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M.A. I SEM

HIGHER MENTAL PROCESSES

- Brief and Intensive Notes
- Long & Short Answers

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M.A. Semester I Subject: Psychology	
Course Code: A090701T	**Course Title: Higher Mental Processes**
UNIT I	Language Comprehension, Spoken Language: Speech Perception, Constituent Structure, Transformational Grammar, Reading: Perceptual Processes and Theories of Word Recognition; Discovering meaning. Interface in Reading.
UNIT II	Language Production; Speaking in Context; Speech Error; Gestures and Context; Writing: Comparison between Speaking and Writing; Cognitive Tasks involved in Writing; Bilingualism: Advantages and disadvantages.
UNIT III	Problem Solving: Understanding Problem Solving Approaches and Factors Influencing Problem Solving.
UNIT IV	Creativity: Nature and Measurement; Factors affecting Creativity.
UNIT V	Logical Reasoning Conditioning and Syllogism, Decision Making: Representativeness and Availability Heuristics, Anchoring and Adjustment; The Framing Effect and Overconfidence in Decisions.

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UNIT I

UNIT I	Language Comprehension, Spoken Language: Speech Perception, Constituent Structure, Transformational Grammar, Reading: Perceptual Processes and Theories of Word Recognition; Discovering meaning. Interface in Reading.

The English word “language” is derived from Proto-Indo-European *dn̥ǵʰwéh₂s "tongue, speech, language" through Latin lingua, "language; tongue", and Old French language. Language can be understood is a system of symbols and rules that enable us to communicate with others. Language comprehension is the process of understanding language by applying stored knowledge to interpret new information. Language comprehension involves two key processes: speech perception and reading.

Language has great importance in human life. Its development is connected with human development. It cannot be separated from our life. Human civilization is based on language, and language is a suitable medium of communication. No other medium is as suitable for communication as language. Culture and language have developed due to communication. Language has been the traditional medium of communication between social individuals.

Each language has its own dictionary. It has its own grammatical structure. Words have their own meanings and each group of letters has a different pronunciation. When a child is expected to learn two languages simultaneously, then he will have to memorize two names of each object and two expression words. When proficiency is achieved in two grammatical formats, then learning the second language becomes easy. Sometimes conflict and opposition is found in grammar, pronunciation and word association, due to which there is a possibility of confusion. To determine bilingual effectiveness or harmony, attention is paid to the speed and correctness of the use of languages. A person's knowledge of different languages indicates his linguistic background.

The first step of language comprehension is language perception in which sounds are translated into speech units. When we perceive speech, we supplement missing sounds and determine boundaries between words according to the context. As listeners, we process language in the form of groups of words called constituents. We listen to language at the surface structure and determine the underlying deep structure of sentences. There is difficulty in understanding those sentences if they use negative or passive voice or contain ambiguities. Similarly, in the reading process of material, perceptual processes such as eye movement, letter recognition and word recognition etc. are found. Context is needed when we have to understand the meaning of an unfamiliar word. When we read, we often make assumptions that are not in the written passage. Unfortunately, people are not necessarily perfect in their meta-comprehension.

If the language suddenly becomes illegal, we neither read it, nor speak it nor write it. We cannot even imagine such words in our memory. If we do not know the language, we can neither describe the disastrous events of our life nor tell which movie we saw two weeks ago. Neither can we understand what the teacher says in the class. We can neither read a book nor do social interaction. As a result, the life of the person will become lonely and the person will experience transformation because the person will be deprived of television, radio, books, newspapers etc.

To understand language, we have to pay attention to the psychological aspect of language,

which is called psycholinguistics. Under psycholinguistics, we see how a person learns and how he uses language to communicate ideas (Taylor & Taylor, 1990). Language can be taken as an important source which is interrelated with cognitive processes. Echoic memory and short-term memory of language provide us an opportunity to store the stimulus so that we can process and interpret the stimulus. Long-term memory provides continuity between previously processed material and perceived material. Thus, it can be said that memory is an important component of language. Though the process of language acquisition is complex, we use language with some difficulty (Singer, 1990) and use language efficiently and accurately in an effective manner. We do not merely listen to language passively but we actively consult previous knowledge, use different strategies, make assumptions, and draw conclusions. When we speak, we are certain about what our listeners know and what message we are giving them. Language is not only our most important cognitive development but also an important aspect of our cognitive processes.

Understanding Spoken Language

The process of understanding language is called language comprehension which involves the use of previously stored knowledge to interpret new input. When we hear a sound, we try to understand its meaning, we use our stored knowledge about sounds, words and the world. We go beyond the limits of the information we receive and interpret metaphors and schemas (Glucksberg. 1989). In this section we will study speech perception, constituent structure, transformational grammar and factors affecting language comprehension.

Speech Perception

Speech perception focuses on the sounds of language. When we try to understand spoken language, we analyze the sounds of speech. In speech perception, the listener's auditory system translates sound vibrations into a string of sounds, which the listener perceives as speech. Speech perception is a very complex phenomenon and the work of many researchers is important (Coren et. al., 1994; Matlin & Foley, 1992; Handel, 1989). When we do not pay attention to speech perception, the nature of speech perception does not seem to be complex. We usually pay attention to what the speaker is saying rather than the vehicle he or she uses to present the information (Darwin, 1976). Similarly, when we listen to an announcer on the radio, we do not pay attention to the meaning of his or her words but to the sound presented. Similarly, when we are tuning our radio and hear a foreign language that we do not understand, we focus on the sound presented with the speech. When we listen to sound sequences, the vocal tract remains open for vowels like 'a' and 'e', closes for some consonants but quickly reopens for sounds like 'b' and 'k'. Similarly, the vocal cords perform other types of contortions from the sounds produced by receiving 'f' and 'r'. There are four important facts in the context of speech perception, which are described below-

1. Parallel Transmission

When we read letters in a sentence, one letter follows another letter in the same way as the beads of a rosary follow each other. But this is not true in the context of phonemes. Phoneme is pronounced as "foe-neem" which is considered as the basic unit of spoken language e.g. 'a', 'k' and 'th'. The sound of a phoneme does not follow the sound before it. (Jusczyk, 1986; Luce & Piconi, 1987). Instead of transmitting a phoneme one at a time, many sounds are transmitted at the same time. The phenomenon when overlapping is found in the spoken phonemes is called parallel transmission. For example, if we present the English word 'bin' to the subject, the sound of the first consonant 'b' affects the other letters as well and the sound of 'a' is affected. The

effect of vowel 'a' is transmitted to the entire word i.e. 'b' and 'n'. The sound of consonant 'n' starts from 'i' itself. Hence, the sound of '.' is also affected. Thus, the sound of every phoneme is modified by the surrounding phonemes.

Due to parallel transmission, speech sounds flow together. This means that a small part of speech does not contain complete information about the phoneme because that information is spread in many parts. Moreover, the sound of a phoneme may change due to the phoneme preceding and following it. Phonemes do not have a single and stable pronunciation. For example, on presenting the conjunct a d, the sound produced a di will be different from the other conjunct a du.
In this way, we can say that there is no stability in the sound of phoneme.

2. Context and Speech Perception

People are active listeners because they do not listen passively to speech sounds but they use contexts as cues to identify sounds or words. Warren et. al. (1970) have shown in a number of experiments that people show phonemic restoration. They use context as cues to replace missing sounds. Warren (1970) played a sentence on a record player. "The state governors met with their legi latures convening in the capital city." In this sentence, the first 5 to 12 syllables of the word legislature were replaced by a simple short cough. 19 out of 20 subjects reported that no syllables were lost in the presented sentence.
In our daily life, we often hear such phonemes which are masked by external sounds. In such a situation, we have to reconstruct the missing sounds. When we are listening to the teacher's speech in the class, many times many types of distracting sounds such as the teacher keeping a book on the table, someone coughing, turning pages, whispering, etc. have an obstructing effect, yet we write down the appropriate word.

Warren & Warren (1970) have shown that people understand the meaning of a sentence by combining appropriate words from a number of alternatives. They presented four sentences to their subjects:

It was found that the *eel was on the axel.
It was found that the *eel was on the shoe.
It was found that the *eel was on the orange.
It was found that the *eel was on the table.

These four sentences are exactly alike. The only difference is that the last word has been changed. Where the star is shown in the sentence, 'cough' has been added. But the subjects read 'eel' as 'wheel' in the first sentence, 'heel' in the second sentence, 'peel' in the third sentence and 'meal' in the fourth sentence. In this study, the subjects did not use the surrounding sounds to form words, but they reconstructed the words based on the context.

Visual Cues as an aid to Speech Perception

Smyth et. al. (1987) believe that visual cues help in speech perception. Information received from the speaker's lips and face helps in resolving perceived ambiguities in the speech signal in the same way as contextual cues help in differentiating between wheel and peel (Dodd & Compbell, 1986). Thus when two people talk face to face, the conversation is clearer than when talking on the telephone (Massaro, 1989). Even those subjects who have normal hearing sensation are not able to use these visual cues appropriately. The reality is that we use visual cues only in unusual circumstances.

Word Boundaries

When we listen to two people talking in an unfamiliar language, we hear a continuous flow of words with no boundaries to separate them. But in a language we know, we have no difficulty in separating word boundaries. In most circumstances, real acoustic stimuli in spoken language do not show clear pauses in boundary setting (Matlin, 1995). But when we use a physical phenomenon like a pause, we can determine a word boundary less than 40% of the time (Cole & Jakimik, 1980, Flores d'Arcais, 1988)1

Jusczyk (1966) gave an example and proposed that this visual analogy problem, which our auditory system has to solve, becomes more difficult when there are no spaces between words or pauses in the language.

THEREDONATEAKETTLEOFTENCHIPS

This task is difficult in the absence of space or pause between two words and we cannot read this sentence as "There, Don ate kettle of ten chips" or "There, donate a kettle of ten chips" or "The red on a tea kettle often chips." Therefore, children should be taught where the boundary lines are located between words so that the possibility of errors can be reduced. If this is not done, they will often make errors. A female psychologist, Dr. Eleanor Maccoby, while teaching at Stanford University, told her class students that a child thought that toast was called "Jamonit" because his mother used to ask him every morning while giving him toast, "Would you like some jam on it". As a result, the child not only learned the wrong name of toast but was also unable to differentiate between the boundaries of two words. Due to lack of clear knowledge of the boundaries of two words, the tendency of incorrect pronunciation is found in children.

Theories of Speech Perception

Theories of speech perception can be classified mainly into two categories. Some psychologists believe that a special mechanism is required to display one's effective skills in this field, while the other category of psychologists believes that the person's skill definitely has a role in speech perception, but the general mechanisms through which many types of cognitive processes are conducted, only those general mechanisms operate in speech perception.

The special mechanism approach, also called the Motor Theory of Speech Perception, argues that a specialized device is found in human beings by which they decode speech stimuli on the basis of the sound presented by the speaker, i.e. there is a relationship between speech perception and speech production. The major proponents of this approach include Alvin Liberman and Ignatius Mattingly, who argue that the unique speech perception ability of humans resembles the special sound localization abilities of barn-owls and bats (Liberman & Mattingly, 1989; Mattingly & Liberman, 1988).

Liberman & Mattingly have most specifically argued that humans have a phonetic module that has a specific, purposeful neural mechanism. This module facilitates speech perception. The phonetic module enables the listener to segment the blurred stream of auditory information reaching the ear so that he or she can perceive specific phonemes and words. One argument in favor of the phonetic module is that it leads to categorical perception. To represent a range of sounds, we use computers that create a gradual continuum between phonemes, such as distinguishing between b and p. Although these stimuli form a smooth continuum, the

perception of a person listening to this range of sounds is typically categorical.

In contrast, the general mechanism approach argues that we can explain speech perception without any specific phonetic module. Those who support this approach propose that human beings process speech sounds and nonspeech sounds through the same neural mechanisms. Thus, it can be said that speech perception is a kind of learned ability which is a very powerful acquired ability and not an innate ability.

