the conditioned stimulus the bell is presented, the dog will drool. This becomes the conditioned response. Essentially, the dog learns to associate the ringing bell with meat, because meat always comes along with the bell. So, if the bell is presented alone, the dog drools expecting the meat. This would not have happened naturally a dog drooling to a bell, and so it is conditioned and signals that learning has taken place.

Another aspect of learning, critical to memory, is operant conditioning. Operant conditioning relies on the impact of consequences to our behavior. It is a system of rewards reinforcement and punishment. Reinforcement and punishment are presented after a behavior has occurred to affect the likelihood that a behavior will occur again. Reinforcement increases the likelihood that a behavior will occur and punishment decreases the likelihood that a behavior will occur. There are four types.

Positive reinforcement involves adding a pleasant stimulus to increase the likelihood a behavior will occur. For instance, receiving a pizza party for bringing home a good report card will increase the likelihood that the student will again try to earn good grades. Negative reinforcement involves taking away a negative stimulus to increase the likelihood that a behavior will occur. For instance, if you have a headache and take brand X and it gets rids of your headache fairly quickly, you will be more likely to use brand X next time you have a headache. In these two types of learning, the positive refers to adding some kind of stimulus and the negative refers to taking some kind of stimulus away. Both are reinforcement, and so both increase the likelihood a behavior is going to occur.

Positive punishment involves adding an unpleasant stimulus to decrease the likelihood a behavior is going to occur. For instance, a child getting caught stealing money out of a wallet may be given an extra months worth of chores to do. Negative punishment involves taking a pleasant stimulus away to decrease the likelihood a behavior is going to occur. For instance, a student brings home a poor report card, as so loses the TV out of his or her bedroom for a month. Again, in these two types of learning, the positive refers to adding some kind of stimulus and the negative refers to taking some kind of stimulus away. Both are punishment, and so both decrease the likelihood a behavior is going to occur.

3. Explicit and Implicit Types of Long-Term Memory

There are two general classifications of long-term memories. They include explicit and implicit types of memory. Explicit memories involve direct awareness. They are declarative; one can talk about the details of explicit memories and discuss them as fact. In comparison, implicit memories evolve outside of awareness, and cannot be consciously recalled. We only know they occur by observing changes in behavior.

There are also three general categories of long-term memory, based on their content, which include both explicit and implicit types. These include semantic, episodic, and procedural. Semantic memories are memories for facts; meaning-based memory. They are explicit, and thus declarative. For instance, you may be able to state, I know the first president of the United Stateswas George Washington.

Episodic memories are memories for specific events of episodes in time. They, too, are explicit, and often involve personally-experienced events. For instance, you may remember the first roller coaster experience you had, or your first kiss. With episodic memories, you should be able to recollect the details revolving around that particular event.

Finally, procedural memories are skill-based memories. They involve knowledge of how to do things. Procedural memories begin as explicit, but with practice and experience, become implicit. For instance, when you first learned to ride a bike, you had to watch the sidewalk, watch your hands, watch your feet. You had to balance your body and the bike, and think about which foot was cycling; left then right. You had to steer the handlebars. You had a lot on your mind and your body was involved in many simultaneous tasks. Each part of this task was explicit you had to pay attention to and consciously monitor. Then, with practice, the task of riding your bike became easier. Over time, you no longer had to think about your feet, or focus on balancing. You didnt have to think about it at all. The memory, with practice, became implicit. You dont recollect the details, now, in how to ride a bike, you just do it. The same could be said about how to drive a car; not any more. When someone asks you how to drive a car, it is difficult for you to explain explicitly, because the memory has become implicit.

4. Forgetting: Infantile Amnesia

One form of forgetting is the tendency for people not to recall events that occurred prior to three years of age. This is often referred to as infantile amnesia, although the amnesia is not due to brain trauma or injury. This is not due to the age of the memories per se, but the life period during which these memories occurred.

Several theories have been postulated to account for lack of memories prior to three years of age. First, biological theories believe that infants simply lack the neurological infrastructure to support memories and memory formation. It is true that in young babies, the hippocampus

and frontal lobes are still immature. These areas grow throughout the second year. Because the frontal lobes and the hippocampus are critical to memory formation and consolidation, it may be that the inability to produce memories during the first couple of years is due to the underdevelopment of the brain.

Second, the lack of memories may be due to the absence of the sense of self in babies. The identification and concept of the self is critical to memories, especially episodic memories, since they rely on personal experiences and personal thoughts. If one cannot differentiate self from other, they cannot encode meaningful memories as happening to themselves. Studies show that babies dont recognize the self until 2-3 years, although some mirror tests show babies can recognize their own faces in mirrors as early as 18 months. At around two years, babies learn verbal labels for you, me, and I. This concept of self and linguistic ability is critical for episodic memory in recalling and retelling personal narrative and rehearsal.

Likewise, the lack of self concept may be reflected in a lack of theory of mind. Theory of mind refers to the ability to attribute mental states of others as different from ones own. Children under four years of age have difficulty comprehending perspectives and motivations of others different than ones present state. This would be a key aspect of storytelling, and so also contributes to the lack of episodic memory at this age.

Debate still continues in identifying the absolute cause for infantile amnesia, however, eclectic approaches accept both biological and self theories. It appears that infantile amnesia is likely due to a combination of both factors.

5. Episodic Memory: Source and Flashbulb Memories

Two types of memory that can be considered episodic, that is, dealing with memories of a specific event, include source memory and flashbulb memory. Both are explicit, as they are detailed and involve conscious recollection.

Source memory involves remembering how and where information was learned; the context of the learning episode. For instance, you might ask yourself, Did I learn that the movie was bad from my friend? TV? Did I read it somewhere? Source memory can sometimes be difficult to recall, especially if the event was not very vivid or devoid of richness in detail.

Reality monitoring is a process that interacts with source memory. Reality monitoring refers to when we try to decide if in fact an event actually happened to us, or if we only thought about it happening, or it happened to someone else. It is the case sometimes, for instance, that we remember a childhood event happening to us, when it actually happened to a brother/sister, or we read about some potential happening and recall it as already happened. Errors in source memory increase into old age. Errors in source memory are also likely to occur regardless of age or level of detail of the trace given that simply envisioning something happening activates the same brain areas that engaging in the happening does. For instance, studies show that motor imagery imagining yourself performing an action activates the same brain areas as performing the action itself, which is why athletes are often instructed by their coaches to visualize themselves in their competition, as a route for practice hoping to leave a familiar trace in memory.

Errors in source memory and reality monitoring tend to persist because we rehearse what we believe, whether it is false or true. The more we retell a story, the more consolidated it becomes in memory, and thus strengthened. As studies show, confidence is no measure of accuracy in memory. Source memory is likely to fall victim.

Flashbulb memories are memories of specific events episodic, but are unusually vivid and often emotionally-charged. These types of memories are very intense and when recalled, are almost like re-experiencing the event. Flashbulb memories are usually 1 important to the individual, 2 involve events that are surprising or extraordinary, and 3 have an emotional impact on the individual. For instance, you may remember exactly where you were and what you were doing when the WorldTrade Centerwas struck by terrorists on 9/11. You remember very clearly the details that surrounded that event and your experience of it.

Flashbulb memories are one of the best and most accurately recalled types of memories for several reasons. First, because flashbulb memories often contain an emotional component, there exists a physiological trace or path for retrieval not only do you remember what it looked like, but what it sounded like, andhow you felt. Secondly, flashbulb memories are more detailed than many other memories. Again, the more information surrounding a memory, the more potential paths exist for retrieval. Finally, flashbulb memories are more often rehearsed. Our most extreme memories are more often retold more frequently and thought about more frequently because of their extraordinary nature. The more an event is

rehearsed, the stronger the memory becomes. Thus, flashbulb memories are unique and powerful forms of memory.

6. The Nature of Long-Term Memory

Memory, the internal repository of stored information, relies on a set of processes by which information is encoded, consolidated, and retrieved.

Long-term memory, information that is acquired in the course of an experience and that persists so that it can memory can be consciously retrieved, so that we can use our remembrance of things past to guide present thought and action. By contrast, other forms of long-term memory influence our present thinking and behavior while operating outside awareness.

7. Processing theory

The information processing theory approach to the study of cognitive development evolved out of the American experimental tradition in psychology. Information processing theorists proposed that like the computer, the human mind is a system that processes information through the application of logical rules and strategies. Like the computer, the mind has a limited capacity for the amount and nature of the information it can process.

Finally, just as the computer can be made into a better information processor by changes in its hardware (e.g., circuit boards and microchips) and its software (programming), so do children become more sophisticated thinkers through changes in their brains and sensory systems (hardware) and in the rules and strategies (software) that they learn.

7.1 Four Main Beliefs of the Processing Approach

7.1.1 Information-processing theory holds that thinking is information-processing. When the individual perceives, encodes, represents, and stores information from the environment in his mind or retrieves that information, he is thinking. Thinking also includes responding to any constraints or limitations on memory processes.

7.1.2 The proper focus of study is the role of change mechanism in development. Four critical mechanisms work together to bring about change in childrens cognitive skills: encoding, strategy construction, automatization, and generalization. To solve problems effectively, children must encode critical information about a problem and then use this encoded information and relevant prior knowledge to construct a strategy to deal with the problem

7.1.3 Development is driven by self-modification. Like Piagets theory of cognitive development, the information-processing approach holds that children play an active role in their own development. Through self-modification, the child uses knowledge and strategies she has acquired from earlier problem solution to modify her responses to a new situation or problem. In this way, she builds newer and more sophisticated responses from prior knowledge

7.1.4 Investigators must perform careful task analysis of the problem situations they present to children. According to this view, not only the childs own level of development but the nature of the task itself constraints childs performance. Thus a child may possess the basic ability necessary to perform a particular task when it is presented in a simple form, without unnecessary complexities. However, if extra or misleading information is added to the same task, the child may become confused and be unable to perform it.

Topic : Working Memory

Topic Objective:

At the end of this topic students will be able to:

- Understand the dopamine receptors in memory
- Understand the dual-coding
- Understand the structures of the brain and memory
- Understand the mnemonic devices
- Understand the levels of processing
- Understand the theories of working memory

Definition/Overview:

Working memory: Working memory is also refers to as short term memory, depending on the specific theory. It is a theoretical construct within cognitive psychology that refers to the structures and processes used for temporarily storing and manipulating information. There are numerous theories as to both the theoretical structure of working memory (see the "organizational map" that follows) as well as to the specific parts of the brain responsible for working memory. However, most researchers agree that the frontal cortex, parietal cortex, anterior cingulate, and parts of the basal ganglia are crucial for functioning. Much of the understanding of the neural basis of working memory has come from lesion experiments in animals and imaging experiments in humans.

Key Points:

1. Theories of Working Memory

There have been numerous models proposed regarding how working memory functions, both anatomically and cognitively. Of those, three have received the distinct notice of wide acceptance.

1.1 The Baddeley and Hitch model

Baddeley and Hitch (1974) introduced and made popular the multicomponent model of working memory. This theory proposes that two "slave systems" are responsible for short-term maintenance of information, and a "central executive" is responsible for the supervision of information integration and for coordinating the slave systems. One slave system, the phonological loop, stores phonological information (i.e., the sound of language) and prevents its decay by continuously articulating its contents, thereby refreshing the information in a rehearsal loop. It can, for example, maintain a seven-digit telephone number for as long as one repeats the number to oneself again and again. The other slave system, the visuo-spatial sketch pad, stores visual and spatial information. It can be used, for example, for constructing and manipulating visual images, and for the representation of mental maps. The sketch pad can be further broken down into a visual subsystem (dealing with, for instance, shape, colour, and texture), and a spatial subsystem (dealing with location). The central executive (see

executive system) is, among other things, responsible for directing attention to relevant information, suppressing irrelevant information and inappropriate actions, and for coordinating cognitive processes when more than one task must be done at the same time. Baddeley (2000) extended the model by adding a fourth component, the episodic buffer, which holds representations that integrate phonological, visual, and spatial information, and possibly information not covered by the slave systems (e.g., semantic information, musical information). The component is episodic because it is assumed to bind information into a unitary episodic representation. The episodic buffer resembles Tulving's concept of episodic memory, but it differs in that the episodic buffer is a temporary store.

1.2 The Theory of Cowan

Cowan regards working memory not as a separate system, but as a part of long-term memory. Representations in working memory are a subset of the representations in long-term memory. Working memory is organized in two embedded levels. The first level consists of long-term memory representations that are activated. There can be many of these, there is no limit to activation of representations in long-term memory. The second level is called the focus of attention. The focus is regarded as capacity limited and holds up to four of the activated representations. Oberauer has extended the Cowan model by adding a third component, a more narrow focus of attention that holds only one chunk at a time. The one-element focus is embedded in the four-element focus and serves to select a single chunk for processing. For example, you can hold four digits in mind at the same time in Cowan's "focus of attention". Now imagine that you wish to perform some process on each of these digits, for example, adding the number two to each digit. Separate processing is required for each digit, as most individuals can not perform several mathematical processes in parallel. Oberauer's attentional component selects one of the digits for processing, and then shifts the attentional focus to the next digit, continuing until all of the digits have been processed.

1.3 The Theory of Ericsson and Kintsch

Whereas most adults can repeat about seven digits in correct order, some individuals have shown impressive enlargements of their digit span - up to 80 digits. This feat is

possible by extensive training on an encoding strategy by which the digits in a list are grouped (usually in groups of three to five) and these groups are encoded as a single unit (a chunk). To do so one must be able to recognize the groups as some known string of digit. One person studied by K. Anders Ericsson and his colleagues, for example, used his extensive knowledge of racing times from the history of sports. Several such chunks can then be combined into a higher-order chunk, thereby forming a hierarchy of chunks. In this way, only a small number of chunks at the highest level of the hierarchy must be retained in working memory. At retrieval, the chunks are unpacked again. That is, the chunks in working memory act as retrieval cues that point to the digits that they contain. It is important to note that practicing memory skills such as these do not expand working memory capacity proper. This can be shown by using different materials - the person who could recall 80 digits was not exceptional when it came to recalling words. Ericsson and Kintsch (1995) have argued that we use skilled memory in most everyday tasks. Tasks such as reading, for instance, require to maintain in memory much more than seven chunks - with a capacity of only seven chunks our working memory would be full after a few sentences, and we would never be able to understand the complex relations between thoughts expressed in a novel or a scientific text. We accomplish this by storing most of what we read in long-term memory, linking them together through retrieval structures. We need to hold only a few concepts in working memory, which serve as cues to retrieve everything associated to them by the retrieval structures. Anders Ericsson and Walter Kintsch refer to this set of processes as "long-term working memory". Retrieval structures vary according to the domain of expertise, yet as suggested by Gobet they can be categorized in three typologies: generic retrieval structures, domain knowledge retrieval structures and the episodic text structures. The first corresponds to Ericsson and Kintschs classic retrieval structure and the second to the elaborated memory structure. The first kind of structure is developed deliberately and is arbitrary (e.g. the method of loci), the second one is similar to patterns and schemas and the last one takes place exclusively during text comprehension. Concerning this last typology, Kintsch, Patel and Ericsson consider that every confirmed reader is able to form an episodic text structure during text comprehension, if the text is well written and if the content is familiar. Guida and colleagues using this last feature have proposed the personalisation method as a way to operationalise the long-term working memory.

2. Levels of Processing

There are two different levels of processing an individual can use to rehearse information and move it from working memory short-term memory to long-term memory. Those two levels of processing include deep processing andshallow processing. Both often involve rehearsal repeated recitation of an item to be remembered as a method.

Deep processing involves thinking about the material that is to be remembered in a meaningful way. It involves making connections, or associations, with knowledge one already holds. Elaborative rehearsal is a method to get information from working memory to short-term memory that utilizes deep processing. In elaborative rehearsal, one would link the to-be-remembered material semantically to something related that is already stored in long-term memory. For instance, if an individual had to learn a new route to work, one might encode and rehearse the route as, at the McDonalds I make a right and I love milkshakes, so I will be sure to stop, and then I pass my moms favorite store, Target, on the left, and then I will pass the exit for the town of my cousin, and so on and so forth. An individual would be more likely to remember the new route because of making meaningful connections and rehearsing the information as linked to what he/she already knows. The individual would be elaborating upon the material that needs to be remembered.

In the converse, shallow processing does not involve strong, meaningful connections. Shallow processing often involves rote memorization. Maintenance rehearsalis one type of method that would be considered to use shallow processing. Maintenance rehearsal simply involves reciting the to-be-remembered material over and over again in your head, without thinking more about the material or attaching meaning to it. For instance, you might attempt to remember your new route to work using maintenance rehearsal by memorizing left, right, left as the turns in your route. Obviously, this type of rehearsal technique may get you to where you need to go, temporarily, but will not easily get you home, and because it is not connected to anything meaningful, or knowledge already stored, it is less likely to last the test of time. Studies show that shallow processing, including maintenance rehearsal, is less likely to get information into long-term memory whereas deep processing and elaborative rehearsal are more likely to get information into long term memory. This is because one would already have retrieval paths for the already present knowledge, and by linking the to-be-remembered information to these paths, one is simply taking advantage of cues already stored. These paths already created in memory would thus be more likely to facilitate recall.

Chunking would also be similar. Chunking involves grouping to-be-remembered material into meaningful units. For instance, if one had to remember the numbers, 6, 4, 8, 9, one might chunk 64 and 89, and thus have more room left over in their working memory span. This would be another way to take advantage of meaningful knowledge one already possesses to facilitate retrieval and enhance working memory.

3. Mnemonic Devices

Mnemonic devices are heuristics or strategies used to store information in memory. They are used during working memory rehearsal to facilitate later recall. Mnemonic devices improve memory by attaching meaning to otherwise arbitrary lists of items to remember. There are several types of mnemonic devices commonly used.

The use of acronyms as a mnemonic device involves taking the first letter of each word/item that needs to be remembered to stand for another meaning. For instance, N.A.S.A stands for National Aeronautics and Space Administration. NASA is much easier to remember. Similarly, acrostics uses each first letter of items in a list to represent a word in a sentence or story. For instance, we rely on the common saying, every good boy does fine to represent the notes on the musical treble clef, E, G, B, D, F. Both make the material that needs to be remembered easier, and in the last case of acrostics, more meaningful.

In the method of loci, one attaches a visual location to each of the to-be-remembered items in a list. These spatial locations, or landmarks, should already be memorized and familiar. Thus, when one has to remember the item, he or she simply thinks of the location, and it should serve as a cue for recall. For instance, many students visualize where learned material was on their notebook during recall on a test. Location is very often a cue for recall for instance, consider how often you retrace your steps to locate a missing item

The pegword system associates words from an already learned and familiar list to items on a list that needs to be remembered. One tries to visualize the two linked items together. The common example is one-bun, two-shoe, three-tree, and so on. One, two, three is already well-rehearsed. To remember that you have to get dog food, eggs, and apples at the grocery store, you might visualize dog food in a bun, eggs in a shoe, and apples in a tree. This may appear as a lot of work, but visualizing these associations is easy.

Finally, clustering involves chunking or categorizing items on a list together by similarity. For instance, if one had to purchase a large variety of fruits, vegetables, and bread products at the grocery store, one might organize his or her shopping by linking together the types of foods. This would facilitate better recall than a random list of the items to remember to be bought. These mnemonic techniques serve as helpers in rehearsing information during working memory, and facilitating recall later.

4. Structures of the Brain and Memory

There are many structures of the human brain that are involved in the processes of memory. Although there are several distinguishable systems in memory, many of these structures work in concert with each other, and provide bidirectional feedback crucial for memory processes. The parts of the brain that have been correlated with memory functions include the: hippocampus, cerebellum, amygdala, thalamus, frontal/prefrontal lobes, and parts of the temporal, parietal and occipital lobes.

The hippocampus is involved in working memory; specifically, moving information from short-term to long-term memory. Individuals with hippocampal damage often suffer from anterograde amnesia, which involves the inability to create new memories. The cerebellumis crucial for procedural or skill-based memories. Memories for actions that involve motor responses and are implicit involve the cerebellum. Damage here would result in loss of memory for familiar actions and behaviors. The amygdala is the emotional center of the brain especially as it relates to fear and anger. Emotional memories involve activation of the amygdala. Emotional memories are also recalled better, in part due to this extra path for retrieval.

The thalamus is the relay station for the brain. It is integral in receiving sensory messages and sending responses back out to the muscles. Likewise, the thalamus is a major pathway for information that is incoming and processed into memory initially sent to sensory memory, and also during retrieval, when one must pull out that information and initiate a response. Likewise, the frontal/prefrontal lobesare crucial for the integration of information, attention, and higher order thinking that is involved in memory especially episodic memory. This area also involves understanding of the self, which is necessary for explicit types of memory.

Portions of the temporal lobes are involved in the phonological loop subprocess of working memory, while portions of the parietal and occipital lobes are involved with the visuospatial scratchpad subprocess. Together these brain structures integrate processes and the experience of memory.

5. Dual-Coding

The encoding of information into memory usually involves either a visual or verbal code which is then subsequently rehearsed by either the phonological rehearsal loop or the visuospatial scratchpad. However, studies show that if one tries to encode using both visual and verbal information in relation to an item, memory will be improved. This involves encoding a verbal label or description of an item, as well as what the item looks like, or some other visual information that is linked to the item. This is called dual-coding.

Dual-coding works well because it provides more than one path for retrieval. For example, if one were asked to remember the address of a house for a new friend, one might encode the verbal address; 123 Sherwood Avenue, but also what the house looks like; white with red shutters. When the individual comes up against the problem of recalling where the new friend lives, if he or she can recall 123 Sherwood or white house with red shutters, he or she will probably find the location. However, if one recalls both123 Sherwood and white house with red shutters, he or she is almost guaranteed a successful retrieval. Again, the more paths or cues for retrieval, the more likely the memory will be recalled.

Although there may be limits on how much information can be stored in a single verbal or visual cue, more information can be inferred by a picture or visual image.
Thus, many mnemonic techniques involve visual imagery. However, when encoding information, people more often encode verbal materials as descriptors rather than visual ones. Many more should take advantage of the great power of visual imagery in memory, especially as it applies to dual-coding practices.

6. Dopamine Receptors

Dopamine receptors are a class of metabotropic G protein-coupled receptors that are prominent in the vertebrate central nervous system (CNS). The neurotransmitter dopamine is the primary endogenous ligand for dopamine receptors.

Dopamine receptors have key roles in many processes, including the control of motivation, learning, and fine motor movement, as well as modulation of neuroendocrine signaling. Abnormal dopamine receptor signaling and dopaminergic nerve function is implicated in several neuropsychiatric disorders. Thus, dopamine receptors are common neurologic drug targets; antipsychotics are often dopamine receptor antagonists while psychostimulants are typically indirect agonists of dopamine receptors.