Many studies have supported the general mechanism approach, in favor of which the following strong evidence can be presented:

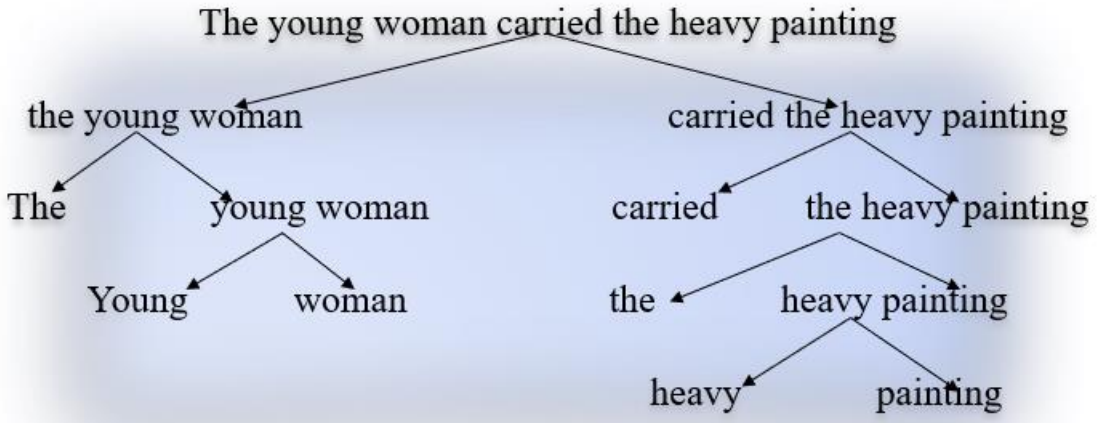
(i) Kuhl (1989), Miller (1990) and Moody et, al. (1990) have demonstrated categorical perception in their studies with impressive nonhuman animals (e.g. Chinchillas, Japanese quail, macaque monkeys) as these nonhuman animals lack human language abilities and do not have special phonetic modalities.

(ii) Humans show categorical perception for complex nonspeech sounds. Thus categorical perception is a general characteristic which is neither restricted to humans nor to speech alone (Jusczyk, 1968).

(iii) One's judgment of phonemes is influenced by visual cues. For example, when we see a person saying ba or da and hear an auditory stimulus, there is similarity in lip movements. Massaro (1987), Massaro & Cohen (1990) are of the opinion that when such sounds reach the ear, the possibility of clear discrimination by the subject is found to be less. Thus it can be said that there is flexibility in speech perception.

Constituent Structure

This is the consensus among psychologists regarding language comprehension. In a sentence, it is in the form of a phrase or a basic unit in which more than one word is found. They are called a small part of a sentence. Broadly, a group of words is called a constituent which can be replaced by only one word without any change in function. For example, if we present the following sentence to the subject -The young woman carried the heavy painting. Then we can break this sentence into two immediate constituents, 'the young woman carried the heavy painting' which are of very detailed and high level. After that, we keep dividing each constituent again till we reach the last constituent. The following picture shows how this sentence has been repeatedly re-divided into its constituents using rewrite rules.



An example of constituents

We will now see how we use **Clark & Clark's replacement rule.** 'The young woman' can be replaced by Susan, Hepzibah or She without changing the rest of the sentence structure. Similarly 'young woman' can be replaced by 'Keniager' or 'student'. But we cannot create a constituent for 'woman carried the' because there is no single word available which can represent the meaning of these words.

Constituents and Understanding

Understanding a sentence requires several processes:

(i) Hearing the speech sound.

(ii) Storing the representation of the speech sound in short-term memory.

(iii) Determining the meaning of the word in semantic memory.

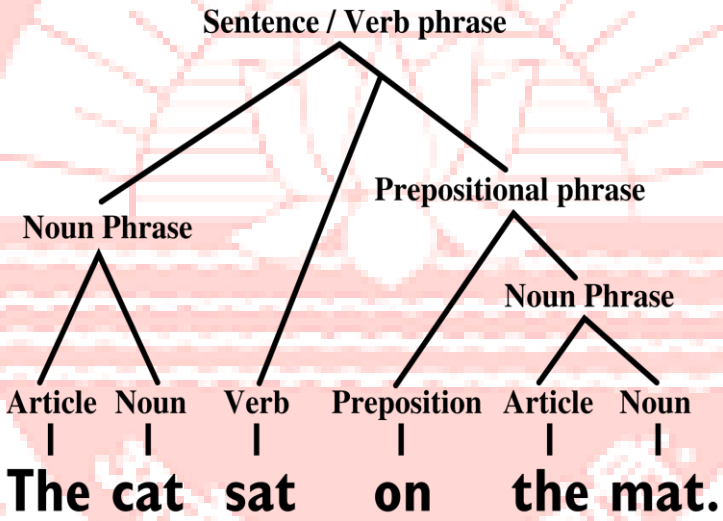
(iv) Organizing the representation of speech sounds into a chain.

(v) Determining the meaning of constituents

(vi) Combine constituents to make sense of a whole sentence.

(vii) Forgets the exact words of constituents and remembers the gist.

Basic constituent structure analysis of a sentence:



The Psychological Reality of Constituent Structure

Martin (1970) concluded that some words have a strong tendency to occur only in the context of a particular word. Only the most strongly associated words occur when that word is presented. Jarvella (1971) used verbatim-word-for-word memory in his study to study the psychological reality of constituent structure and took two passages as material which had similarity in the second and third lines.

For example:

1. The confidence of Kofach was not unfounded.
   So stack the meeting for McDonald.
   The union had even brought in outsiders.
2. Kofach had been persuaded by the international.
   To stack the meeting for McDonald.
   The union had even brought in outsiders.

In their study, they also interrupted the subjects by asking them to repeat the third line after

completion and got the interesting result that recall of the second line 'to stack the meeting for McDonald' was higher for those subjects who had read the first passage. Thus the second line acted as the constituent. In contrast, recall of the second line was the lowest for those subjects who had read the second passage because they had completed the second line as the first constituent.

Strategies for Identifying Constituents Structure

Here we will look at how listeners divide sentences into constituents. Kimbal (1973) proposed that listeners develop different types of constituents. For example, let us consider a constituent that relates to the function of words. Function words are those words (such as prepositions and conjunctions) that are very important to the structure of a grammatical sentence. Kimbal proposed that once a listener has found a function word, they will introduce new constituents. For example, '**Mary said that the boy went to the store'.** When a listener hears this sentence, they will introduce new constituents by hearing the words 'that' and 'to'. Kimbal also proposed another constituent called content word. Kimbal argues that as soon as the function words indicate the beginning of a constituent, the listener starts looking for the content words. Content words are words (such as nouns and verbs) that indicate persons, things and actions. For example, a function word like 'in' alerts the listener to look for a noun. The listener knows that there will be a noun in the sentence, no matter how many words later it is. Clark & Clark (1977) have proposed another type of affix called an affix. 'Affixes' are parts of speech such as 'er', '-y' and '-ly' which indicate that they are parts of speech. Hence, words in '-ev' are nouns, words in '-' are adjectives and words in '-ly' are usually adverbs. Listeners use word parts to identify the word present. Not all these strategies are foolproof. They do not always guarantee a solution and can mislead us. However, these strategies usually allow us to understand the sentence correctly. Hence, such language comprehension strategies are called heuristic methods.

Transformational Grammar

People usually think of a sentence as a line of letters on paper in which words are presented in an ordered sequence. Noam Chomsky (1957, 1965) caused a stir among psychologists by proposing that there is more to a sentence than meets the eye. His research work in the context of language psychology led to the decline of the popularity of behaviorism. Behaviorists have emphasized the observable nature of language behavior. Chomasky, on the other hand, has emphasized that human language abilities can only be explained in terms of a complex system of rules and principles represented in the mind of the speaker. Tratter (1986) and Wascow (1989) believe that Chomsky was the most influential theorist among modern linguistics.

Specifically, Chomsky invented a model of transformational grammar to transform a sentence with underlying deep structure into a sentence with surface structure. Surface structure is represented by the words that are actually spoken or written. Deep structure is represented at the base, in the form of the abstract meaning of a sentence. Chomsky argues that two sentences may differ in surface structure but have similar deep structure, for example:

Sara threw the ball.

The ball was thrown by Sara.

There is a lot of difference in the surface structure of both the sentences. The position of the letters in the first sentence is not the same in the second sentence. Apart from this, 3 such words have been used in the second sentence which were not there in the first sentence.

But the meaning of both the sentences is the same.

Chomsky is of the opinion that sometimes it happens that similarity is found in the surface structure but significant difference is found in the deep structure. For example-

John is easy to please.

John is eager to please.

The difference between the two is of only one word. But there is a lot of difference in their meaning.

Chomsky is of the opinion that identical surface structure (identical deep structure) can be found in the sentences but there can be a lot of difference in their deep structure. Such sentences are called ambiguous sentences.

For example-

The shooting of the hunters was terrible.

They are cooking apples.

The lamb is too hot to eat.

It is worth noting here that rewrite rules are used to generate two different types of constituent structures (They are cooking apples).

Chomsky proposed that people transform surface sentences into basic, deep structure or kernel form to understand sentences. They convert surface structure into deep structure using transformational rules for understanding. In addition, transformational rules are used to convert deep structure into surface structure during speech production or writing.

Chomsky's ideas about transformational grammar led to dozens of studies between the 1960s and 1970s. For example, Mehler (1963) found that subjects accurately recalled kernel sentences (e.g. The biologist has made the discovery) more than other transformations (e.g. Hasn't the discovery been made by the biologists). The second sentence presented was a negative-passive question of the abstract sentence.

Not all the empirical evidence was in favor of Chomsky's theory. For example, a sentence like 'The cookies were smelled by John' should theoretically take less time to process than a sentence like 'The cookies were smelled' because the second sentence required an additional transformation *by removing 'by John'. While Slobin (1960) showed on the basis of his experiment that the second sentence took relatively less time to check.

In general it can be said that psychologists have accepted Chomsky's concept and have recognized the distinction between surface and deep structure. But they have shown less interest in the fact that there is a close correspondence between the number of transformations and psychological complexity (Prideaux, 1985; Tartter, 1986). In addition, Chomsky's most modern theory places less emphasis on transformation than transformational grammar (Chomsky, 1973; 1981; Wasow, 1989).

Factors Affecting Language Comprehension

Research in the field of transitional grammar has led psychologists to study the factors that affect the understanding of sentences. Under this heading, we will see when difficulty in sentence comprehension is found - when the word 'nahi' is used in a sentence or when the sentence is in active voice/passive voice or when it is ambiguous.

Negatives Taylor & Taylor (1990) have concluded on the basis of their studies that when such

sentences are presented which contain many negatives, then there is difficulty in understanding the sentence. Sentences which contain 'nahi', 'nahi' or implied negatives take more time to process than similar affirmative sentences.

Clark & Chase (1972) have also found the same result that respondents have reacted more intensely when positive sentences are presented. The probability of errors increases when the sentence is in the negative form.

If it is difficult to understand a sentence if it contains one negative, then what will happen if it contains two or three negatives?

For example - Few people strongly deny that the world is not flat (Sherman, 1976).

If this sentence contains 3 negatives, it is a difficult task to understand it. As the number of negatives increases in the sentence, it becomes difficult to understand the sentence. Sherman (1976) has found the result that people can understand every positive sentence well, but if there are 4 negatives in the sentence, they can understand only 59%. This means that when the number of negatives is more, the performance of the subject is slightly better than expected (more than 50%).

Passive Voice

Chomsky (1957, 1965) has pointed out that the active and passive voice of a sentence may differ on the surface level, but at a deeper level their meanings may be similar. The active voice is more basic, but the passive voice requires some additional words. Some passive forms sound inappropriate, and some verbs do not have sensible passive forms at all (Anisfeld & Klenbort, 1973). What passive voice can we make for verbs like 'sleep', 'resemble', 'be', and 'cost'?