In Section 3 of this course you will cover these topics:
- Executive Processes
- Emotion And Cognition

Topic : Executive Processes

Topic Objective:

At the end of this topic students will be able to:

- Understand the hypothesized role of executive processes
- Understand the executive processes.
- Understand to frontal lobe connection
- Understand the monitoring and executive processes
- Understand the stimulus-response compatibility
- Understand the phineas gage
- Understand the frontal lobe damage and disorders

Definition/Overview:

Executive Processes: The executive process is a theorized cognitive system in psychology that controls and manages other cognitive processes. It is also referred to as the executive function, executive functions, or cognitive control.

The concept is used by psychologists and other neuroscientists to describe a loosely defined collection of brain processes which are responsible for planning, cognitive flexibility, abstract thinking, rule acquisition, initiating appropriate actions and inhibiting inappropriate actions, and selecting relevant sensory information.

Key Points:

1. Hypothesized role of Executive Processes

The executive system is thought to be heavily involved in handling novel situations outside the domain of some of our 'automatic' psychological processes that could be explained by the reproduction of learned schemas or set behaviors. Psychologists Don Norman and Tim Shallice have outlined five types of situation where routine activation of behavior would not be sufficient for optimal performance:

- Those that involve planning or decision making.
- Those that involve error correction or troubleshooting.
- Situations where responses are not well-learned or contain novel sequences of actions.
- Dangerous or technically difficult situations.
- Situations which require the overcoming of a strong habitual response or resisting temptation.

The executive functions are often invoked when it is necessary to override responses that may otherwise be automatically elicited by stimuli in the external environment. For example, on being presented with a potentially rewarding stimulus, such as a tasty piece of chocolate cake, the automatic response might be to take a bite. However, where this behaviour conflicts with internal plans (such as having decided not to eat chocolate cake whilst on a diet), the executive functions might be engaged to inhibit this response. The neural mechanisms by which the executive functions are implemented is a topic of ongoing debate in the field of cognitive neuroscience.

Neuropsychologist Elkhonon Goldberg, a disciple of Alexander Luria, introduced the metaphor of the prefrontal cortex as the director of an orchestra and the cortex as the front rows in order to explain the role of executive functions

2. Frontal Lobe Damage and Disorders

The frontal lobe is vulnerable to injury being at the forefront of the head forehead, and lesions to no other part of the brain cause such a wide variety of symptoms. This is because the frontal lobe is involved in many functions, including motor function, problem solving, spontaneity, memory, language, initiation, attention, judgment, impulse control, emotion regulation, and social and sexual behavior. The frontal lobe is also responsible for higher

order thinking, including the identification of the self and some aspects of personality. Thus, there are many disorders or syndromes that result from frontal lobe injury. In general, frontal lobe damage results in attentional deficits, memory deficits and perseveration, some language problems, lack of spontaneity, affective problems such as indifference and lack of concern, sometimes euphoria and disinhibition, aggression and irritability, and disturbances of movement. Specific disorders involving the frontal lobe can fit into 3 classifications: orbitofrontal syndromes disinhibited symptoms,frontal convexity syndromesapathetic symptoms, and medial-frontal syndromes akinetic symptoms.

Orbitofrontal syndromes involve disinhibited, impulsive behavior that resembles psychopathic symptomology. Also, inappropriate affect and emotion perhaps euphoria are observed in orbitofrontal syndromes. Poor judgment and insight, distractibility inattentional symptoms are also common symptoms.

Frontal convexity syndromes involve apathy and general indifference with occasional and brief, angry or aggressive outbursts occurring often. Also, some motor retardation, perseveration, and/or impersistence may be observed such as rhythmic tapping. There may also be a loss of self which affects personality and metacognition. Verbal and spatial capabilities may also be hindered, with affected individuals exhibiting poor abstraction and categorization and poor visuospatial processing.

Medial frontal syndromes involve lack of spontaneous movement and gesturing, with sparse verbal output repetition may be preserved. There may also be a weakness of lower extremities and loss of sensation including incontinence.Epilepsy may also be allocated to the frontal lobe. Epilepsy involves brief seizures electrical storms in the brain that have sudden onset and cessation. Bizarre motor behavior accompanies these seizures. EEG patterns help detect the localization of the electrical surge in the brain, which may often occur in the frontal lobe.

Individuals suffering from schizophrenia have also showed abnormality in the frontal lobe regions. Affective abnormalities and lack of motivation and problem solving ability are some symptoms that often accompany the disorder that may be due to frontal lobe impairment.

Dementia, as defined as a progressive decline in cognition not due to aging. Dementia is due to atrophy of the frontal lobe, and thus, a decline in memory, attention, language, and

problem solving may be observed. Later throughout the development of the disease, individuals may also lose a sense of time, place, and self.

Although assessing frontal lobe damage can be difficult, there are several cognitive tests used to assess frontal lobe functioning. They include tests of word fluency, abstract thinking, proverb interpretation, card sorting, block design, maze tests, copying tests, and rhythm tapping tests.

3. Phineas Gage

Phineas Gage was one of the first clinical case studies that revealed the underlying functions of the frontal lobe. His story is remarkable in that Phineas survived a horrific, potentially fatal accident, and was still cognizant enough to be tested for mental and behavioral functioning following such great trauma to the brain.

Phineas Gage was a 25-year-old foreman working on constructing a railroad, in 1848. While blasting rock to make way for the new railroad, Phineas incorrectly followed procedure, and a 3-foot-long, 14 pound tamping iron shot through the bottom of his skull left cheek and exited through the top of his head, shooting into the sky and landing nearly 100 feet away. Immediately following the accident, Phineas was speaking and acting fine and showed no signs of impairment, though a gaping hole three and a half inches long by two inches wide bore through his head. However, in the weeks following, Phineass doctor noted changes in his disposition and demeanor.

Before the accident, Phineas was characterized as a pleasant, easy-going, and popular man who was responsible and reliable. Following the accident, Phineas was reported to be irritable, fitful, and angry using profanity quite often; which he had not previously done, impatient and obstinate, and one who never followed through with any of his plans. He was rude, egoistic, and no longer the altruistic individual he had once been. Although strong enough to return to work, Phineas could no longer secure a job because of his unpleasant personality characteristics. Not much is known about Phineas since, except that he began also experiencing brain seizures at age 37 soon after which, he subsequently passed.

After post-mortem study several years later, it was determined that Phineas sustained damage to the frontal lobe primarily the left side. Many claim the damage was equivalent to a frontal

lobotomy. The result was impairment not in cognitive functions per se, but in social functioning and aspects of personality. This was a new revelation given that prior to Phineass accident, the frontal lobe was not believed to support such functions. Now we know that the frontal lobe is involved in aspects of metacognition and the self.

4. Stimulus-Response Compatibility

The Simon effect, also known as the compatibility effect, shows that responses to a stimulus are quicker if both the stimulus and the required response appear on the same side or in the same direction/location. For instance, one must turn a car steering wheel left to turn the car left, and turn the steering wheel right to turn right. It would be quite awkward if to turn left, one had to turn the steering wheel towards the right. Functionally, having stimulus-response events occur in the same location is practical and natural. This ergonomic design is used in many industries, including that of aircraft cockpits and control towers.

Stimulus-response compatibility was first exhibited in a series of studies. Simons studies showed that compatibility matters even if the position of the stimulus doesnt. For instance, research participants were asked to make a right-handed response whenever a circle appeared and a left-handed response whenever a square appeared. Participants responded quicker when the circle or square appeared on the same side as the required response, even though the objects position being right or left was irrelevant to the task.

This effect may occur for several reasons. First, if a response is automatic for instance a left-handed response being natural for something on the left, because our experience in the world often occurs that way, little executive attention is needed and thus the response is quicker. Or, it may be that the association of a stimulus to a response is arbitrary for instance responding to a high pitched tone on the left versus the right. Either way, an association is learned. When location of response and some other salient feature of the stimulus compete or are incompatible, reaction time slows due to the monitoring involved in executive processing; one must attend to the relevant information required to make the response it is no longer automatic. We may have to inhibit our natural response, which takes time increases reaction times.

5. Monitoring and Executive Processes

Sometimes we must monitor what we are doing as we engage in a task, so as to keep on the right path. This is called monitoring, and it is one of the many functions achieved by our executive control. Monitoring is different than changing or correcting responses after a task has been completed; monitoring involves keeping tabs on our performance as we engage working memory. We must switch back and forth from what we are currently processing in working memory and assessing how we are making progress towards achieving our goal.

The featured classroom activity is an example of how we monitor working memory. For example, participants were presented a picture of six items, and they had to remember one of the six items. However, the order of the six items changed across six trials, and on each of the six trials, participants had to remember a different item; one that had not been recalled before. One would have to constantly monitor working memory to be sure that one was not selecting an item they had on a previous trial. One would have to consciously update and inspect working memory so not as to make errors. Monitoring is necessary to be successful at this task.

We use monitoring in many of our everyday tasks. As we engage in novel tasks, or tasks that we do not yet have much experience with that are not automatic, we often must monitor our progress throughout the sequence of steps involved in the task. In order to ensure we get to our goal state, we assess our ability to achieve the sub-steps along the way how am I doing so far?. For instance, as you are learning to drive a car, you monitor your ability to steer the wheel, apply the gas and brake, and so on. There is an order of events that must occur for you to successfully drive the car. You must monitor them along the way. Once this task becomes automatized, monitoring is no longer needed.

The frontal lobes are involved in monitoring processes. Individuals with frontal lobe damage have difficulty with this task. Frontal lobe patients can recall six items, but not monitor them while being processed in working memory. Individuals without frontal lobe damage find this task fairly easy. Again, monitoring is something we engage in on a daily basis.

6. The Frontal Lobe Connection

One of the major reasons for thinking that executive processes form a distinct class of cognitive processes comes from relatively early studies of patients who had suffered frontal brain damage as a result of a closed head injury, injury caused by an external bump that does not pierce the skull. Frontal damage can result from other events as well, for instance, from a stroke or from brief deprivations of oxygen.

Topic : Emotion And Cognition

Topic Objective:

At the end of this topic students will be able to:

- Discuss the role of the amygdala in emotion.
- Identify the six basic emotions.
- Understand the mood-congruent memory effect
- Understand the observational learning
- Understand the emotion and automatic processes
- Understand the amygdala in emotion.

Definition/Overview:

Emotion: An emotion is a mental and physiological state associated with a wide variety of feelings, thoughts, and behaviours. It is a prime determinant of the sense of subjective well-being and appears to play a central role in many human activities. As a result of this generality, the subject has been explored in many, if not all of the human sciences and art forms. There is much controversy concerning how emotions are defined and classified.

Cognition: Cognition is a concept used in different ways by different disciplines, but is generally accepted to mean the process of awareness or thought. For example, in psychology, it refers to an information processing view of an individual's psychological functions. Other interpretations of the meaning of cognition link it to the development of concepts; individual minds, groups, organizations, and even larger coalitions of entities, can be modelled as societies which cooperate to form concepts. The autonomous elements of each 'society' would have the opportunity to demonstrate emergent behavior in the face of some crisis or

opportunity. Cognition can also be interpreted as "understanding and trying to make sense of the world"

Key Points:

1. Amygdala in Emotion.

In complex vertebrates, including humans, the amygdalae perform primary roles in the formation and storage of memories associated with emotional events. Research indicates that, during fear conditioning, sensory stimuli reach the basolateral complexes of the amygdalae, particularly the lateral nuclei, where they form associations with memories of the stimuli. The association between stimuli and the aversive events they predict may be mediated by long-term potentiation, a lingering potential for affected synapses to react more readily.

Memories of emotional experiences imprinted in reactions of synapses in the lateral nuclei elicit fear behavior through connections with the central nucleus of the amygdalae. The central nuclei are involved in the genesis of many fear responses, including freezing (immobility), tachycardia (rapid heartbeat), increased respiration, and stress-hormone release. Damage to the amygdalae impairs both the acquisition and expression of Pavlovian fear conditioning, a form of classical conditioning of emotional responses.

The amygdalae are also involved in appetitive (positive) conditioning. It seems that distinct neurons respond to positive and negative stimuli, but there is no clustering of these distinct neurons into clear anatomical nuclei. Different nuclei within the amygdala have different functions in appetitive conditioning.

2. Emotion and Automatic Processes

There are several processes or aspects involved in emotion that may be considered automatic. First, we are biologically prepared to respond to arousing stimuli through the autonomic nervous system. The autonomic nervous system, part of the peripheral nervous system, is responsible for regulating many automatic processes in the body, through the glands and muscles, which sustain life. It regulates processes like skin conductance, heart rate, breathing, and digestion.

The autonomic nervous system can be further broken down into the sympathetic and parasympathetic divisions. The sympathetic nervous system is responsible for what is known as the fight-or-flight response. The sympathetic nervous system arouses the body and prepares it for action. Emotions like fear or anger cause by activating the sympathetic nervous system our pupils to dilate, a decrease in salivation, an increase in perspiration and respiration, an acceleration in heart rate, an inhibition of digestion, and the secretion of stress hormones. All of these things our body initiates automatically, in response to strong emotions.

In contrast, the parasympathetic nervous system calms the body down and prepares it for rest. Pupils contract, salivation increases, skin dries, respiration decreases, heart rate slows, digestion increases, and adrenal glands decrease production. Tranquil emotions facilitate this effortlessly.

The affective primacy hypothesis also supports the notion that processing of emotion may involve some automatic operations. Studies have shown that detecting stimuli of emotional salience occurs prior to, and independent of, awareness and appraisal, and thus are processed automatically. For instance, environmental stimuli indicating a threat, such as an animal lunging toward you, are processed automatically the sympathetic nervous system responds, you pay attention to the animal automatically, and feel fear instantaneously without cognitive appraisal. Evolutionarily speaking, this built-in response that we respond to emotionally arousing stimuli quickly and effortlessly makes sense for survival. This early warning system may reach the amygdala without higher-order processing.

Affective primacy has been demonstrated in more than one species, and neuroimaging studies show similar responses and pathways in humans. Most evidence surrounds a threat stimulus and accompanying emotion, however, further studies will have to prove the affective primacy hypothesiss generalizability to other emotions.

Several theories regarding how emotion is cognitively processed also argue for some automaticity. The James-Lange theory of emotion states that we first experience physiological arousal autonomic nervous system in response to emotional stimuli such as heart palpitations and sweating, and then feel an emotion fear. This theory subsumes that the bodys reaction to emotional stimuli is automatic does not necessitate cognitive appraisal before being processed. The Cannon-Bard theory states that we experience physiological

arousal at the same time we feel an emotion. It assumes that both occur simultaneously, but still not assuming that cognition precedes emotion. However, Schacters Two-Factor theory of emotion states that cognition does play an important role in emotion. Schacter felt that emotions include a physiological response and a cognitive label which together reinforces our experience of an emotion and determines which emotion we feel. For instance, if we feel anxious and agitated around someone and our sympathetic nervous system becomes engaged sweaty palms, heart racing, is it because we feel romantically interested in that person? Or is it because we hate them? Both may initiate the same physiological response, but the emotion we attach to it depends on how we label through cognition what we feel love or hate.

Taken together, much evidence supports the idea that emotion, at least in part, is processed automatically. This processing occurs at many different levels physiologically, cognitively and perhaps, ensures our survival.

3. Observational Learning

Sometimes, learning can occur without direct experience, or even knowledge that we are learning! When learning occurs by observing associations indirectly, we say that observational learning has occurred, which is an indirect form of learning. Lets first make the distinction between direct and indirect learning.

Direct learning involves oneself directly experiencing an association. A classical conditioning example might involve a dog learning to associate a bell with dinner time; he has learned that he gets fed and eats when a bell rings. An operant conditioning example might involve a child getting punished having to wash dishes for a week for being mean to her sister. Both involve the participant directly taking part in the learning exercise. Indirect learning would involve inferring associations by either watching or hearing someone or something else experience them. Observational learning is indirect learning. There are several types of observational learning, which include modeling, imitation, vicarious conditioning, and vicarious reinforcement.

Modeling involves observing others engage in a task, thus facilitating the ease of ones own participation in the same task. For instance, modeling is a common therapeutic technique to get individuals to confront their fears. For instance, a psychotherapist may be counseling a client who is afraid of heights. The therapist might show the client that he or she can stand on

top of a building and not feel ill at ease, thus modeling the desired behavior for the client. Following, the client is allowed to try standing on top of the building, and should feel more at ease having witnessed someone else do it first the therapist and succeed.

Imitation simply involves repeating behaviors that are witnessed in others, without necessarily understanding the meaning behind them. For instance, it is a common fact that young babies imitate many of the behaviors they witness in their caretakers. Babies may reproduce foul language, for instance, without understanding the repercussions or the meaning behind the words. Even as we get older, we imitate role models we want to be like, as we are developing our sense of self. Imitation and modeling show that we learn by observing others.

Similarly, vicarious conditioning involves learning through a classical conditioning paradigm, but indirectly. The word vicarious means through someone else. Vicarious conditioning allows us to learn associations, but not through direct experience with the associated stimuli. For instance, a child may learn to associate a car key with the ignition in order to start the car, without having put the key in the ignition herself. She may have never have even handled the car keys. However, she can learn the association that keys start the car by watching Dad or Mom drive the car.

Vicarious reinforcement is similar. We learn about the consequences of behaviors by witnessing reward and punishment in others operant conditioning. For instance, perhaps a child witnessed a sibling get a new pair of wanted sneakers for bringing home a good grade. The child now works hard to get him- or herself a good grade hoping that he or she will get the same treatment. That child learned to associate good performance with a reward without having had accomplished that success him- or herself. We, too, read about the moral of the story and recall the lesson without having had to experience the hardship that lead to that wisdom, ourselves. These are all examples of observational learning, which can be just as effective as direct forms of learning.

4. Mood-Congruent Memory Effect

The mood-congruent memory effect refers to the finding that memory is better if the mood during encoding matches the mood during retrieval. For instance, if one were angry when an

event occurred, one would recall the event better later if in the same angry mood. This effect is very similar to context-dependency and more especially, state-dependency.

Studies often use a mood-induction technique to elicit the mood-congruent effect. In one common method, participants are shown a movie that is meant to elicit a certain emotion or mood. Participants are then given a mood assessment questionnaire, and then given a list of words to memorize. These words are emotionally-charged. Afterward, participants are again assessed on their mood, and given a recall test. It has been found that participants recall words better that are congruent with their mood i.e., happy mood and happy words. However, studies also show that the mood-congruent effect occurs more often with tests of recall than tests of recognition. Also, research shows that effects are stronger for positive mood than for negative mood perhaps we try to forget the negative.

There are several reasons why the mood-congruent effect is found. First, it may be that mood creates a bias in responding. Assuming that mood-congruent and mood-incongruent stimuli are equally accessible in memory, we chose, or may be biased to respond to, the mood-congruent stimuli. Second, mood or emotion may serve as a cue or separate retrieval path for memory. As we know, physiological responses may be housed as procedural memories, and thus serve as a separate path from semantic or episodic types for retrieval. Finally, mood-laden memories that carry strong emotions may simply be stronger. Studies show that the more emotion a memory carries, the easier it is to retrieve and the better detail of the memory itself, perhaps working similar to flashbulb memories. Not all memories are accompanied by moods, but for those that do, where mood is congruent, memory is likely to be improved.

5. Six Basic Emotions

In humans, there exist six basic emotions that can be recognized by most anyone anywhere in the world. After years of studying emotion all around the world, first precedented by animal studies, it was found that there is a universality of emotional expression. There are six basic emotions; anger, fear, disgust, happiness, sadness, and surprise. Studies have shown that the muscular arrangement of the expression of each of these emotions is distinct, and yet people of every culture, age, race, and gender express them the same way. Studies also show that the expression of these six basic emotions is innate. Babies from birth and blind individuals both of whom have not had the experience of modeling, learning, or imitating the expression of these emotions display these six basic emotions.

Further research has concluded that there are specific brain systems responsible for the recognition of faces and facial emotions. The recognition of faces has been linked to the Fusiform Face Area FFA located within the fusiform gyrus in the temporal lobe. In regards to the expression of specific emotions, the amygdala has been linked to the perception of the expression of fear, and the insula and basal ganglia have been linked to the perception of disgust. The perception of anger has been linked to the ventral striatum and the neurotransmitter dopamine. It has also been suggested that the perception and expression of facial emotion are lateralized to a great extent in the right hemisphere rather than the left. And thus, being that much of our bodys functions are contralaterally represented in the brain, the left side of the face has been shown to be more expressive of emotions, more uninhibited, and more likely to display culture-specific emotional norms. The right side of face, on the other hand, is less susceptible to cultural display norms and has been shown to exhibit more universal emotional expression.

The six basic emotions, though remarkable, are not the only emotions that humans are capable of. There are a wide variety of complex emotions that may vary by expression. Just as there are universal emotions, there, too, exist culture-specific emotions. There are also gender biases in the expression of emotion, including females being more expressive in general. Thus, the basics of emotional expression may be innate and biological universal, yet some aspects of more complex emotion expression may be socialized and culturally determined.

In Section 4 of this course you will cover these topics:

- Decision Making
- Problem Solving And Reasoning

Topic : Decision Making

Topic Objective:

At the end of this topic students will be able to:

- Describe the Allais paradox.
- Describe the Ellsberg paradox.
- Understand the framing effects
- Understand the risk in decision making

- Understand the alternative: multiattribute decision making
- Understand the heuristics as biases

Definition/Overview:

Decision making: Decision making can be regarded as an outcome of mental processes as cognitive process that leads to the selection of a course of action among several alternatives. Every decision making process produces a final choice. The output can be an action or an opinion of choice.

Human performance in decision making terms has been subject of active research from several perspectives. From a psychological perspective, it is necessary to examine individual decisions in the context of a set of needs, preferences an individual has and values he/she seeks. From a cognitive perspective, the decision making process must be regarded as a continuous process integrated in the interaction with the environment. From a normative perspective, the analysis of individual decisions is concerned with the logic of decision making and rationality and the invariant choice it leads to.

Yet, at another level, it might be regarded as a problem solving activity which is terminated when a satisfactory solution is found. Therefore, decision making is a reasoning or emotional process which can be rational or irrational, can be based on explicit assumptions or tacit assumptions.

Logical decision making is an important part of all science-based professions, where specialists apply their knowledge in a given area to making informed decisions. For example, medical decision making often involves making a diagnosis and selecting an appropriate treatment. Some research using naturalistic methods shows, however, that in situations with higher time pressure, higher stakes, or increased ambiguities, experts use intuitive decision making rather than structured approaches, following a recognition primed decision approach to fit a set of indicators into the expert's experience and immediately arrive at a satisfactory course of action without weighing alternatives. Also, recent robust decision efforts have formally integrated uncertainty into the decision making process.