The passive voice is easier to understand, however. For example, Hornby (1974) asked his subjects to decide whether the picture accurately represented the sentence. The subjects quickly answered the question, 'whether the picture was a passive voice or not.' The response was given when the sentence was in the active voice (The girl is petting the cat) and not when the sentence was in the passive voice (The cat is being petted by the girl). The use of passive voice is more popular in scientific writings. That is why scientific articles are very pompous. That is why it is recommended to write scientific articles in the active voice (Publication Manual of American Psychological Association, 1983).

Ambiguity –

Matlin (1995) has three types of ambiguity, surface structure ambiguity, lexical ambiguity and deep structure ambiguity. The first type of ambiguity is lexical ambiguity in which a word has two meanings. For example:

Time flies like an arrow,

but fruit flies like a banana.

This is a surprising sentence because the meaning of the word 'flies' is ambiguous. In surface structure ambiguity, words are grouped in more than one way, for example: 'The only ones who volunteered are a few incompetent people like John and You'. This sentence is incompetent because the last part of the sentence can be grouped in many ways, for example: incompetent people like John/and you/incompetent people like John and you. The third type of ambiguity is called deep structure ambiguity in which the essential logical relations between

phrases can be interpreted in two ways. For example: Senator found drunk on capital steps When two deep structures are used in surface structure, the form of the sentence becomes ambiguous. Several studies have shown that understanding ambiguous sentences is a difficult task.

Understanding Reading Process:

Reading is a complex process. Reading involves perception, language, memory, thinking, and intelligence (Adams, 1990, 1999; Garrod & Daneman, 2003; Smith, 2004). Reading involves recognizing the letters on a page, putting them together to form words that have meaning, and keeping their meaning in memory until reading the sentence or even paragraph have finished. According to Bartlett, reader's understanding and memory for text is an active, constructive process rather than a passive, receptive process. In everyday life, we repeatedly encounter written language, we see signs, billboards, labels, and notices. These items contain a lots of information that helps us make decisions and understand situations. Thus, reading is a foundational skill in our daily lives.

Perceptual Processes in Reading:

During reading, when the correct letter is presented in a wide array of typestyles and typefaces it's somehow manages to perceive. For example, it can be perceived correctly in capital and lowercase forms, and even in cursive forms. These aspects refers to orthographic. Reading comprises two basic kinds of processes: (1) lexical processes, and (2) comprehension processes. Lexical processes are used to identify letters and words. They also activate relevant information in memory about these words. Lexical processes involves saccadic eye movement and fixations. Our eyes make a series of little jumps as they move across the page. Saccadic movement refers to these very rapid movements of the eyes from one spot to the next. Our eyes make these movements to align the center of our retina where the vision is sharpest. This is precisely over the words you intend to read, allowing for clear and focused perception. Fixations occur in the intervals between saccadic movements; during each fixation, the visual system gathers the essential information needed for reading (Blanchard, 1987). The average fixation lasts approximately 250 milliseconds, or a quarter of a second. Readers fixate for a longer time on longer words than on shorter words. They also fixate longer on less familiar words. Although most words are fixated, not all of them are. Readers fixate up to about 80% of the content words in a text. These words include nouns, verbs, and other words that carry the bulk of the meaning. Saccadic movements leap an average of about seven to nine characters between successive fixations. Good/Skilled readers make larger eye movements, known as saccades, and rarely move backward to previous text. They pause for only about 0.2 seconds between saccades, allowing for efficient reading and minimizing re-fixations on earlier words. Whereas, poor readers tend to make smaller eye movements, or saccades, and are more likely to move backward to re-read earlier material. They also pause for a longer period—about 0.5 seconds—before making the next saccadic movement, which can disrupt the flow of reading and slow comprehension. Another important aspect of reading is lexical access. This refers to the identification of a word that allows us to gain access to the meaning of the word from memory. Most psychologists who study reading believe that lexical access is an interactive process. Lexical access is often studied by presenting isolated words to subjects looking at the center of a display screen. It combines information of different kinds, such as the features of letters, the letters themselves, and the words comprising the letters (Morton, 1969).

Comprehension processes in reading involves:

1. Comprehending Known Words: Retrieving Word Meanings from Memory

This process, known as semantic encoding is the process of translating sensory information,

such as written words, into meaningful representations based on our understanding of those words. Through lexical access, we identify words by their letter combinations, which activates our memory of the word. Once identified, we retrieve its meaning stored in memory. If the meaning is not already encoded, we rely on context to infer its meaning. People with larger vocabularies can access lexical information more quickly than those with smaller vocabularies (Hunt, 1978). This rapid access allows for more efficient processing of information, especially since verbal information is often presented quickly in both reading and listening.

2. Comprehending Unknown Words: Deriving Word Meanings from Context

A large vocabulary not only helps with fast lexical access but also enhances text comprehension by facilitating learning from context. When we cannot semantically encode a word due to lack of prior knowledge, we must use strategies to derive its meaning. This may involve consulting external resources like dictionaries or teachers, or using context clues from the surrounding text. Context-based strategies allow us to infer the meaning of unfamiliar words by drawing on existing knowledge stored in memory. Studies show that varying retrieval cues can affect what details are remembered, though not necessarily their accuracy (Gilbert & Fisher, 2006).

3. Comprehending Ideas: Propositional Representations

Understanding what we read depends on how well we can hold information in working memory. According to Walter Kintsch's model of text comprehension, we don't attempt to store the exact words in memory. Instead, we focus on extracting the fundamental ideas from the text and store these ideas in a simplified, representational form. This form is known as a proposition, which is the smallest unit of meaning that can be independently verified as true or false. For example, the sentence "Penguins are birds, and penguins can fly" contains two propositions: "Penguins are birds" and "Penguins can fly." Propositions generally assert actions (like flying) or relationships (such as categorization, e.g., penguins being birds).

Theories of Word Recognition

Word recognition refers to a component process of language. Word recognition transforms written and spoken forms of words into linguistic representations. In visual word recognition, a whole word may be viewed at once (provided that it is short enough), and recognition is achieved when the characteristics of the stimulus match the orthography (i.e., spelling) of an entry in the mental lexicon. Three different hypotheses have been developed to explain how readers recognize printed words when they read to themselves.

1. **The Direct-Access Hypothesis:** The hypothesis states that the reader can recognize a word directly from the printed letters. The evidence for the hypothesis that words can be recognized directly without a translation into sound-comes from homonyms. Homonyms are words that are spelled differently but sound the same. When you see the two homonyms "hole" and "whole", you know that they have different meanings. If each of those visual stimuli were translated into sound, as the indirect-access hypothesis claims, then we would be left with two identical sounds. It would be difficult to explain how those two identical sounds could then lead to the two different meanings. In a study by Bradshze and Nettleton (1974), pairs of words were presented that were similar in spelling but not in sound, such as moun-down, etc. When subjects pronounced the first word of a pair aloud, it caused a delay in pronouncing the second word due to interference from the differing pronunciations, but no such delay occurred during silent reading, suggesting silent reading does not trigger a silent pronunciation of words.The strongest evidence for the direct-access hypothesis comes from clinical observations of deep dyslexia. For example, these people are unable to pronounce

simple nonsense words, such as dap, ish, and lar. They also are unable to judge which visually presented words rhyme with each other. Clearly, these people cannot use the intermediate step of translating words into sound. Nevertheless, they are able to look at a printed word and identify its meaning (Besnes et al., 1981; Coltheart, et al., 1980). Thus, it is possible to read without an translation into a speech code.

2. **The Indirect-Access Hypothesis**: The hypothesis states that "there is an obligatory translation from ink marks on the page to some form of speech code in order to gain access to a store of word meanings during reading" (Besner et al., 1981). Several studies suggest that visual information may be converted into sound during reading. Hardyck and Petrinovitch (1970) found that people often sound out words when the material is difficult. In their experiment, when people were prevented from making any lip movements, they had trouble reading dificult material. This indicates that people translate the visual stimulus into sound. Word sounds are also important when children begin to read. Wagner and Torgesen (1987) summarize numerous studies demonstrating that children with high phonological awareness have superior reading skills. A study by Doctor and Coltheart (1980) also supports the indirect-access hypothesis. Doctor and Coltheart, found that the children were likely to judge sentences as meaningful if they sounded meaningful. For example, "He ran threw the street" would be pronounced just the same as the meaningful sentence, "He ran through the street." Therefore, they judged that sentence as meaningful. In contrast, they did not judge sentences as meaningful if they remained meaningless when they were pronounced, for example, "He ran sew the street."
3. **The Dual-Encoding Hypothesis:** The hypothesis states that “semantic memory can be reached either directly, through the visual route, or indirectly, through the sound route”. Thus, visual symbols can be encoded in two ways. Some results favor a direct access to word recognition, whereas others favor an intermediate step involving a word's sound. The dual-encoding hypothesis argues that both routes are possible. The flexibility of this hypothesis is certainly one of its strengths. It argues that the characteristics of the reader and the characteristics of the reading material determine whether access is direct or indirect.

   In their study, Baron and Strawson (1976) identified two types of readers: direct-access and indirect-access readers. Indirect-access readers processed words faster when they followed standard spelling-sound correspondence rules (e.g., "sweet") than when they did not (e.g., "sword"). In separate tests, these readers demonstrated a strong reliance on spelling-sound correspondence, indicating they convert visual stimuli into sounds before recognizing the word. Direct-access readers, by contrast, demonstrated minimal differences in reading speed between regular and irregular words and did not rely heavily on rules of spelling-sound correspondence. This suggest they recognize words without mentally translating them into sound. This hypothesis argues that both the characteristics of the reader and the natureof the reading material determine whether the access will be direct or indirect. Experienced or mature readers, such as teachers and college students, are more likely to use direct access and apply discretion in their approach. However, under stress, readers often shift to indirect access, such as when reading exam questions, where subvocalization may occur as they mentally process the content.

Discovering the Meaning of an Unfamiliar Word: Sternberg and Powell (1983) pointed out that when we read, we often come upon a word whose meaning is unfamiliar. We then typically attempt to use the context in which the word occurs to figure out its meaning. Sternberg and Powell propose that context can provide several kinds of information cues about meaning, including the following:

1. Temporal cues indicate how often X (the unknown word) occurs or how long it lasts.

2. Spatial cues identify X's location.

3. Value cues suggest the emotion that X arouses.

4. Functional descriptive cues describe the possible actions X can perform.

5. Stative descriptive cues concern the physical properties of X (that is, its physical state).

For example, the following sentence:

At dawn, the blen arose on the horizon and shone brightly.

This sentence contains several contextual cues that make it easy to infer the meaning of blen. The phrase 'at dawn' provides a temporal cue, about the time at which the arising of the blen occurred. 'Arose' is a functional descriptive cue, describing an action that a blen could perform. 'On the horizon' provides a spatial cue. 'Shone' is an additional functional descriptive cue, further limiting the possible candidates for blen. Finally, 'brightly' provides a stative descriptive cue, describing a property of the shining of the blen, that is, its brightness. With all these different cues, an experienced reader can easily understand that the nonsense word blen is a synonym for the familiar word sun.

Naturally, we do not always use contextual cues in decoding a word's meaning, and when we do use them, they do not always work. For example, we are more likely to use contextual cues if an unknown word appears in a variety of different contexts.

Studies have found that people with large or small vocabularies (high verbal/ low verbal) learn word meanings differently. High-verbal participants perform a deeper analysis of the possibilities for a new word's meaning than do low-verbal participants. In particular, the high-verbal participants used a well-formulated strategy for figuring out word meanings. The low-verbal participants seemed to have no clear strategy at all (van Daalen-Kapteijns & Elshout-Mohr, 1981; Sternberg & Powell, 1983).

Interface in Reading:

The term "interface" refers to the point of interaction or communication between two systems, entities, or components. In technology and design contexts, an interface typically refers to the point where humans interact with machines or software systems. It includes visual, auditory, tactile, and functional elements that facilitate communication and interaction between users and devices.