Key Points:

1. Allais paradox

The **Allais paradox** is a choice problem designed by Maurice Allais to show an inconsistency of actual observed choices with the predictions of expected utility theory. The problem arises when comparing participants' choices in two different experiments, each of which consists of a choice between two gambles, A and B. The payoffs for each gamble in each experiment are as follows:

Experiment 1				**Experiment 2**			
Gamble 1A		**Gamble 1B**		**Gamble 2A**		**Gamble 2B**	
Winnings	**Chance**	**Winnings**	**Chance**	**Winnings**	**Chance**	**Winnings**	**Chance**
$1 million	100%	$1 million	89%	Nothing	89%	Nothing	90%
		Nothing	1%	$1 million	11%		
		$5 million	10%			$5 million	10%

Allais asserted that, presented with the choice between 1A and 1B, most people would choose 1A, and presented with the choice between 2A and 2B, most people would choose 2B. This has been borne out in various studies involving hypothetical and small monetary payoffs, and recently with health outcomes. Allais further asserted that it was reasonable to do so.

2. Ellsberg paradox

The Ellsberg paradox is a paradox in decision theory and experimental economics in which people's choices violate the expected utility hypothesis. It is generally taken to be evidence for ambiguity aversion.

Suppose you have an urn containing 30 red balls and 60 other balls that are either black or yellow. You don't know how many black or yellow balls there are, but that the total number of black balls plus the total number of yellow balls equals 60. The balls are well mixed so that each individual ball is as likely to be drawn as any other. You are now given a choice between two gambles:

Gamble A	**Gamble B**
You receive $100 if you draw a red ball	You receive $100 if you draw a black ball

Also you are given the choice between these two gambles (about a different draw from the same urn):

Gamble C	Gamble D
You receive $100 if you draw a red or yellow ball	You receive $100 if you draw a black or yellow ball

Since the prizes are exactly the same, it follows that you will *prefer* Gamble A to Gamble B *if, and only if,* you believe that drawing a red ball is more likely than drawing a black ball (according to expected utility theory). Also, there would be no clear preference between the choices if you thought that a red ball was as likely as a black ball. Similarly it follows that you will *prefer* Gamble C to Gamble D *if, and only if,* you believe that drawing a red or yellow ball is more likely than drawing a black or yellow ball. If drawing a red ball is more likely than drawing a black ball, then drawing a red or yellow ball is also more likely than drawing a black or yellow ball. So, supposing you *prefer*Gamble A to Gamble B, it follows that you will also *prefer* Gamble C to Gamble D. And, supposing instead that you *prefer* Gamble D to Gamble C, it follows that you will also *prefer* Gamble B to Gamble A.

3. Heuristics as Biases

Heuristics, or mental shortcuts used in problem solving, can sometimes act as biases and detrimentally affect our decision making. In making our decisions, sometimes it is not efficient to consider every possible solution or outcome. Sometimes we must take best guesses in our decision making, and so we sacrifice accuracy for efficiency. There are several biases in decision making, including the representativeness heuristic, availability heuristic, confirmation bias,anchoring, and overconfidence.

The representativeness heuristic is a strategy that we use when we make decisions about an object or event based on how well the instance fits our prototype. For instance, if we were to encounter a birdlike animal called a robin, and need to make a decision about whether or not the robin is a bird, we compare the robin to whatever our prototype for bird may be lets say a canary. We would then decide that yes, a robin is a bird because the robin looks similar enough to our prototype for bird the canary. However, the representativeness heuristic may fail us if an object is not similar enough to our prototype. What if we were to encounter a penguin? A penguin is a bird, but is not a prototypical member of that category and would be very different from our prototype for bird: a canary.

The availability heuristic involves a tendency to estimate the probability of an event by how easily the instance of it comes to mind. We make decisions about an object or event based on how available it is in our memory. The availability heuristic is most affected by recency how recently we have encountered the object or event. For instance, if someone asked you if Brand X was a good brand of car, and you knew of three people who recently had accidents in Brand X cars, you might make the decision and respond that Brand X is not a reliable brand. Rather than survey all of the statistics on car brand safety which would take a lot of time and energy, we make our decision based on what recent experiences we have had with that car brand. Our decision may not be accurate, and we are biased by our recent encounters with a given stimulus whether that is through what we hear, read, see, or experience ourselves.

The confirmation bias also known as belief perseverance shows that we have a tendency to only seek out evidence that confirms out beliefs and ignore disconfirming evidence, in our decision making. The old proverb that we hear only what we want to hear rings true. Whether we are cognizant of it or not, we often notice or pay more attention to instances that are in line with our beliefs. For instance, if we believe that kids are more hyperactive when they ingest sugary foods, we may be more inclined to only notice instances where kids are acting out of control after ingesting sugar, and neglecting to take note of them behaving badly when they have not eaten sugary foods. Again, we may not be aware of this bias, but it certainly leads us to strengthen our pre-existing beliefs and make further decisions based on them.

Anchoring shows that we may be anchored by previously considered information. We estimate probabilities of events, or make decisions regarding stimuli, based on adjusting earlier beliefs. We find it difficult to stray from preconceived notions. For instance, if we see a sale price tag for an item that shows the item has been marked down from $100 to $75, we think that is a better investment than buying a comparable item that does not show a sale price, but an original retail price of $75. We are anchored by the initial estimate of $100. This is a common technique in marketing; placing marked down sale tags on items in order to affect our perceptions during our decision making. Again, whether we are aware of it or not, we are anchored by our pre-existing beliefs and this can negatively bias our decision making.

Finally, we tend to overestimate the accuracy of our decisions especially if they are representative, available in our memory, have been reinforced by our confirmation bias, and strongly anchored. We are overconfidentof many of our decisions, and research shows that

confidence is no measure of accuracy in our decision making. We are not aware of our inaccurate overconfidence, just as we are not aware of many of our biases in decision making. Studies also show that making people aware of their biases still does not alter the course of their decisions.

4. Alternative: Multiattribute Decision Making

When we make decisions, it is rarely that we only have one option to consider. Many times, we have several alternative courses of action to weigh as we choose the best solution for us. Or, perhaps one solution has several different caveats to consider several pros and cons in itself. When we have multiple possibilities to consider when making a decision, we call this multiattribute decision making.

In considering the range of alternatives that may be available, we might create a decision tree, to map out our possible courses of action and their consequences. Each possible course would be weighted by our beliefs, or probabilities of occurrences. We may be uncertain of the consequences, or just make best guesses about the outcomes of events. For instance, we might map out the course of our day if we take the train to work, or drive our car to work. We might consider the costs, time, and hassle involved. Perhaps we might estimate the probability of being late to work traffic or being home in time for dinner missing the train. Either way, the decision tree is meant to visually organize our possibilities and what might happen should we choose a course of action.

We may also weigh our choices a different way. Sometimes we find it helpful to create a list of pros positive aspects and cons negative aspects for eachoption being considered. If an option has more positives than negatives, we may weigh that option more heavily increasing the likelihood that we choose that option. Each aspect or caveat listed under each pro and con heading would also be weighed; as some negatives are more negative than others, and some positives are more positive than others. And thus, an internal weighting system would rank order positives and negatives within each option. For instance, we might be considering several options for how to study for an exam. We could study the night before and cram, or space out our studying and begin a week before the exam. The first option involving cramming has positives have more free time during the week, dont have to stress about the exam until night before, etc., but also has negatives less likely to remember the information after the exam, may have to stay up late the night before and not get any sleep, etc.. Each of

these aspects may be differentially weighted for instance, maybe not getting enough sleep is more important to you than not remembering the information in the long-term. You would also create a list of positives and negatives associated with distributed studying, and so on.

Weighting in multiattribute decision making is subjective. We assign values to options or caveats based on our own personal preferences and experiences, called utility. For instance, having to wash laundry might be seen as a negative consequence to one person, but a positive consequence to another who likes to keep tidy. Utility is the subjective value that we place on our options. And as we have discussed, different options have different weights values and therefore different utilities. One persons rank order of negatives might be different than another, even if all aspects listed under a con category are the same.

In making our decisions, we are rational and efficient. We often do not consider and weigh every possible solution, as that would not be parsimonious and would take too much time and effort. We only consider the options that are most valuable to us have the greatest utility, are most relevant to us affect us the most, and have the greatest probability of occurring, according to our beliefs. And so, our problem space might not be all-encompassing, but it does contain the most pertinent options that we can consider in choosing our courses of action, among many alternatives.

5. Risk in decision making

The way a problem is framed affects the way we consider our options or alternative choices in decision making. Options may be framed in a way that highlights our potential for risk. Risky choices are framed in a way such that the probability of a result occurring are small, or vary are not certain. A riskless choice has a definite outcome and thus is known, or stated in the problem set. There exist some regularities in how we are affected by perceived risk.

Although risk attitudes vary from person to person, people tend to be risk-seekingwhen the options available to them appear to involve losses. People also tend to be risk-adverse or risk-avoiding when the options available to them appear to involve gains. Thus, when a loss is involved, we are more likely to take chances and will more often opt for risky choices because there exists a probability however small that we may not have to lose anything. However, when there is a gain involved, we would rather take the sure bet. We are less likely to take risks when a definite gain is an option; we choose the gain even if there exists another

option with a probability of gaining more. This is because there exists a bias between losses and gains: losses appear more significant than gains for instance, the loss of $10 is seen as more terrible than the gain of $10 is beneficial. The decision will thus be biased in favor of retaining the status quo. We exhibit loss aversion, which favors stability over change.

6. Framing Effects

The way a situation, and your choice of options in regards to responding to a situation, are worded and presented affect the choice that is made. This is whats known as a framing effect. Decision making depends on our view of the situation, and the way that situation is framed affect our view. For instance, would we be more likely to A be in support of a drug that saves 1 out of 10 lives, or B be against a drug that kills 9 out of 10 people? Actually, both have the same statistical outcome, however, the differential wording leads people to chose option A more frequently. Option A appears more favorable.

Many different aspects of decision making are affected by framing effects. Anchoringshows that the order in which information is framed can affect our decision making; information presented preceding a decision anchors our judgment. Also, risky decision making shows that we are more or less likely to take risks, depending on the way information our choices is framed. Two other decision making tactics that take advantage of framing effects are the foot-in-the-door technique and the door-in-the-face technique.

The foot-in-the-door technique gets people to comply to a large request by getting them to comply to a smaller one. For instance, you may say to a significant other, honey, would you mind running out to the store to get some milk? He or she will likely comply. And then you might add, While youre at it, can you also pick up a gallon of ice cream, some soda, some chips and so on. Framing your request in this way allows you to get your foot in the door and increases the likelihood that the other person will make a decision to comply. The door-in-the-face technique works in a similar way. It involves getting another person to reject a large request as expected, and then present a smaller request, which the other person is more likely to accept because it appears more reasonable compared to the first request. The door-in-the-face technique works like anchoring does. For instance, a car salesperson may mark up the price on a new car, knowing fully that the buyer will not accept the initial sticker price for the car. Thus, when the car salesperson offers a price lower than the initial sticker price for the

car, the buyer is more likely to accept, and the car salesperson gets what he or she wants; a car sale. We again are anchored by the way information is initially presented to us, or framed.