Interfaces can take various forms, including graphical user interfaces (GUIs), command-line interfaces (CLIs), touchscreens, voice-controlled interfaces, gesture-based interfaces, and more. They provide users with the means to input commands, access information, manipulate data, and receive feedback from systems.

Interfaces play a critical role in shaping user experiences, as they determine how users interact with and navigate digital environments, applications, devices, and services. Well-designed interfaces prioritize usability, accessibility, intuitiveness, and efficiency, enhancing the overall user experience and enabling users to complete tasks effectively and efficiently.

An interface is a point of interaction between two systems or components, allowing them to communicate and exchange information. In the context of reading, it may refer to how the information is presented to a reader and how they interact with it. If

a reader prefers physical materials to read, the interface may encompass aspects like layout, typography, color scheme, spacing, and illustrations. If a reader prefers to read via digital devices, the interface encompasses elements like screen brightness, navigation tools, hyperlinks, interactive features, and multimedia additions like videos or audio.

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Very Short Questions/True Facts:

1. **Language** is the use of an organized means of combining words in order to communicate with those around us.
2. **Psycholinguistics** is the psychology of our language as it interacts with the human mind. It considers both production and comprehension of language.
3. **Semantics** is the study of meaning in a language. A semanticist would be concerned with how words and sentences express meaning.
4. **Grammar** is the study of language in terms of noticing regular patterns.
5. **Discourse** involves units of language larger than individual sentences—in conversations, lectures, stories, essays, etc.
6. **Lexical processes** are used to identify letters and words.
7. **Comprehension processes** are used to make sense of the text as a whole.
8. **Lexical access** is the identification of a word that allows us to gain access to the meaning of the word from memory.
9. **Semantic encoding** is the process by which we translate sensory information into a meaningful representation.
10. **Dyslexia** is a difficulty in decoding, reading, and comprehending written text.
11. **Linguistic community-"**A group of people who share the same language variety and the rules for using it in everyday communication, and who center their identity around that language"
12. **Speech community-"**A speech community is a group of people who share a set of linguistic norms and expectations about the use of language. It is a concept mostly associated with sociolinguistics and anthropological linguistics.

Short Questions:

1. **What are the essential components that make up words and sentences in language?**

Language can be broken down into many smaller units. The smallest unit of speech sound is the phone, which is simply a single vocal sound. A phoneme is the smallest unit of speech sound that can be used to distinguish one utterance in a given language from another. In English, phonemes are made up of vowel or consonant sounds, like a, i, s, and f. At the next level of the hierarchy after the phoneme is the morpheme—the smallest unit of meaning within a particular language. The word recharge contains two morphemes, "re-" and "charge," where "re" indicates a repeated action. There are two forms of morphemes: root words and affixes. Root words are the portions of words that contain the majority of meaning. Affixes include prefixes, which precede the root word, and suffixes, which follow the root word. Linguists analyze the structure of morphemes and of words in general in a way that goes beyond the analysis of roots and affixes. Content morphemes are the words that convey the bulk of the meaning of a language. Function morphemes add detail and nuance to the meaning of the content morphemes or help the content mor- phemes fit the grammatical context. The lexicon is the entire set of morphemes in a given language or in a given person's linguistic repertoire.

The average adult speaker of English has a lexicon of about 80,000 morphemes (Miller & Gildea, 1987). Beneath our ability to form sentences lies a robust framework of rules. Syntax refers to the way in which we put words together to form sentences. It plays a major role in our understanding of language. A sentence comprises at least two parts. The first is a noun phrase, which contains at least one noun (often the subject of the sentence) and includes all the relevant descriptors of the noun (like "big" or "fast"). The second is a verb phrase (predicate), which contains at least one verb and whatever the verb acts on, if anything. Linguists consider the study of syntax to be fundamental to understanding the structure of language.

2. **What is the role of linguistics in psychology?**

Linguistics is the study of languages as structured systems of rules. It also encompasses the study of the origin of languages, the relationships among languages, how languages change over time and the nature of language sounds. Psycholinguistics is concerned with the ways in which people use linguistic competency to generate and understand language. The field of psycholinguistics is also concerned with the behaviour of using language and conversely the ways in which behaviour is influenced by language. We have to know the rules for combining the basic elements of language, i.e., grammar or syntax Along with the grammar rules, we have to store in long-term semantic memory, the meanings of thousands of words. We must know how to use speech to impress others and the rules for processing and interpreting the speech of others. These are the major characteristics of linguistic competence.

3. **Briefly discuss the important facts in the context of speech perception.**

Some important facts are:

i) Information about sounds is transmitted in parallel which means phonemes in a sentence overlap as they are spoken. Each phoneme sound is modified by the surrounding phonemes. Thus, speech sound flow together due to parallel transmission.

ii) Context allows listeners to fill in the missing sounds. People are active listeners as they use contexts as cues to identify sounds or words rather than listening passively to speech sounds. This process refers to phonemic restoration.

iii) Visual cues from the speaker's mouth help us interpret ambiguous sounds. Information that is received from the speaker's lips and facial expressions aids in clearing ambiguities within the speech signal.

iv) Listeners can impose boundaries between words. When we listen to a language we know well, identifying word boundaries is easy. However, when hearing two people speak in an unfamiliar language, we perceive it like a continuous stream of words with no clear boundaries separating them.

4. **Briefly state the stages of processing in listening to speech.**

The main processes involved in listening to speech are: In the first stage, we often have to select out the speech signal of interest from several other irrelevant auditory inputs (e.g., other voices). Decoding involves extracting discrete elements (e.g., phonemes or basic speech sounds) from the speech signal. The second stage of speech perception involves identifying phonemes or syllables. According to Goldinger and Azuma (2003), the perceptual unit varies flexibly. The third stage is stage of word identification. The fourth and fifth stages both put emphasis upon the comprehension of speech. In the fourth stage, the emphasis is on interpretation of the utterance, involving construction of a coherent meaning for each sentence on the basis of information about individual words and their position in the sentence. The fifth stage involves integrating the meaning of the current sentence with previous speech to create an overall model of the speaker's message.

5. **What are the research methods used to study reading processes?**

Several methods are used for studying reading processes. One is assessment of the time taken for word identification or recognition. Another is lexical decision task that involves deciding quickly whether a sequence of letters forms a word. The naming task involves saying a printed word out loud as quickly as possible. Balota et al. (1999) explained that reading involves several kinds of processing: orthography (the spelling of words); phonology (the sound of words); semantics (word meaning); syntax or grammar; and higher-level discourse integration. The involvement of these kinds of processing varies across tasks. The naming task emphasises links between orthography and phonology. In contrast, the lexical decision task emphasises links between orthography and semantics. Another method to study reading process is recording eye movements during reading. It offers real-time record of attention-related processes. Finally, Event-related potentials (ERPs) are of special interest and importance. ERPs provide a accurate measure of the time taken for certain processes to occur.

6. **What are the key differences between single sentence and sentences within a discourse?**

A sentence is a grammatical unit that expresses a complete thought. It typically contains a subject and a predicate and can stand alone. Discourse involves units of language larger than individual sentences—in conversations, lectures, stories, essays, and even textbooks (Di Eugenio, 2003). Just as grammatical sentences are structured according to systematic syntactical rules, passages of discourse are structured systematically. Single sentences often stand alone, conveying a complete thought independently, while sentences within a discourse rely on each other to build meaning. In discourse, context shapes each sentence, creating a cohesive flow that connects ideas through logical progression and linguistic cues like pronouns and transitions.

7. **What are the concepts of the segmentation and coarticulation in speech perception?**

Segmentation refers to separating out or differentiating phonemes and words from the pattern of speech sounds. When listening to someone speak an unfamiliar foreign language, speech has few periods of silence. This makes it hard to know when one word ends and the next word begins. Segmentation is influenced by the constraints on what words are possible.

Coarticulation refers to the fact that a phonological segment is not realized identically in all environments, but often apparently varies to become more like an adjacent or nearby segment. In coarticulation, the pronunciation of a phoneme depends on the previous and following phonemes. For example, the /b/ phonemes in ‘bill’, ‘ball’, ‘able’, and ‘rub’ are all acoustically slightly different (Harley, 2010)

8. **Briefly state the McGurk effect in speech perception.**

McGurk effect, is an audiovisual speech illusion that demonstrates the impact of visual cues on speech perception, particularly the identification of spoken syllables (Payne, 2023). The effect was named after cognitive psychologist Harry McGurk, who, along with cognitive psychologist John MacDonald, discovered the phenomenon when they were studying the perception of language by infants. According to this effect, when the brain is given incomplete or incongruent input from the senses, it fills in the blanks or makes best guesses to construct reality. The McGurk effect shows listeners often use visual information even when it impairs speech perception. However, under normal listening conditions, visual information typically enhances speech perception.

9. **What are the processes which may be impaired in dyslexia?**

The processes which may be impaired in dyslexia are:

Phonological awareness, which refers to awareness of the sound structure of spoken language. A typical way of assessing phonological awareness is through a phoneme-deletion task. To assess this, children are asked to say, for example, "seat" without the "-t."
Phonological reading, which involves reading words in isolation. This skill is sometimes called "word decoding" or "word attack." For assessment of the skill, children might be asked to read words which may be easy or difficult in isolation.
Phonological coding in working memory. This process is involved in remembering strings of phonemes that are sometimes confusing. It can be assessed by comparing working memory for confusable versus nonconfusable phonemes.
Lexical access refers to one's ability to retrieve phonemes from long-term memory. It can be assessed by asking questions like, if you see the word lake, do you immediately recognize the word as lake, or does it take you a while to retrieve it?

10. **Briefly explain the concept of Transformational Grammar.**

Noam Chomsky (1965) proposed the concept of Transformational Grammar. There is more to a sentence than meets the eye (or ear). Transformational grammar is a theory of grammar that accounts for the constructions of language by Linguistic transformations and phrase structure. Chomsky devised a model of transformational grammar to convert underlying, deep structure into the surface structure of a sentence. Chomsky proposed that people understand sentences by transforming the surface structure into a basic, deep structure or kernel form. They use transformational rules to convert surface structure to deep structure (Understanding). They use transformational rules to convert deep structures to surface structure during speech production or writing.

11. Explain Language Ideology.

Language ideology is a marker of conflict between social groups with different interests, manifested in what people say and the way they say it. It is mainly studied in the field of linguistic anthropology. The study of language ideology provides evidence that the way we talk will always be embedded in a social world of power differences. They mark conflict between social groups that do not have the same interests or beliefs. This is manifested in what people say and the way they say it. Language ideologies are very active and effective. Language ideologies are very important to many fields of study; some examples are anthropology, sociology, and linguistics. Language ideologies have become a very good way for us to understand how human groups are organized despite differences in beliefs and ways of life. For example, many different languages are spoken in one society, which proves that the linguistic theory of considering human societies as monolingual will be of very limited help. Using language ideologies instead we see that speakers of different languages or dialects may possibly share some beliefs or practices, or even have conflicts involving a language.

Long/Extensive Questions:

1. **What are the fundamental properties of language?**

i) The communicative property of language: Language permits us to communicate with one or more people who share our language. For example, writing what we are thinking and feeling so that others may read and understand our thoughts and feelings. Despite the frustrations of miscommunications, however, for one person to be able to use language to communicate to another is impressive.
ii) The shared system of arbitrary symbolic reference: Language creates an arbitrary

relationship between a symbol and what it represents: an idea, a thing, a process, a relationship, or a description. Words are symbols that were chosen arbitrarily to represent something else, such as a "plant," "drive," or "excellent." The thing or concept in the real world that a word refers to is called referent.

iii) Regular structure of language: Language has a structure. Particular patterns of sounds and of letters form meaningful words. Random sounds and letters, however, usually do not. Furthermore, particular patterns of words form meaningful sentences, paragraphs, and discourse.

iv) Language is structured at multiple levels: Any meaningful utterance can be analyzed at more than one level. We look at:• sounds, such as p and t; • words, such as "pat," "tap," • sentences, such as "Pat said to tap the top of the pot, then tip it into the pit;" and • larger units of language, such as this paragraph

v) Language is productive: Within the limits of a linguistic structure, language users can produce novel utterances. The possibilities for creating new utterances are virtually limitless. Productivity refers here to our vast ability to produce language creatively. However, our use of language does have limitations. We have to conform to a particular structure and use a shared system of arbitrary symbols. We can use language to produce an infinite number of unique sentences and other meaningful combinations of words.

vi) Language is dynamic: Languages constantly evolve. Individual language users coin words and phrases and modify language usage. The wider group of language users either accepts or rejects the modifications. Each year, recently coined words are added to the dictionary, signifying the extensive acceptance of these new words.