Thus, framing leads us to think certain ways. Framing effects are witnessed in other venues besides problem solving. For instance, leading the witness in a court of law frames information in one direction or another to bias ideas, and advertising using framing may make you believe that you need a certain product, and so on and so forth. Many different industries in our society rely on framing affects to sway an audience to think a certain way, and it usually works!

Topic : Problem Solving And Reasoning

Topic Objective:

At the end of this topic students will be able to:

- Understand the impediments to problem solving
- Understand the problem solving strategies
- Understand the insight of the problem solving
- Understand the probability and problem solving

Definition/Overview:

Problem solving: Problem solving forms part of thinking. Considered the most complex of all intellectual functions, problem solving has been defined as higher-order cognitive process that requires the modulation and control of more routine or fundamental skills (Goldstein & Levin, 1987). It occurs if an organism or an artificial intelligence system does not know how to proceed from a given state to a desired goal state. It is part of the larger problem process that includes problem finding and problem shaping.

The nature of human problem solving methods has been studied by psychologists over the past hundred years. There are several methods of studying problem solving, including; introspection, behaviorism, simulation and computer modeling, and experiment.

Reasoning: Reasoning is the cognitive process of looking for reasons for beliefs, conclusions, actions or feelings. Humans have the ability to engage in reasoning about their

own reasoning using introspection. Different forms of such reflection on reasoning occur in different fields. Although reasoning was once thought to be a uniquely human capability, other animals also engage in reasoning.

In philosophy, the study of reasoning typically focuses on what makes reasoning efficient or inefficient, appropriate or inappropriate, good or bad. Philosophers do this by either examining the form or structure of the reasoning within arguments, or by considering the broader methods used to reach particular goals of reasoning. Psychologists and cognitive scientists, in contrast, tend to study how people reason, which cognitive and neural processes are engaged, how cultural factors affect the inferences people draw. The properties of logics which may be used to reason are studied in mathematical logic. The field of automated reasoning studies how reasoning may be modelled computationally. Laywers also study reasoning.

Key Points:

1. Impediments to Problem Solving

Sometimes there can be impediments, or obstacles, in our problem solving. These obstructions can impair our problem solving at anytime, even in our everyday problem solving. Some of these impediments include mental setsor entrenchment, and functional fixedness.

A mental set occurs when we reapply an existing problem solving model that does not work for, or fit, a current problem. This is also called entrenchment, because we may become so entrenched in a strategy that normally works that it becomes difficult for us to realize new solutions to problems. It can be considered an over-usage of analogy. For instance, when we want to stop our car as we are driving so to avoid an accident, we may slam on our breaks. However, using this solution when it is wet and/or snowy may not be the best course of action the car may skid and fishtail. Many people often slam on their breaks to immediately stop the car in slick weather, as they are applying a solution to a problem that normally works. However, the road conditions are not analogous, and so the solution of slamming ones breaks will not work best in such situations.

In another example, perhaps as children, we have learned that the best way to get a lodged, small object out of a hole is to stick a fork or spoon down the shaft to pull the object out. This solution will not work well to say the least for electrical appliances, and in fact this solution can be deadly. Thus, we believe that reapplying solutions or strategies that have worked in the past will save us time and effort, however, there is no guarantee that old solutions will work for new ones. It may be like trying to fit a square peg in a round hole. It may look similar on the surface, but we must use some critical thinking and reasoning in deciding the best plan of action.

Functional fixedness is another type of hindrance to problem solving. In functional fixedness, we become fixated on a normal or common usage or function of an object, such that we cannot envision using it in new ways as part of solving a problem. For instance, we might not know to reshape a wire hanger to get into a locked car. We may not envision a spoon being used as a mirror to see if we have anything stuck in our teeth at an important dinner function. We must be flexible in our thinking and learn to use ideas in novel ways. Otherwise, we may succumb to mental sets and functional fixedness in our problem solving, which can lead to bigger problems!

2. Problem Solving Strategies

There exist several problem solving strategies that may help solve a problem. These strategies, though they dont ensure a correct solution, can help guide our thinking and organization of the problem. They include random search trial and error, hill-climbing, means-ends analysis, analogy, working backward, working forward, and incubation.

Random search involves trial and error processing. The problem solver randomly picks a solution out of many possible solutions to test out. If it doesnt work, he or she moves on to another, and so on. In random search, we have no direction, and so spontaneously try out potential solutions until we find one that works. Random search may take very little time, or a very long time. How long it takes depends on the luck of the draw, so to speak. Because we have no direction and are choosing potential solutions randomly, chance dictates that we may find the correct solution at any time that could be sooner or later. Random searching is not the best strategy, since it can be quite inefficient, but can be used as a last resort, if we have no direction to our solution search.

Hill-climbing involves simply looking forward one step closer to the goal state. One does not have the big picture in mind, but choose steps one at a time which get the problem solver closer to a solution. This does not always work well if all the steps are not thought out beforehand. For instance, one may have a map in front of them, and needs to get from point A to point B as quickly and as directly as possible. Hill-climbing would dictate that the individual simply chooses the shortest and most direct route from A to B. This may be a highway. However, if one is traveling during rush-hour, this would not be the best route to take back-roads which may have more turns but less traffic would take less time. Here, the problem solver would miss the correct solution to the problem, and not get to point B in time. In general, hill-climbing is not a very efficient strategy to use, but works with less complex options.

Means-ends analysis is considered to be a more successful strategy. It involves breaking the problem into subgoals, and working on satisfying those first. One would continue breaking down a task until one could begin solving the problem at that smaller level. For instance, if one had to build a bridge, one would not simply take some steel and extend it across two lands. There are many other problems that need to be satisfied for the bridge to work properly. One might break down the larger task of building a bridge into 1 finding the proper material that is strong enough, 2 figuring out the length and the width that the bridge should be, 3 estimating how much weight the bridge can withstand, and so on. One would work to solve each of these smaller problems in an attempt to combat the larger one. Once each of the smaller tasks is satisfied, then the problem as a whole would be considered solved. The means-ends strategy is much more efficient, and one can measure how many steps it takes someone to arrive at a solution.

Analogy is used when we reapply a strategy that has worked in the past. Sometimes we become entrenched in over-applying old strategies mental sets. However, solving by analogy can save us time and effort if we are good at mapping an old solution onto a new one. Working by analogy involves transfer: the carrying over of knowledge or skills from one problem to another. In analogy, one hopes for positive transfer where the application of an old solution facilitates the solving of a new one. However, mental sets and functional fixedness can occur where negative transfer is observed where an earlier problem solving skill impedes later problem solving. So how do we know if an analogy is going to transfer to a new problem? Experts do it best, and know problem sets in their area of expertise well

enough to be able to detect when analogies can be used to save time. Novices have a harder time at realizing analogies, but, analogy can be an efficient tool if used properly.

Working forwards and working backwards are also two strategies that differ among experts and novices. A forward search involves searching from an initial state to a goal state, whereas a backward search involves moving from the goal state to the initial state. Experts have an easier time moving forward because they are familiar with the problem set and know what steps must be involved to get them to the goal state best. Novices, who do not know where to start, begin from the goal and move backwards to discover what steps may get them there similar to means-ends analysis. The choice of working forwards or backwards, then, depends on ones knowledge base, and if one knows what steps are most likely involved in getting from the initial state to the goal state, forward search would work best.

Incubation is a strategy used when we find ourselves against a mental roadblock in our problem solving. We may have become entrenched, or fixated, and are having difficulty looking at the problem from a new perspective. So, one solution would be to step aside and let the problem incubate for a while. Incubation refers to putting the problem temporarily aside without conscious contemplation. It is believed that during incubation, we may be unconsciously attacking the problem. This would help facilitate a solution assuming that unconscious processing is not bound by conscious constraints such as mental sets, functional fixedness, or negative transfer. The break may provide an opportunity for any false assumptions to dissipate. Then, returning to the problem with a fresh state of mind might free us from our obstacles. It is not completely understood if and how incubation works, but many studies have shown it to be a beneficial problem solving strategy especially if one is already suffering from problem solving fixations.

3. Insight of the problem solving

Insight is often described as a magical Aha experience that can take place during problem solving. During insight, a solution appears suddenly in a flash of understanding. Insight may involve breaking away from existing associations to view the problem in a completely new and different light. Perhaps similar to incubation, insight is not something we command. Some argue that insight, as incubation, occurs unconsciously. The problem with defining insight experiences is that those who claim to have used insight in problem solving cannot detail their problem solving steps because the solution simply appears to them.

Some researchers have shown that perhaps primates are capable of insight. It has been proven that many animals can form concepts. In one report, a chimp formed an insight to obtain a piece of fruit. The fruit, along with a long stick was out of reach from the chimps cage. A shorter stick was within reach, although too short to push the fruit toward him, but close enough to touch the longer stick. After some trial and error, the chimp all of a sudden figured to use the short stick to obtain the longer stick, which could then be used to obtain the fruit. Kohler claimed this to be insight, showing there was more to animal cognition than just conditioning.

But, are these examples truly insight? Insight, thus, is a controversial topic because we cant seem to define it especially if a solution comes to us unconsciously. Solutions may appear to us without any deliberation. When they do, it is called insight.

4. Probability and Problem Solving

It is interesting that during problem solving, adults often have trouble using probability to discover a correct solution. Most adults are familiar with how to use probabilities, yet do not take advantage of this information while problem solving. For instance, consider the following problem: Miles is a short, quiet man who wears glasses. He has a small frame and a kind demeanor. Is Miles more likely to be a librarian or a truck driver? Many will answer that Miles is more likely to be a librarian, even though statistically, there are more employed truck drivers than librarians which may or may not be a known fact. Thus, we tend to rely on our schemas ideas and concepts about how the world works and stereotypes classification characteristics of members of a group to problem solve.

Another example involves a coin toss. If a coin is tossed ten times, and already nine out of the ten flips it has landed on tails, what is the probability that the tenth flip will land on heads? Many will report a very high percentage above 50%, given that the coin only has two sides and it has already landed on one side so frequently. However, the correct response is 50%. The coin has no memory, and regardless of how many times it is flipped, it has a 50/50 chance of being heads or tails each time.

Gamblers make the same mistake. If a slot machine has not won in a while or if a number or color has not been called in a while, it is due. Many believe that chances of occurrence will even out over time, which is true, however how long that evening out takes is usually a lot

longer than the individual has standing there at a table or slot machine. This is known as the gamblers fallacy. In general, the gamblers fallacy includes the belief that an event is more likely to occur because it has not happened for a long period of time the coin toss example, or an event is less likely to occur because it has not happened for a long period of time this slot machine hasnt hit in a long time; its never going to. Also, we may think that an event is more likely to occur because it recently happened a slot machine keeps hitting and we rush over to get in on it! or some believe that an event is less likely to occur because it recently happened the slot machine just hit, so it is not due for another hit in a while. All of these assumptions are wrong and contradictory, yet can be rationalized to ourselves in our heads. Our logic and reasoning is flawed. Thus, we do not make use of proper statistics and probability, and rely on schemas or gut intuitions.

In Section 5 of this course you will cover these topics:

- Motor Cognition And Mental Simulation
- Language

Topic : Motor Cognition And Mental Simulation

Topic Objective:

At the end of this topic students will be able to:

- Describe mental rotation.
- Define simulation theory or the theory of mind
- Understand the effect of apparent motion.
- Understand the nature of motor cognition
- Understand the biological motion
- Understand the mirror neurons
- Understand the apraxia

Definition/Overview:

Motor Cognition: The concept of motor cognition grasps the notion that cognition is embodied in action, and that the motor system participates in what is classically considered as high-level mental processing, including those involved in social interaction. The fundamental

unit of this paradigm is action, defined as the movements produced to satisfy an intention towards a specific goal, or in reaction to a meaningful event in the physical and social environments. Motor cognition takes into account the preparation and production of actions, as well as the processes involved in recognizing, predicting, mimicking and understanding the behavior of other people. This paradigm has received quite a lot of theoretical attention as well as empirical support in recents years from a variety of research domains including developemental psychology, cognitive neuroscience, and social psychology.