2. **What is speech perception? Discuss in detail the various facts in the context of speech perception.** (Refer to the content of Unit I)

3. **What are the key theories of speech perception and how do they explain the process of interpreting spoken language?** (Refer to the content of Unit I)

4. **What are the key factors that influence the perceptual process during reading, and how do they impact our understanding of written text?**

   Some of the factors that enhances the duration of fixation during reading, and thus simplify the interpretation, are word length, word infrequency, and syntactically or semantically anomalous words (Just and Carpenter, 1987). According to Just and Carpenter, when readers encounter a new word, they try to interpret it and assign it a role. The eye–mind hypothesis was proposed which posits that the interpretation of each word occurs during the time it is fixated. Therefore, the time spent on each fixation provides information about ease of interpretation. In their studies conducted in 1980 and 1983, Just and Carpenter presented college students with magazine passages featuring topics like scientific inventions, technical innovations, and biological mechanisms. The results of their study revealed that more time is dedicated to the meaningful or semantically rich parts of the text, as this aligns with the reader's goal of understanding the meaning of the content. Another factor that influence reading comprehension is semantic factors. Kintsch and Keenan (1973) revealed that two sentences which are of equal length might be differentially difficult to process. They suggested, that the sources of the difficulty is due to the propositional complexity of the sentences, the number of basic ideas conveyed. Two sentences can be approximately equal in length, but they can differ greatly in the number of underlying propositions, or basic ideas. This model posits that the sentence, that have the same number of words but more propositions than the first sentence, will be more difficult to process. Another factor that influences text processing is the relationship between

sentences. Haviland and Clark (1974) explained that the given-new strategy helps integrate or connect related ideas that are spread across different sentences. This strategy is a pragmatic approach to processing sentences by which listeners and readers divide sentences into two parts: the given and the new. The given part of a sentence contains information that is (or should be) familiar from the context, the preceding information (including other sentences just presented), or background knowledge. The new part, as the term implies, contains unfamiliar information. Listeners first search memory for information corresponding to the given information and then update memory by incorporating the new information, often as an elaboration of the given. The given–new strategy can work only if the information in the given part of the sentence corresponds to some information in the listener's memory, called the antecedent.

5. **How do contextual factors influence speech perception and the way we interpret spoken language?**

Context refers to the essential information that is not directly present in the auditory signal currently available to listeners. Numerous types of contextual information are there that includes information provided by prior input (e.g., earlier segments of a sentence) and that influenced by our knowledge of language and words. Context typically influences spoken word recognition (Samuel, 2011). Harley (2013) identified two extreme positions. According to the interactionist account, contextual information can alter processing at an initial stage and may influence word perception. In contrast, the autonomous account claims context has its effects late in processing. Social and cultural context also play a crucial role in language comprehension. Pragmatics, which refers to the study of how people use language, includes sociolinguistics and other aspects of the social context of language. We often change our use of language in response to contextual cues without giving these changes much thought under most circumstances. For example, in speaking with a conversational partner, we seek to establish common ground that refers to shared basis for engaging in a conversation (Clark & Brennan, 1991). When we are with individuals who share similar background, knowledge, motives, or goals, establishing common ground tends to be effortless and often goes unnoticed. Sociolinguists have observed that people engage in various strategies to signal turn-taking in conversations. Research on gender differences suggests that variations in conversational style are largely due to men's and women's differing perceptions of the goals of conversation. It has been revealed that men tend to see the world as a hierarchical social order in which their communication aims involve the need to maintain a high rank in the social order. In contrast, women tend to see communication as a means for establishing and maintaining their connection to their communication partners (Tannen, 1990, 1994).

6. **What significant contributions has Noam Chomsky made to the field of linguistics?**

Chomsky claimed there is an innate Universal Grammar. In Chomsky's own words, "Whatever universal grammar is, it's just the name for our genetic structure" (Baptista, 2012). According to him, there is more to a sentence than meets the eye (or ear). The behaviourist emphasized the observable aspects of language behavior only. Noam Chomsky (1965) proposed the concept of Transformational Grammar. He argued that it explains why only humans develop language fully. Second, it explains the broad similarities among the world's languages if there is a Universal Grammar. Third,

Chomsky claimed the spoken language young children experience is too limited to allow them to develop language with the breathtaking speed they display. According to Chomsky (2006), human language abilities could be explained only in terms of a complex system of rules and principles represented in the mind of speakers. Humans have innate language skills. Transformational grammar is a theory of grammar that accounts for the constructions of language by Linguistic transformations and phrase structure. According to him, rules guide the ways in which an underlying proposition can be arranged. Chomsky devised a model of tranformational grammar to convert underlying, deep structure into the surface structure of a sentence. Surface structure is represented by the words that are actually Spoken or written. On the other hand, deep structure is the underlying, more abstract meaning of the sentence.He pointed out that: Two sentences may have very different surface structures but very similar deep structures or two sentences may have very similar surface structure but very different deep structures. These are called ambiguous sentences. Chomsky proposed that people understand sentences by transforming the surface structure into a basic, deep structure or kernel form. They use transformational rules to convert surface structure to deep structure (Understanding).They use transformational rules to convert deep structures to surface structure during speech production or writing. Chomsky also claimed that children's rapid acquisition of language cannot be fully explained on the basis of their exposure to language alone. However, he minimised the richness of children's linguistic input. Children are exposed to child-directed speech that is easy for them to understand (Eysenck, 2013)

7. **What are the various factors that influence language comprehension? Discuss in detail.** (Refer to the content of Unit I)
8. **Discuss in detail the TRACE model of speech perception by McClelland and Elman (1986).**

McClelland and Elman (1986) proposed a network model of speech perception which is based on the principles of interactive activation. Their model is called the TRACE model because the network of units forms a dynamic processing structure called "the Trace," which functions simultaneously as the perceptual processing mechanism and the system's working memory. According to the TRACE model of speech perception, bottom-up and top-down processes interact flexibly in spoken word recognition. Bottom-up activation moves upwards from the feature level to the phoneme level and on to the word level, whereas top-down activation moves in the opposite direction from the word level to the phoneme level and on to the feature level.

The TRACE model is based on some assumptions which are:

i)There exists individual processing units or nodes at three different levels: features (e.g., manner of production), phonemes, and words.

ii)Feature nodes are connected to phoneme nodes, and phoneme nodes are connected to word nodes.

iii)Connections between levels work bidirectionally and are consistently facilitative.

iv)Connections exist between units or nodes at the same level, and these connections are inhibitory.

v)Nodes influence one another according to their activation levels and the strength of their connections.

vi)A pattern of activation develops when excitation and inhibition is spread among nodes

vii)The word recognised by the listener is decided by the activation level of the potential candidate words.

9. What are the Modularity Hypothesis and the Whorfian Hypothesis in the study of language and cognition?

Modularity Hypothesis: According to Jerry Fodor (1983, 1985), cognitive processes like perception and language are modular. This implies that the process is domain-specific, meaning that in language, sentence parsing involves mechanisms particular to the division of phrases and words into constituents. Modularity of a process also emphasize that it is an informationally encapsulated process: It operates independently of the beliefs and the other information available to the processor. This means that an informationally encapsulated process operates relatively independently of other processes. The modularity hypothesis also implies that certain perceptual and language processes are modules. These processes are believed to be distinct from other cognitive functions which are considered nonmodular, such as memory, attention, thinking, and problem-solving. The modularity hypothesis was supported by the findings of the experiment by Swinney (1979) on lexical ambiguity resolution.

Whorfian Hypothesis: The Whorfian hypothesis of linguistic relativity was developed by Benjamin Whorf. According to this hypothesis, language both guides and constrains thought and perception. Linguistic relativity means the ways in which speakers of any given language think are influenced by the language they speak. Whorf argued that the language or languages one grows up learning and speaking thus determine the way one perceives the world, organizes information about the world, and thinks. The hypothesis was based on the observation that each language differs in how it emphasizes various aspects of the world. For example, Whorf (1956) observed that the Eskimo language has several words for snow, whereas English has one. Whorf's hypothesis predicts that language differences could limit the information available to speakers of different languages. As a result, English speakers might fail to make distinctions between kinds of snow that Eskimos are thought to make routinely.

10. What is neurolinguistics. Discuss the different types of aphasia?

Neurolinguistics is the study of relation between language and the structure and function of the nervous system. This field examines how the brain processes language. Aphasia is a disorder that results from damage to portions of the brain that are responsible for language. For most people, these areas are on the left side of the brain. Aphasia usually occurs suddenly, often following a stroke or head injury, but it may also develop slowly, as the result of a brain tumor or a progressive neurological disease. The disorder impairs the expression and understanding of language as well as reading and writing. Specific aphasia syndromes are dependent on the location of the lesion in the brain. Fluent aphasia is characterized by fluent speech produced at a normal rate and melody, accompanied by impaired auditory comprehension. It is generally associated with a lesion in the vicinity of the posterior portion of the first temporal gyrus of the left hemisphere. People with non-fluent aphasia struggle to get words out, omit words, and speak in very short sentences.

Types of Aphasia:

Wernicke's Aphasia: The most common variety of fluent aphasia is Wernicke's aphasia.In Wernicke's aphasia, the ability to grasp the meaning of spoken words and sentences is impaired, while the ease of producing connected speech is not very affected. Therefore Wernicke's aphasia is also referred to as 'fluent aphasia' or 'receptive aphasia'. Reading and writing are often severely impaired. As in other forms of aphasia, individuals can have completely preserved intellectual and cognitive capabilities unrelated to speech and language.

Broca’s Aphasia: Broca’s aphasia is caused by damage to Broca’s area of the brain. It

is characterized by the production of agrammatical speech at the same time that verbal comprehension ability is largely preserved.

Global Aphasia: Global aphasia is the combination of highly impaired comprehension and production of speech. It is caused by lesions to both Broca's and Wernicke's areas. Aphasia fol- lowing a stroke frequently involves damage to both Broca's and Wernicke's areas. In one study, researchers found 32% of aphasias immediately following a stroke involved both Broca's and Wernicke's areas (Pedersen, Vinter, & Olsen, 2004).

Anomic Aphasia: Anomic aphasia involves difficulties in naming objects or in retrieving words. The patient may look at an object and simply be unable to retrieve the word that corresponds to the object. Sometimes, specific categories of things cannot be recalled, such as names of living things (Jonkers & Bastiaanse, 2007; Warrington & Shallice, 1984).

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UNIT II

UNIT II	Language Production; Speaking in Context; Speech Error; Gestures and Context; Writing: Comparison between Speaking and Writing; Cognitive Tasks involved in Writing; Bilingualism: Advantages and disadvantages.

Language serves as a primary tool for communication, enabling us not only to convey information but also to express emotions and connect with individuals or groups. Language production, the process of generating language, involves two essential channels: speaking and writing.

Language is a system that associates sounds (or gestures) with meanings in a way that uses words and sentences. The complex process of linguistic communication involves a number of interconnected, yet functionally and anatomically separable cognitive processes. Linguistics is the scientific study of human language. It has several sub-fields:

1. Phonetics & Phonology: Phonetics - the production and perception of speech sounds as physical entities. Phonology - the sound system of a particular language and sounds as abstract entities. Phonemes are the smallest units of sound. A phoneme roughly corresponds to a letter of the alphabet, and different languages have different numbers of phonemes (English has approximately 30 phonemes, whereas some languages such as Mandarin have more than 50).

2. Morphology: The word structure and the systematic relations between words. Morpheme - The building-blocks of words, the smallest linguistic unit which has a meaning or grammatical function. For example, the word "talked" has two morphemes – "talk" and "-ed". The first morpheme describes a conversation event, and the second morpheme places this event in the past.

3. Syntax: Phrase and sentence structure. The set of rules of a particular language that determine the ways words are combined to make sentences. Syntax refers to word order, for example the exact place of negation in a sentence. It also refers to type of sentences (question, conditional) and grammatical forms (passive, active).

4. Semantics: The meaning of morphemes, words, phrases, and sentences. This term overlaps with semantic memory. 5. Pragmatics: The way language is used, how context influences the interpretation of utterances, and how sentences fit into a conversation (Gill and Damann, 2015). The same phrase (e.g., he is really smart) could be said seriously or ironically, and the interpretation is related to pragmatics.

In the process of language production, we move from semantics to phonology, and in the process of language comprehension we move from phonology to semantics.

Language Production: Language production refers to the process of converting thoughts into speech or writing, involving the creation and expression of meaning through language. This is language production involves two main processes: speaking and writing. Language production is a goal-directed activity whose main goal is communication. People speak and write to impart information, to be friendly and so on. Most of the researches has been done on speech production than writing. One explanation for this is nearly everyone spends more time talking than writing, and so it is of more practical use to understand the processes involved in talking. However, writing is a crucial skill in many societies.

Speaking: Speech production is clear-cut process. Most people spend numerous hours chatting, quarreling, talking on the telephone, story telling, and speaking to ourselves almost everyday. Speaking is one of our most complex cognitive and motor skills (Bock & Griffin, 2000; Dell, 2005). We usually speak at a rate of 2–3 words per second, or about 150 words per minute, and this fast pace supports the idea that speaking requires minimal processing resources. Speech production may involve several levels. First level is the semantic level which is the plannic level involving the meaning of what is to be said or the message to be communicated. Planning might occur at the level of the clause (a part of a sentence containing a subject and a verb). Alternatively, it might occur at the level of the phrase (a group of words expressing a single idea). In the sentence, "Failing the exam was a major disappointment to him", the first three words form a phrase. Second level is syntactic level which involves the grammatical structure of the words in the planned utterance. The third level is the morphological level that is related to the morphemes (basic units of meaning). The fourth level is the phonological level related to the phonemes (basic units of sound).

Selection of the Content of Speech: According to Garrrett (1984), speech production requires a series of stages which are:

i) Figuring out the gist or overall meaning of what we intend to say.
ii) Devising the general structure of the sentence without selecting the exact words.
iii) Choosing both the words & their forms (eg: come, came)
iv) Converting these intentions into overt speech by articulating the phonemes.

The stages of speech comprehension may also take place simultaneously with these stages while these stages may also overlap with time. According to Holmes(1904), we plan ahead for more than one sentence when we are speaking. We may also encounter issues while speaking, such as hesitations, where speech becomes slow and halting.

Selecting the Active or the Passive Voice: Active voice is much easier to understand than the passive voice. This is because people are more likely to produce the active voice. The results of a study by Taylor & Taylor (1990) revealed that in tabulation of spoken language samples, the simple active form occurred 81% of time in contrast to 14 % for the passive form. The selection of active versus the passive voice can also be influenced by the sentences heard immediately beforehand.

Speaking in Context: Speaking demands attention to the content of speech. There are several challenges while speaking like producing error-free speech, accompanied by appropriate gestures. The challenges also includes requirement of attention to the social context of speech. Herbert Clark (1985) suggested that language is really a social instrument. We direct our words to other people, and our goal is not merely to express our thoughts but to also influence the people with whom we are talking. Speakers are required to take into account their conversation partners, make several assumptions about those partners, and plan their utterances appropriately. Thus this is a complicated process demanding precise coordination. Like how two people going through a doorway at the same time need to coordinate their motor actions, two speakers also need to coordinate turn-taking, they need to coordinate their understanding of ambiguous terms, and they need to understand intentions of each other. Pragmatics is the study of how people use language. It includes sociolinguistics and other aspects of the social context of language. Pragmatics focuses on how speakers successfully communicate messages to their audience. Research on pragmatics put emphasis on many important concepts. These are common ground, the given-new strategy, conversational format, and an understanding of directives.

Common Ground: Common ground is a central notion in pragmatics, and a fixture in discussions of reference, speech acts, implicature, language conventions, fiction, and many other topics related to language use. Stalnaker (2014) defined common ground as "a body of information that is presumed to be shared by the parties to a discourse". Common ground happens when people involved in converstaion share the similar background knowledge, schemas, and experiences that are necessary for mutual understanding (Clark & Van Der Wege, 2002; Fox Tree, 2000; Hanna & Tanenhaus, 2005). For example if a young man named Andy asks his friend Lisa, "How was your weekend?" and Lisa answers, "It was like being in Conshohocken again." Andy will understand this reply only if they share a similar understanding about the characteristics or events that took place in Conshohocken. Speakers should avoid ambiguous statements when talking with anone to ensure the correct communication. Speakers also use nonverbal language to clarify their message.

The Given-New Strategy: According to the given-new strategy, a speaker's sentence contains some "given" information, with which the listener is already familiar, and some new information. This enables the listener to integrate the new information into memory along with the old information. For example, the sentence

The story Dr. Lisa told was excellent.

The information given here conveys that Dr. Lisa told a story, whereas the new information incorporated in the sentence is that the story was excellent. Thus, it is crucial for the speaker to match the given information with the information already stored in the listener's memory, to accurately convey the new information successfully. We converse as though speakers and listeners follow an unspoken agreement to adhere to the given-new rule, meaning the speaker must establish a suitable framework that allows new information to be easily understood.

Conversational Format: We have social rules about the format of our conversations also. One rule is that the speakers should alternate (Goodwin, 1981; McLaughlin, 1984). Speakers avoid talking simultaneously and typically do not leave long pauses in the middle of a conversation. This rule of alternation can be applied in different situations. In a telephone conversation, for example, alternation is required in the beginning interchanges. The

answerer may say "Hello," or " Lisa speaking," or "Yes," but longer segments will not be tolerated. The caller must provide identification and wait for a brief acknowledgment from the receiver before continuing with the message. Proper etiquette also specifies that the closing of conversations must be highly structured (Ervin-Tripp, 1993). The speakers may require no. of alternations to "wind down" a conversation. Certainly, a polite adult cannot end a conversation by saying a simple "good-bye" into a random pause in the interchange.

Directives: A directive is a sentence that requests someone to do something. Ervin-Tripp gathered large samples of speech in natural settings and found six different kinds of directives used in American English. Each kind of directive seemed to be used in certain, well-defined circumstances. For example, one kind of directive was used to express need. It was used either by a higher-ranking person in a work setting. Another kind of directive is very abbreviated, because the necessary action is obvious.

Speech Error: The speech that people produce is generally very accurate and well-structured. However, everyone is prone to error. Studies have suggested that the average person makes a speech error approx. every 500 sentences. Thus, study of speech errors is very crucial. People often pause in the middle of the sentences. Mackay & Osgood (1959) found that the professors are just as guilty of speech errors as everyone else. They recorded the speech of 13 professors who attended a conference at University of Illinois and concluded their research. Researchers have also been interested in slip-of-the-tongue error in which sounds or entire words are rearranged between two or more different words.

Types of Speech Errors

S. No.	Types of Error	Meaning of the error	Example
1.	Addition	Add Linguistic Material	Target: We Error: We and
2.	Anticipation	A later segment takes the place of an earlier segment	Target: Reading List Error: Leading List
3.	Blends	More than one item is being considered during speech production. Consequently two intended items blend together.	Target: Person/ People Error: Perple
4.	Deletion	Or Omissions leave some linguistic material out	Target: Unanimity of Opinion Error: Unamity of Opinion
5.	Exchange	They are double shifts. Two linguistic units change places.	Target: Getting your nose remolded. Error: Getting your model renosed.

6.	Lexical Selection Error	Speaker has problem with selecting the correct word.	Target: Tennis racquet Error: Tennis Bat
7.	Malapropism	The speaker has the wrong beliefs about the meaning of a word. Consequently, he produces the intended word, which is semantically inadequate. Therefore, this is a competence error rather than a performance error. Malapropism are name after Mrs. Malaprop, a character from Richard B. Sheridan's 18th century play 'The Rivals'.	Target: The flood damage was so bad that they had to evacuate the city. Error: The flood damage was so bad that they had to exaporate the city.
8.	Metathesis	Switching of two sounds each taking the place of the other.	Target: Pus pocket Error: Pos Packet
9.	Morpheme Exchange Error	Morphemes change places	Target: He has already packed two trunks Error: He has already packs two trunked
10.	Morpheme Stranding	Morphemes remain in place but are attached to the wrong words.	Target: He has already packed two trunks Error: He has already trunked two packs
11.	Perseveration	An earlier segment replaces a later Item	Target: Black boxes Error: Black Bloxes
12.	Shift	One speech segment disappears from it's appropriate location and appears somewhere else.	Target: She decides to hit it Error: She decide to hits it.
13.	Sound Exchange Error	Two sounds switch places	Target: Night Life Error: Knife Light
14.	Spoonerism	It is a kind of metathesis. Switching of initial sounds of two separate words. They are named after Reverend William Archibald Spooner who probably invented most of his famous spoonerisms.	Target: I saw you light a fire. Error: I saw you fight a liar.

15.	Substitution	One segment is replaced by an intruder. The source of intrusion is not in the sentence.	Target: Where is my tennis racquet? Error: Where is tennis bat?
16.	Word- Exchange error	It is a subcategory of lexical selection errors. Two words are switched.	Target: I must let the cat out of the house. Error: I must let the house out of the cat.

There are many errors that we use casually while speaking or comprehending our sentence. If we are aware of all the errors we can identify the types of error we are making while language production and can work on it.

Gestures and Context: Gestures are essential component of language production. Gestures refers to the movements of the arms and hands that accompany speech. It is assumed that people use gestures because they believe it will increase their ability to communicate with their listener(s). McNeill (1985) suggests that speech and gestures are closely realted, both generated by the same psychological processes. Gestures develop together with speech as children learn to communicate, and gestures disappear when people develop speech disorders as adults. In our ancestral past as well, human communication likely relied on gestures, with vocalization developing much later. Holler and Wilkin (2011) to find the responsiveness of speakers to feedback from listeners, compared the gestures of speakers before and after listener feedback. The findings of their study suggests that:

1. The number of gestures decreased when the listener signaled understanding of what was communicated.
2. Feedback prompting clarification, elaboration, or correction was followed by gestures that were more precise, larger, or visually emphasized.

Gestures make it easier for speakers to communicate what they want to say. Gestures often form an important accompaniment to speech. Speakers use gestures because they make it easier to work out what they want to say and also because they facilitate communication with their listener.

Understanding Writing: Writing requires almost every cognitive processes like attention, memory, decision-making, creativity, reasoning, etc. Writing is an important component of many people's occupations. Students, teaching professionals, editors, spend a major portion their daily life taking notes on lectures, making lesson plans and writing papers, editing article, respectively.

Comparison between Speaking and Writing:

The differences between speaking and writing are as follows:

1. Speakers mostly know clearly who is receiving their communication while writers don't.
2. Speakers generally receive moment-by-moment verbal and non-verbal feedback (e.g., expressions of surprise, awe, etc.) from the listener(s) and modify what they say in response based on that feedback but writers don't usually get real-time feedback (get delayed feedback).
3. Speakers generally have much less time than writers to plan their language production. This kind of provide an explanation of why spoken language is shorter and less complex than

written language.
4. Writers typically have direct access to what they have produced so far as their writing can be recorded in comparatively permanent form whereas speakers do not.
5. Writers are required to extensive revisions and editing.
6. Children require elaborate teaching to master written language, whereas they learn spoken language very easily.
7. Adults who can read tend to learn new words more quickly when they appear in a written form, rather than a spoken form.