Mental Simulation: Mental Simulation is the imitation of some real thing, state of affairs, or process. The act of simulating something generally entails representing certain key characteristics or behaviours of a selected physical or abstract system.

However, the connection between simulation and dissembling later faded out and is now only of linguistic interest. Simulation is used in many contexts, including the modeling of natural systems or human systems in order to gain insight into their functioning. Other contexts include simulation of technology for performance optimization, safety engineering, testing, training and education. Simulation can be used to show the eventual real effects of alternative conditions and courses of action.

Key Points:

1. Mental Rotation

Mental rotation involves the ability to mentally image objects rotating in space. The research has shown that mental rotation does involve motor cognition depending on strategy used. Their work also provided many other interesting experimental findings.

The common mental rotation task MRT involves making a same/different or matching decision between objects that are rotated at different angles. For instance, one object may be presented in its normal, upright position, and another object that looks similar to the first, but rotated at a different angle. Ones task would be to decide if the two objects are in fact the same. The common strategy used to solve this problem involves mental rotation; rotating the second object to match the orientation of the first in order to determine if the two are the same. It has been shown that the greater the disparity of the angle between the first and second object that need to be matched one of the objects needs to be rotated in order to fit or

match the other, the longer it takes participants to decide. That is, reaction time increases with the angle of rotation required to make a decision. So, for instance, if an object had to be rotated 35 degrees into congruence, this would take a participant less time to make a match than if the object had to be rotated 85 degrees. This finding would be similar to time required for actual manual physical rotation.

Mental rotation can involve rotating in the depth plane or the picture plane. More difficult versions of the MRT involve simultaneous rotations in both. Other variations on the classic MRT involve two-dimensional figures, so to be used with younger child populations. Objects may include common everyday objects gingerbread men, hands, stick figures or more abstract objects cubes, other geometric shapes.

Research on mental rotation has also shown large and robust gender differences in MRT performance favoring males. Several reasons for this difference have been postulated, including the fact that males have more spatial experiences which would incline them to do better on tests of mental rotation. Performance on the MRT has also been linked to videogame playing, which studies show males to participate in more than females. Regardless of the initial gender difference in performance, studies have shown that both men and women can improve their mental rotation with appropriate training. This is an important skill that we not only used on MRT assessments or videogames, but everyday navigation through our environment.

2. Stimulation Theory or the Theory of Mind

"Theory of mind" is the ability to attribute mental states beliefs, intents, desires, pretending, knowledge, etc. to oneself and others and to understand that others have beliefs, desires and intentions that are different from one's own.

'Theory of Mind' is different from 'Philosophy of Mind', although there are philosophical approaches to issues raised in discussions of Theory of Mind.

Stimulation Theory is the ability to attribute mental states beliefs, intents, desires, pretending, knowledge, etc. to oneself and others. As originally defined, it enables one to understand that mental states can be the cause of and thus be used to explain and predict others behavior. Being able to attribute mental states to others and understanding them as causes of behavior

means, in part, that one must be able to conceive of the mind as a generator of representations and to understand that others mental representations of the world do not necessarily reflect reality and can be different from ones own. It also means one must be able to maintain, simultaneously, different representations of the world. It is a theory of mind in that such representations are not "directly observable". Many other human abilities from skillful social interaction to language use are said to involve a theory of mind.

Beyond the basic definition of ToM, there is considerable debate as to precisely what other kinds of abilities and understandings constitute a theory of mind, when these abilities develop, and who can be said to have a theory of mind. How one defines the basic mental states that underlie ToM structures the possibilities and limits of the field. Inherent in ToM is the understanding that others are intentional agents, that is, individuals whose behavior is goal- or perception-driven and so debate about ToM has also reignited previous arguments on the nature of intentionality. In addition, efforts at defining the "mind" generally understood as the totality of ones conscious thoughts and perceptions are relevant to the discussion of ToM. Although these debates are important, they do not inhibit the ToM research and progress in the fields of philosophy, psychology, and neuroscience. In fact, empirical research often sheds light back on the nature of these concepts.

Research on theory of mind in a number of different populations (human and animal, adults and children, normally- and atypically-developing) has grown rapidly in the almost 30 years since Premack and Woodruff's paper "Does the chimpanzee have a theory of mind?", as have the theories of theory of mind. The emerging field of neuroscience has also begun to address this debate, through brain imaging of subjects who fail ToM tests and through exploration of the potential neural basis of the abilities that underlie ToM, in particular, so-called "mirror neurons" (see final section).

Theory of mind appears to be an innate potential ability in humans (and, some argue, in certain other species), but one requiring social and other experience over many years to bring successfully to adult fruition. It is probably a continuum, in the sense that different people may develop more, or less, effective theories of mind, varying from very complete and accurate ones, through to minimally functional. It is often implied or assumed (but not stated explicitly) that this does not merely signify conceptual understanding "other people have minds and think," but also some kind of understanding and working model that these thoughts and states and emotions are real and genuine for these people and not just

ungrounded names for parroted concepts. Empathy is a related concept, meaning experientially recognizing and understanding the states of mind, including beliefs, desires and particularly emotions of others without injecting your own, often characterized as the ability to "put oneself into another's shoes."

3. Apparent motion

Apparent motion occurs when a stimulus is flashed in one location followed by another identical stimulus flashed in another location. It refers to both the phi phenomenon, an illusion of movement created when two or more adjacent lights blink on and off in succession, and stroboscopic motion, the movement seen in movies and television, wherein a series of quickly flashed stills creates an illusion of movement. It is also sometimes referred to as illusory motion. The term is also sometimes used in astronomy to refer to an effect which appears to cause the position of a celestial object to move (for more details see improper motion).

4. Apraxia

Apraxia is a neurological disorder which involves the loss of the ability to execute or carry out skilled movements and gestures, despite having the motivation and capability to perform them. Apraxia results from dysfunction of the cerebral hemispheres of the brain especially the left hemisphere and often the parietal lobe. Several neurological diseases and/or types of damage to the brain can result in apraxia.

There are also several different types of apraxia. Many involve the inability to express facial movements, the inability to make fine motor responses, the inability to coordinate activities with multiple, sequential movements, as well as difficulty coordinating mouth and speech movements, which may also result in the language disorder called aphasia.

In relation to motor cognition and imitation, people with apraxia often exhibit difficulty with imitation. What is interesting is that apraxic patients may be able to imitate meaningful gestures for instance, shaking hands but are unable to imitate meaningless gestures for instance, a dance move. This dissociation gives rise to the theory that the imitation of motion is perhaps separated into two different paths; one for meaningful action, and another for meaningless action. The meaningful route may be linked to memory for, and familiarity of,

certain actions. The other route may be more direct; linking perception to action immediately as it occurs without tapping into the memory.

Distinction should also be made between the means of imitation and the goal of imitation. Research has shown that, in the case of apraxia, priority should be given to more distal aspects of imitation involving a goal state rather than the means used to achieve the goal of a modelled action. This means that the completion of a goal state using imitative action may be more impaired in apraxia than individual means or process finer, integrated movements used to get there. However, if the movement or goal state is already part of an apraxics repertoire, than the imitation of that movement may be left in tact.

5. Mirror Neurons

According to recent research with monkeys Rizzolatti et al., 1996, there exist specialized cells in the ventral premotor cortex that are involved in the observation of others imitating our behaviors. Apparently, mirror neuronsfire when monkeys perform an action and also when they observe a human performing the same or similar action.

Mirror neurons are specialized, such that each cell only fires to a particular type of action such as a grasping motor neuron, or a placing motor neuron. The object itself makes no difference: it is the action that matters.

Because mirror neurons fire the same for our own actions and the same actions of others, it may be the mirror neurons role to help us understandthe actions of others. It may help us to prepare action in ourselves. It may help us, especially as young infants, to imitate the behaviors of others, and thus help facilitate development.

Studies have also provided evidence for audiovisual mirror neurons, for actions that produce sound. Again, in monkeys, these mirror neurons fire when a monkey performs an action, but also when it hears a sound closely associated with that action. For example, an audiovisual mirror neuron may fire when a monkey smashes a glass jar on the ground, when a human smashes a glass jar on the ground, or when the monkey hears the smashing of the glass jar on the ground by itself. Firing for these mirror neurons is strongest when the visual accompanies the audio together for a specific action.

Mirror neurons are not the only neurobiology that supports the empathy of the motor system. Similar studies with humans show excitation of the motor system when observing others engage in an action, such that the muscles that would be used to perform that action are activated. There is also evidence that the sensorimotor and motor cortex areas light up during observation of others performing actions. No such activation is found for observing still-shots of action. This converging evidence shows that the performance of action and the observation of action may involve processing in similar parts of the brain.

6. Biological Motion

Biological motion refers to the perception of motion that is executed by a living body; whether actually performed or inferred apparent motion. All living creatures, whether human or animal, produce unique and characteristic kinematic patterns of motion, which are different from inanimate forms of motion. The perception of biological motion involves the ability to perceive motion of both self and others, which can be considered an antecedent to survival; through evolution, the perception of a living thing moving towards or away from us may have meant life or death.

Research on biological motion truly took shape with the development of point-light displays as a technique in reproducing either biological or non-biological motion. In point-light displays, small lights are attached to joints of moving human bodies amidst a dark background. These point-light displays would resemble human motion through a kinematic pattern; that is, the lights attached conformed to key movements of joints during real motion. People who view kinematic patterns through point-light displays can readily identify many common human motions, including walking, running, and even humans performing jumping jacks! When remaining still, the representation of light is meaningless, as is random movement of the point-lights, but when put into biological motion, we can infer action.

Humans are very adept at perceiving biological motion. In point-light displays, we can infer different categories of action social actions, such as greeting, versus instrumental actions, such as hammering. Individuals can even recognize the sex of actors in point-lights displays based on the characteristics of their movement, and can distinguish between recordings of self action filmed earlier as point-light actors versus other-action other point-light actors. We are very sensitive to even the smallest idiosyncratic movement in perceiving biological motion.

The fact that infants as young as 3 months can discriminate between, and prefer looking, at displays of biological motion in comparison to inanimate motion using point-light displays. Thus, the ability to perceive biological motion is not reliant on experience. Even individuals who were born without limbs judge biological motion similar to participants with limbs. For instance, on tests of mental rotation using pictures of bodily limbs, reaction times were similar between both samples, such that the greater rotation required to match two pictures of limbs into congruence, the greater the reaction time required see Mental Rotation Lecture Lead above for more information on mental rotation. Again, perhaps this ability to perceive biological motion arrives hardwired through evolution.

The perception of biological motion may take place in distinct areas of the brain. Double-dissociation cases, where individuals had no other deficits besides the disrupted perception of biological motion and other individuals had almost all other types of perception impaired with biological motion perception left in tact. The parieto-occipital region appears to be a key area, given that other disorders, such as periventricular leukomalacia PVL, which involve damage to the parieto-occipital region, are associated with impairments in the perception of biological motion. Other regions have also been associated with the perception of biological motion. In fact, separate areas have been dissociated for the perception of animals versus humans Martineau & Cochin, 2003.