Cognitive Tasks involved in Writing: The cognitive tasks that are involved in writing includes planning, generating sentences, and revising. These processes can occur in a sequence or can occur simultaneously.During writing, numerous simultaneous demands or constraints are dealt.

i) Planning: The planning stage involves at least three kinds of elements that are goals to express content knowledge about the topic, goals not related to the content, like the form of the essay or persuasive techniques, and goals to use certain words and phrases that sound appropriate. Prewriting is difficult and strategic and is much different from many relatively automatic language tasks. An outline help to sort the ideas into an orderly, linear sequence. Studies suggest that the amount of planning and the quality of planning are highly related with the quality of the written text. Kellogg (1988, 1990) reported that college students who were instructed to prepare a written outline later wrote significantly better essays than students in a control group. Thus, an outline may assist in reducing attention overload. In addition, an outline may help students overcome the linearization problem, which occurs in writing as well as in speaking.

ii) Sentence Generation: During sentence generation, the writer translates the general ideas developed during planning, in order to create the actual sentences of the text. The outline planned is greatly expanded during this process. One important characteristic of sentence generation is that the final essay can be at least eight times longer than even the most elaborate outline. Another important characteristic is that hesitant phases tend to alternate with fluent phases. It is often believed that writing will sound more sophisticated if lengthy words are used. However, according to research by Oppenheimer (2006), people actually judge writers to be more intelligent if their essay uses shorter words.

iii) Revision: For revision, it is required to reconsider the goals of the text, to predict how well the text accomplishes these goals, and to propose improved ways to accomplish the goals. Hayes et al. (1987) compared the revision capabilities of seven expert writers and seven first year college students. The results of the study suggested that first year students of college were likely to approach the text one sentence at a time, fixing relatively minor problems with spelling and grammar, but ignoring problems of organization, focus, and transition between ideas in comparison to the expert writers.

Bilingualism: Bilingualism is the ability to speak two distinct languages. Although before diving into the aspects of bilingual education or Learning, it is essential to understand that the native language helps form the foundation of learning in every child. When a child grows up **speaking and learning two languages,** they are likely to have a bigger world of meanings than those who speak only one language. Bilingual Learning is learning two different languages simultaneously. It is a widespread phenomenon worldwide and is experienced by

most students, especially in India, where the students are required to learn their native language with English as a second language.

Advantages of Bilingual Learning

There are multiple advantages to bilingual Learning and reasons why it is still a significant yet prevalent part of Indian education. These are:

It is easy to learn a second language- Learning a second language, especially by children, is much easier as they grab onto learning quickly and don't feel much embarrassment while practicing. Both the process of Learning works simultaneously, helping them majorly in development. The information they absorbed is apt to their mental ability and less complex for their age, although the complexity does rise with generation but still needs to be undoable.

It is a way forward to multilingual Learning-Learning a foreign language makes it easier to learn other languages and brings fluency to learning the previous language. This helps brain development, increases concentration, and reduces the time it takes to transition from one task to another.

Develops Wisdom- Learning a second language encourages wisdom. As it comes from personal experience, learning a new language increases the amount of new knowledge and experiences. It also increases the potential of pursuing studies abroad, expanding the exposure to learning about new cultures and experiencing them.

Exploring diversity- A child doesn't necessarily care about issues important to adults, such as same-sex marriages. However, they care about exploring, making new friends, and learning about new things and cultures. Learning a second language allows them to explore diversity in different cultures and be a part of them.

Increases prospects for future opportunities-Being bilingual offers numerous opportunities in the future for other cultures and domains. In addition, fluency in two or more languages makes you an ideal candidate for jobs in vocational paths. It also creates opportunities in the local market and increases the chances of getting a higher salary.

Improves working memory-Learning bilingual languages help improve working memory. It also allows students to experience lower anxiety levels and is less likely to develop any mental health disorders. It also helps them make new friends and enhance their capabilities when exposed to new concepts or experiences.

Disadvantages of Bilingual Learning

As discussed below, there are a few downsides to bilingual education or Learning.

Lack of qualified assistance- The teacher should be fluent in both languages for the students to learn bilingual languages simultaneously. In addition, they should have adequate knowledge and patience while having little expectations for their student's progress. With modern education, teachers need help to fulfill the minimum requirements sufficiently.

Split students' concentration-Learning bilingual languages can split the concentration of students, especially for those students who find learning a second language difficult, as they'll direct their attention and concentration more toward learning the second language. As a result, they'll spend more time catching up with the second language and be left behind in learning life skills.

It prevents involvement in local culture- Although learning a second language is advantageous, it does have downsides too. One of them is the cultural gap between the student

and the local culture as they spend more time isolated or with friends from different cultures. Moreover, this gap worsens as the next generation gets more isolated and equipped with other cultures.

Bilingual Learning is a little expensive-Foreign language learning courses are costly. Due to this, most schools only prefer them in their curriculum if mandated. However, education in a single language is more accessible and allows educators to provide vital skills students may require.

Learning a second language has pros and cons, but understanding them and finding a balance is the key. It helps understand a different culture and experience new things and is a crucial part of India's education system. Best schools in India emphasize learning other languages apart from a native language, such as Sanskrit, which gives a sneak peek into Indian history, and English to learn and be a part of the global integration that is taking place in the modern world.

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Very Short Questions/True facts:

1.We usually speak at a rate of 2–3 words per second, or about 150 words per minute.

2. **Pragmatics:** The study of how social rules or context influences the interpretation and meaning derivation of communication.

3. **Gestures:** Gestures refers to the spontaneous movements of fingers, hands, and arms that frequently accompany speech.

4. **Slip of the tongue:** Slips-of-the-tongue are errors in which sounds or entire words are rearranged between two or more different words.

5. **Linearization Problem:** The problem of arranging words in an ordered, linear sequence is called the linearization problem.

6. **Directives:** A directive is a sentence that requests someone to do something. For example, "Could you lend me your book?".

7. **Multilingualism:** Multilingualism refers to the ability of engaging on a regular basis, with more than two languages in day-to-day lives.

8. **Metaphorical Language:** Metaphorical language is a type of language involving metaphors, placing two nouns side by side, emphasizing their similarities while not disconfirming their dissimilarities.

9. **Expert writers** are more likely than **novice writers** to revise a paper's organization, focus, and transitions, as well as to identify incorrect sentences.

10. **Agrammatism:** A condition in which speech production lacks grammatical structure and many functional words and word endings are missed.

Short Questions:

1. **What is indirect speech act?**
   Speech acts are sometimes indirect, meaning we accomplish our speaking goals through subtle or less direct methods. A common example is an indirect request, where a request is made without being explicitly stated. There are four basic ways to make indirect requests: by asking or making statements about abilities, expressing a desire, indicating a future action, or providing reasons.

2. **What are the four maxims proposed by Grice (1975) that a speaker should follow**

in conversation?
Grice (1967) proposed four maxims a speaker should pay attention to:
1 Maxim of relevance: the speaker should say things relevant to the situation.
2 Maxim of quantity: the speaker should be as informative as necessary.
3 Maxim of quality: the speaker should be truthful.
4 Maxim of manner: the speaker should make his/her contribution easy to understand

3. **What are the stages in speech production? (**Refer to the content of Unit II)

4. **Briefly explain the linguistic importance of gestures.**
Gestures refers to the movements of the arms and hands that accompany speech. It is assumed that people use gestures because they believe it will increase their ability to communicate with their listener(s). McNeill (1985) suggests that speech and gestures are closely realted, both generated by the same psychological processes. Gestures develop together with speech as children learn to communicate, and gestures disappear when people develop speech disorders as adults.

5. **Briefly state the similarities in speaking and writing.**
The similarities between speaking and writing are supported by various theoretical approaches to language production, which suggest that both processes start with determining the overall meaning to be communicated. Whether language is written or spoken, it is intended to convey meaningful messages, facilitating communication between speakers of a particular language. Thus, both spoken and written language share a common communicative function. The language we use to communicate, either through writing or speech, is largely shaped by the context of the interaction also.

6. **What is a dialect?**
A dialect is a regional variety of a language distinguished by features such as vocabulary, syntax, and pronunciation. The study of dialects provides insights into such diverse phenomena as auditory discrimination and social discrimination. Many of the words we choose are a result of the dialect we use. The most well-known example is the word choice for a soft drink. Depending on the dialect you use, you may order a "soda," "pop," or a "Coke".

7. **How do the Single System Hypothesis and Dual System Hypothesis explain language processing in bilingual individuals?**
The single-system hypothesis suggests that two languages are represented within a single or unified system or brain region. Whereas, the dual-system hypothesis suggests that two languages are represented somehow in separate systems of the mind.

8. **What do you mean by additive and subtractive bilingualism?**
In additive bilingualism, an individual gains proficiency in a second language without losing proficiency in their first language, with both languages being valued and respected. In subtractive bilingualism, the new language replaces the first language. For example, most linguistic minority groups in the United States and Canada are pressured to develop high-level skills in English at the expense of their first language.

9. **What is a critical period hypothesis?**
Critical period hypothesis states that our ability to acquire a second language is strictly limited to a specific period of our life. In fact the critical period hypothesis proposes

that individuals who have already reached a specified age like for inference, perhaps early puberty, will no longer be able to acquire a new language with native- like fluency.

10. **In what way does language production affected in individuals with Autism Spectrum Disorder?**
Individuals with Autism Spectrum Disorder may have difficulty developing language skills. The individual experience delay in speech development. Some individuals with ASD may exhibit echolalia which refers to the involuntary condition of repeating a certain word over and over. They also often have difficulty communicating nonverbally, such as through hand gestures, eye contact, and facial expressions.

Long/Extensive Questions:

1. **Discuss the various kinds of slip-of the tongue.**
Various kinds of slips of the tongue are:
- In anticipation, the speaker uses a language element before it is appropriate in the sentence since it matches an element that will be needed later in the utterance. For example, instead of saying, "an inspiring expression," a speaker might say, "an expiring expression."
- In perseveration, the speaker uses a language element that was appropriate earlier in the sentence but that is not appropriate later on. For example, a speaker might say, "We sat down to a bounteous beast" instead of a "bounteous feast."
- In substitution, the speaker substitutes one language element for another. For example, we may have warned someone to do something "after it is too late," when we meant "before it is too late."
- In reversal (also called "transposition"), the speaker switches the positions of two language elements. An example is the reversal that reportedly led "flutterby" to become "butterfly." This reversal captivated language users so much that it is now the preferred form. Sometimes, reversals can be fortuitously opportune.
- In spoonerisms, the initial sounds of two words are reversed and make two entirely different words. For example,"You have hissed all my mystery lectures," [missed all my history lectures].
- In malapropism, one word is replaced by another that is similar in sound but different in meaning (e.g., furniture dealers selling "naughty pine" instead of "knotty pine").

2. **What do you mean by speech act? Discuss the various kinds of speech acts.**
Speech acts address the question of what we can accomplish with speech.
According to Searle (1975), five basic categories of speech acts are:
Representative: A speech act by which a person conveys a belief that a given proposition is true. The speaker can use various sources of information to support the given belief. But the statement is nothing more, nor less, than a statement of belief. Qualifiers can be added show the speaker's degree of certainty.
Directive: An attempt by a speaker to get a listener to do something, such as supplying the answer to a question. Sometimes a directive is quite indirect. For example, almost any sentence structured as a question probably is serving a directive function. Any attempt to elicit assistance of any kind, however indirect, falls into this category.
Commissive: A commitment by the speaker to engage in some future course of action.

Promises, pledges, contracts, guarantees, assurances, and the like all constitute commissives.
Expressive: A statement regarding the speaker's psychological state.
Declaration (also termed performative): A speech act by which the very act of making a statement brings about an intended new state of affairs. Declarations also are termed performatives (Clark & Clark, 1977).