The differences between perceiving human motion and other animal, object motion may reflect the fact that there is direct involvement of the motor system for human motion, but not other types of motion. Likewise, our perception of biological motion comes with the tacit knowledge of possible can be made by the human body and impossible cannot be made by the human body movements. The motor cortex is only activated during the perception of possible motion. Again, we may perceive the actions of others in relation to our own motor systems.

7. The Nature of Motor Cognition

Humans have a tendency to interpret the actions of others with respect to underlying mental states. One important question is whether the perception-action matching mechanism and its product, shared motor representations, can account (or to what extent it does) for the attribution of mental states to others (often dubbed theory of mind mechanism). Some authors have suggested that the shared representations network that stems from the perception-action

matching mechanism may support mental state attribution via covert (i.e., non conscious) mental simulation. In contrast, some other scholars have argued that the mirror system and the theory of mind system are two distinct processes and its likely that the former cannot account for mental state understanding.

Topic : Language

Topic Objective:

At the end of this topic students will be able to:

- Describe the model of the lexicon.
- Understand the development of language
- Understand the aphasia and language
- Understand the language production errors
- Understand the bilingualism

Definition/Overview:

Language: A language is a dynamic set of visual, auditory, or tactile symbols of communication and the elements used to manipulate them. Language can also refer to the use of such systems as a general phenomenon. Language is considered to be an exclusively human mode of communication; although other animals make use of quite sophisticated communicative systems, none of these are known to make use of all of the properties that linguists use to define language.

In Western Philosophy, language has long been closely associated with reason, which is also a uniquely human way of using symbols. (In Ancient Greek philosophical terminology, the same word, logos, was used for both language and reason.) Language refers only to expressions of reason which can be understood by other people, most obviously by speaking.

Key Points:

1. Model of the lexicon

In linguistics, the lexicon (from GreekΛεξικόν) of a language is its vocabulary, including its words and expressions. More formally, it is a language's inventory of lexemes.

The lexicon includes the lexemes used to actualize words. Lexemes are formed according to morpho-syntactic rules and express sememes. In this sense, a lexicon organizes the mental vocabulary in a speaker's mind: First, it organizes the vocabulary of a language according to certain principles (for instance, all verbs of motion may be linked in a lexical network) and second, it contains a generative device producing (new) simple and complex words according to certain lexical rules. For example, the suffix '-able' can be added to transitive verbs only, so that we get 'read-able' but not 'cry-able'.

Usually a lexicon is a container for words belonging to the same language. Some exceptions may be encountered for languages that are variants, like for instance Brazilian Portuguese compared to the Portuguese language, where a lot of words are common and where the differences may be marked word by word.

When linguists study the lexicon, they study such things as what words are, how the vocabulary in a language is structured, how people use and store words, how they learn words, the history and evolution of words (i.e. etymology), types of relationships between words as well as how words were created.

2. Bilingualism

Being bilingual involves the ability to speak two different languages. Though being bilingual can be experienced on many different levels, fluent bilinguals can comprehend and speak two distinct languages well enough to communicate effectively. There are several different types of bilingualism: additive bilingualism, subtractive bilingualism, simultaneous bilingualism, and sequential bilingualism.

Additive bilingualism refers to the addition of a second language after a first has already been completely established. It becomes secondary. For instance, if one speaks English, and then Spanish is then acquired in the third grade, it would be considered additive bilingualism. In subtractive bilingualism, the second language replaces the first. For instance, if one originally spoke English, but moved to a foreign country where English is not spoken, but another, different language is spoken, that second language may have to replace the first.

Another type of bilingualism is called simultaneous bilingualism. This reflects the learning of two different languages at the same time. These two languages are both learned and spoken

beginning at birth. A child learns no preference for one or the other since both are most likely spoken in the home.

Finally, sequential bilingualism occurs when an individual learns one language followed by another. The individual usually sets precedence, and preference for the language learned first. Thus, the learning is sequential serial.

The ease of facilitation or learning of a second language is affected by many factors. In general, the earlier a second language is learned, the better. This is related to the fact that infants and young children have the ability to produce more variation and differentiation between phonemes than adults. Also, the more similar the two languages are in grammar and phonetic pronunciation, the easier the coexistence of the two languages will be. Depending when and how the two languages are learned simultaneously, sequentially, etc. will also determine the ease of usage and comprehension. Subtractive bilingualism is probably the most difficult type of bilingualism to facilitate. Proactive interference, or intrusions from the original language, may often be witnessed. Complete replacement of the first language will be related to the developmental stage the individual is in when subtractive bilingualism begins. Again, the general rule is that the earlier in development the second language is learned, the easier any form of bilingualism will be.

3. Language Production Errors

Regardless of our intentions in communication, it is common to produce errors in language. These linguistic errors can be considered slips of the tongue and can occur at any level phonetic to discourse level. Several types of language production errors have been documented, including anticipation, perseveration, reversal, substitution, insertion, deletion, malapropism, andparapraxia Freudian Slip.

In the error of anticipation, an individual uses a language element before it is appropriate although it should emerge later in the production. For instance, a speaker might say, redding ring instead of wedding ring, in anticipation of the r in the second word ring.

In perseveration, an individual continues to use a language element that was used earlier when it is no longer appropriate. For instance, a speaker might say, wedding wing instead of wedding ring, in perseveration of the w in the first word wedding.

During reversal, an individual switches order of language elements somewhere throughout the production. For instance, an individual might say, flutterby instead of butterfly in a reversal of the f and the b letters.

The substitution error involves an individual replacing a language element with another that is inappropriate and only remotely related to the utterance. For example, a speaker might say, after its too late instead of before its too late. Here, the speaker incorrectly produces, or misunderstands, the usage of these elements to get his or her point across although the general meaning is there.

During insertion errors, language elements are incorrectly added to the production. For instance, little children often add syllables into words. In the example, drownded, the letter d is added to the word drowned. In the converse, during deletion, language elements are missing. In the example, sketti, little children may delete the syllables out of spaghetti.

Finally, malapropisms occur when intended words, during production, are replaced by other words that are similar in sound, but not in meaning. For instance, a speaker might say, pigment of my imagination instead of figment of my imagination. Freudian slips, as known as parapraxia, are similar in that individuals may utter similar words to what one wants to produce that are not intended. These slips of the tongue can sound similar, rhyme, or somehow otherwise be connected to the intended word/s. The intrusions are thought to reflect unconscious desires or wishes as first postulated by Sigmund Freud. For example, a man who is on vacation might send his wife a postcard that reads, Wish you were her, instead of Wish you were here, which may reflect his desire to cheat on his wife while away from home. Freudian slips can manifest within any language element, but usually at the word, syntactic, or discourse level.

4. Aphasia and Language

There are several different types of aphasia; a language or speech impairment often due to brain damage. Aphasia can reflect disruptions in language production, as in Brocas aphasia, or language comprehension, as in Wernickes aphasia.

Named after the French physician who founded the area in the left portion of the frontal lobe in the brain, Brocas aphasia involves difficulty producing grammatical language.

Specifically, individuals with Brocas aphasia cannot produce complex sentences, but can convey meaning through telegraphic speech usually devoid of conjunctions and proper syntax, and missing function morphemes. They know the meaning of words, but have trouble combining the relationships among words in sentences. Individuals with Brocas aphasia can comprehend speech to varying degrees, however. Thus, Brocas aphasia is also known as non-fluent aphasia due to the disruption in normal production. Because Brocas patients can comprehend speech and can derive meaning from language, their production deficits can be quite frustrating for them.

Also named after the neurologist/psychiatrist who founded the resulting deficit, Wernickes aphasia results from left temporal lobe damage. It involves primarily a comprehension deficit although some production deficits are also manifested. Because many Wernickes pateinets can speak, this type of aphasia is also known as fluent aphasia. Individuals with Wernickes aphasia have difficulty comprehending the meaning of speech cannot derive semantic content from what is spoken to them. They produce fairly grammatical speech, but their language production often lacks semantic content morphemes, or meaning-based words. Because Wernickes patients have tremendous difficulty comprehending the meaning behind language, they are usually unaware of their comprehension and production errors.

In summary, Wernickes aphasia derives from missing semantic content, while Brocas aphasia is missing syntax. The double-dissociation of language production and comprehension, though not ensuring mutual exclusivity of the two, provides evidence for separate language processing centers in the brain. Both areas work together to facilitate proper communication. Damage to both areas can result in vast language impairment. Another type of aphasia known as global aphasia involves damage to multiple portions of the brains language centers often left, frontal and temporal lobes, and thus may result in both Brocas and Wernickes-type symptoms. Both production and comprehension are often impaired, and the individual experiences severe communication deficits.

5. Development of Language

Although there are many different languages around the world, there appears to be universal developmental stages of language acquisition. Although we know environment shapes and modifies language, babies tend to acquire language at the same developmental milestones.

Babies demonstrate the ability to learn and comprehend language at a very young age. Even during prenatal development, babies respond characteristically to human voices. Babies, at birth, can produce all possible phonemes of the human language and thus, all babies, regardless of native tongue, sound alike in their language production during the first few months of development. They are cooing language production comprised of vowel sounds during their first few months.

Then, at about six month of age, babies begin babbling, which is characterized by consonant vowel phoneme repetition for example, Ba Ba, or Ga Ga. As babies begin to tie meaning to their utterances, their language production becomes more selective and they begin to use their own native language to communicate desires and wishes. By six months babies also reliably respond to their own name.

At about one year of age, babies utter their first word content morpheme. This first word is usually a noun person, place, or thing. It is usually a simple word with few syllables such as Up. Then, at about two years of age, babies begin combining these words into two-word utterances, known as telegraphic speech. Telegraphic speech is characterized by two content morphemes. The two-word utterance is communicated in order to convey meaning but is missing function morphemes and grammatical structure. However, babies may soon learn to become efficient at syntax, and better at ordering the two words for example, Me cookie, not Cookie me. At the same time, babies at this age often exhibit overextension errors, where they over-apply their limited vocabulary to inappropriate objects or places. For instance, a young child may repeat doggie for all furry animals he or she comes in contact with because doggie may be the only content morpheme in his or her vocabulary, at present, to describe a furry animal.

Between three and four years of age, young children are producing rudimentary sentences, which in the English language often contain noun-verb-noun syntactical structure. Their vocabularies are growing exponentially often tripling from 300 words at two years to over 1,000 words at 3 years of age. However, young children at this age often exhibit overregularization errors. Overregularization errors are characterized by the over-application of grammatical rules to common words. For instance, a young child might say, I goed instead of I went, overusing the ed function morpheme to express have done. At about three years of age, young children are also using many common pronouns correctly I, you, and me. Reading

ability may begin during this time, but usually does not become reliable until the school-aged years.

After four years of age, children have many of the basic grammatical structures in place for mature language and sentence structure although they learn much more about the rules of grammar once attending formal education/school. Vocabulary continues to increase and language systems become increasingly sophisticated. At five years, children begin to regularly use adjectives and adverbs and language production includes fairly long sentences and should include some compound and some complex sentences. Speech on the whole should be grammatically correct and reading ability should begin to become established.

At eight years, complex and compound sentences are used effortlessly. All speech sounds, including consonant blends are well-established and children should be reading with considerable ease and writing simple compositions. By the age of ten years, childrens language barring more advanced vocabulary is essentially the same as adults. Children can carry on conversation at a rather mature level and begin to explore the more complex facets of language.