3. **What do you mean by speech errors? Name the different types of speech errors.**
(Refer to the content of Unit II)

4. **Explain the theory of speech errors by Dell.**
Dell and his colleagues proposed an elaborate and comprehensive theory for speech errors that is similar to the connectionist approach and includes the concept of spreading activation (Dell, 1986, 1995, 2005; Dell, Burger & Svec, 1997; Dell et al., 1997; Dell et al., 2008). For instance, when we are about to speak, each element of the word we are planning to say will activate the sound elements to which it is linked. For example, the words in the tongue twister "She sells seashells" might activate each of the six sounds in the last word, seashells.
Dell et al. (1997) developed spreading-activation theory. They implied that most speech errors belong to two categories:

1 Anticipatory: Sounds or words that are spoken ahead of their time (e.g., "caff of coffee" instead of "cup of coffee"). These errors mainly reflect inexpert planning.

2 Perseveratory: Sounds of words are spoken later than they should have been (e.g., "beef needle" instead of "beef noodle"). These errors reflect planning failure or a failure to monitor what one is about to say.

We utter the sounds that are most highly activated mostly, and usually these sounds are the appropriate ones. However, each sound can be activated by several different words. Dell also emphasized thet incorrect items sometimes have activation levels that are just as high as (or higher than) the correct items. Dell also assumed that expert speakers plan ahead more than non-expert ones. As a result, a higher proportion of their speech errors will be anticipatory.

5. **What are the key brain structures involved in language? Discuss.**
Studies of patients with brain lesions, and brain damage have revealed about the relations between particular areas of the brain and particular linguistic functions. In general, language-related functions are predominantly located in the by Broca's area and Wernicke's area both located in the left hemisphere, which are important for language production and comprehension. fMRI studies have suggested that the middle part of the superior temporal sulcus (STS) responds more strongly to speech sounds than to non-speech sounds. According to Binder (2009), five key brain regions are involved in the storage and retrieval of meaning are the ventral temporal lobes (including middle and inferior temporal, anterior fusiform, and anterior parahippocampal gyri), the angular gyrus, the anterior aspect (pars orbitalis) of the inferior frontal gyrus, the dorsal prefrontal cortex, and the posterior cingulate gyrus. Broca's area in the posterior half of the left inferior frontal gyrus has traditionally been

considered an important node in the speech production network. Some other subcortical structures (e.g., the basal ganglia and the poste- rior thalamus) also are involved in linguistic function. The left hemisphere seems to be better at processing well-practiced routines. The right hemisphere is better at dealing with novel sti- muli. A possibly related finding is that individuals who have learned language later in life show more right-hemisphere involvement (Neville, 1995; Polkczynska- Fiszer, 2008).

6. **Discuss about complex interplay between gestures, context, and language production in various settings.** (Refer to the content of Unit II)

7. **What are the cognitive tasks involved in writing? Explain.** (Refer to the content of Unit II)

8. **Discuss the strengths and limitations of Dell's spreading activation theory.**
The strengths of Spreading-activation theory by Dell are:

-The mixed-error and lexical bias effects suggest that the processing associated with speech production can be highly interactive as predicted theoretically.
-Several other types of speech error (e.g., exchange errors, anticipatory errors) can be accounted for.
- The theory's emphasis on spreading activation provides links between speech production and other cognitive activities (e.g., word recognition: McClelland & Rumelhart, 1981).
-Our ability to produce novel sentences may owe much to the flexibility resulting from widespread activation between processing levels assumed within the theory.
-The original version of the theory was vulnerable to the change that it predicted more speech errors than are actually found.

The limitations of Spreading-activation theory by Dell are:

-It downplays the processes involved in the construction of a message and its intended meaning.
-Although the theory anticipates numerous errors in speech production, it does not account for the time required to produce correct or incorrect spoken words.
-The interactive processes emphasised by the theory are less apparent in error-free data than speech-error data (Goldrick, 2006).
-There is insufficient focus in the theory on the factors determining the extent of interactive processes during speech production. The interactive processing occurs less often when overall processing demands are high than when they are low (Mädebach et al., 2011).

9. **What is bilingualism, and what are the main benefits and drawbacks associated with it?** (Refer to the content of Unit II)

10. **What are the factors that influence second language acquisition? Discuss**
The dynamic and intricate process of second language acquisition is shaped by a complex interplay between individual physiological and psychological traits, influencing the outcomes of language learning. Some factors are:
Age: Some researchers have suggested that native-like mastery of some aspects of a second language is rarely acquired after adolescence. Some also disagree with this

view. They found that some aspects of a second language, such as vocabulary comprehension and fluency, seem to be acquired just as well after adolescence as before. Some aspects of syntax seem to be acquired readily after adolescence.

Intelligence: Lightbown and Spada in their study suggested that intelligence, as measured by verbal IQ tests, plays an important role in language-related learning tasks, such as reading and grammar, which involve language analysis and rule application. Despite that, the impact of intelligence is less significant, when it comes to spoken language focusing on communication and interaction.

Aptitude: The aptitude for second language (L2) learning is characterized by the strengths exhibited by individual learners in cognitive abilities relevant to information processing during second language acquisition. This involves their performance in diverse contexts and at different stages of the learning process, in comparison to the broader population (Harley and Hart, 1997; Robinson, 2005)

Motivation: Motivation for second language learning is a multifaceted phenomenon that defined by two key factors: learners' communicative needs and attitudes toward the second language community. Lightbown and Spada argued that an individual's identity and social dynamics, including power relationships, significantly influence language motivation. Both children and adults are sensitive to these social dynamics and power relationships, which can impact their motivation in the language-learning process (Lightbown and Spada, 2000).

Learner preferences and styles: Individuals demonstrate a range of learning preferences and styles, advancing at different rates owing to inherent biological and psychological distinctions (Reiff, 1992). Based on learners' learning characteristics in a specific domain.

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UNIT III

UNIT III	Problem Solving: Understanding Problem Solving Approaches and Factors Influencing Problem Solving.

Problem-solving is the process of observing what is going on in your environment; identifying things that could be changed or improved; diagnosing why the current state is the way it is and the factors and forces that influence it; developing approaches and alternatives to influence change; making decisions about which alternative to select; taking action to implement the changes; and observing impact of those actions in the environment.

A problem arises when a person tries to achieve a goal or wants to change his current circumstances into a different situation but his initial efforts fail to achieve the goal. Two or more alternative solutions may be possible for any action. Along with this, a problem may also arise because the usefulness of the information received by humans is limited economically. They cannot keep more than one mechanism in their study at a time. Therefore, they keep using strategies. Strategies are such capable methods which are used sequentially in a problematic situation. Bourne has indicated that what we call thinking in our daily life has neither any direction nor any result, such as thinking about daydreaming etc.

All this has no purpose and neither is any internal thoughtful action possible in it. Therefore, it is necessary to distinguish between the two stages of thinking and thinking about something. It is perhaps not possible to find a definition of thinking that is appropriate for scientific purposes and on which all experimenters agree. However, it is necessary to pay attention to the explanation of problem solving that has been given. In this regard, the views of Johen Dewey can be quoted. He has said about goal-directed or goal-oriented thinking that it is a multi-faceted process. Its first stage is the recognition of a problem or difficulty experienced. The second stage is the knowledge of the problem. In this situation, the relevant characteristics are separated and then the specific problem is understood. The third problem is the creation of possible alternative solutions. The fourth problem is to reason about various problems and determine one. The fifth stage is the examination of the resources used.

Kendler has described three main characteristics in the solution –

1. **In a problematic situation, the right solution is not easily obtained.**
2. **Mediating responses are found in problem solving behaviour, and**
3. **Initially the person feels that there is no progress in his solution behaviour, but often those solution behaviors are suddenly achieved which Gestaltists consider as insight.**

Problematic Situation - A problematic situation is one in which a being receives various types of stimulating signals but despite making various types of responses, he is unable to make progress towards his goal. In such a situation the being is in an abnormal condition.
According to Geddard, **"When a person faces such a situation in which he is unable to immediately and appropriately behave, a problem arises for him."**
In particular, a problem is an important response.

Every problem has three symptoms- **Original state, goal state and rules**.

1. Original state describes the state when the problem starts.
2. Goal state is found when the solution to the problem is achieved.
3. Whereas rules describe the restrictions that need to be followed to move forward from original state to goal state.

According to Andreas (1959), any problematic situation has six components.

(i)The organism has one or more goals.

(ii) The organism receives different types of stimulating signals.

(iii) It makes different types of responses to achieve the goal.

(iv) Each signal of the problematic situation is associated with different intensities due to previous experience with many responses occurring in that situation.

(v) The organism keeps gaining knowledge between correct and incorrect response.

(vi) By making the organism aware of the result, we provide feedback in the right manner.

In Kohler's cage, the orangutan's objective was to reach the target in order to reduce his hunger motivation. The open space between the sockets in the cage was a stimulus for him to go out and to reach the banana by extending his hand. The effort to reach the banana, i.e. moving around in the cage, holding the stick in the hand, all these were responses which were stimulated by the stimulus signals in the cage, when the orangutan's hand did not reach the banana, he understood that his response was not correct.

Johnson (1972) has defined the problem in such a way that 'when a person is motivated to reach a goal and his initial efforts fail, then a problem arises.' The motivation to reach the goal can be due to any reason like hunger, thirst, fear etc.

According to Bourne (1977) etc. 'In a problematic situation, the initial efforts of a person fail to achieve a goal and he has two or more types of effective signals available for response. The motivation of rats in Skinner's box, cat in Thorndike's cage, orangutans in Kohler's cage was hunger. Apart from this, there are some psycho-biological or mental motives as well. Like curiosity and interest. If a person achieves the goal in his primary efforts, then there is no problem for him. If he does not reach the goal, but he feels that he is moving towards it, then even in such a situation he does not have any problem because if his first response does not provide a solution then it can be said that he has a problem.

Problem solving behaviour refers to the meaningful efforts of an organism through which it achieves its goal by using appropriate methods and means. Problem solving behaviour has many characteristics. According to Johnson (1972)-

(i) Goal orientation is found in the behaviour of an organism.
(ii) Continuity is found in the behaviour of an organism.
(iii) Change is found in the behaviour of an organism after achieving the goal.
(iv) An organism does not make just one but many responses for solving a single problem.
(v) If one response made for solution fails, the organism makes another response.
(vi) The behaviour of all organisms for solution is not the same.
(vii) Solution behaviour takes less time than unsuccessful responses.
(viii) Mediating responses occur in problem solving.

Matlin (1983) has emphasized on cognitive process in problem solving because he makes a solution plan by acquiring knowledge about various aspects of the problematic situation. In this way he solves the problem by using many strategies.

Stages in Problem Solving

When problems are complex, a person takes more time to solve them, in which many cognitive activities take place in a particular sequence. There are many component processes found in problem solving, of which four processes are very special-

1. **Preparation**

Preparation means preparation to understand the problem. In this first stage, a person collects all the meaningful information related to the problem to get a solution. The time and effort spent in preparing for the same problem varies from person to person and problem to problem. The following actions are found in it

(i) Identifying the initial statement of the problem
(ii) Identifying the solution criteria
(iii) Determining the constraints imposed on solution attempts
(iv) Comparing the problem with those previously experienced (LTM)
(v) Outcome: Construction of a representation of the problem.

Option

Dividing the total problem into parts or sub-problems
Constructing a simpler problem by ignoring some information
According to the above actions, for solving the chess problem, the human being will have to do the following-

(i) Position of the pieces found on the chess board.
(ii) Attainment of two moves (black and white) goal.
(iii) Acquisition of knowledge about the constraints which are to be moved according to the rules of the game in order to achieve the solution.

An experienced chess player quickly assimilates this information and concentrates on the problem statement. As a result the third stage of solution takes relatively less time because it is retrieved from long term memory. The outcome of preparation is considered as the interpretation of the problem. One's analysis depends on the structure of the problem.

Production- There are various activities involved in solving a problem-

(i) Retrieving facts and procedures from long term memory (LTM)
(ii) Scanning information available in the environment
(iii) Operating on the content
(iv) Maintaining outcomes of prior opearions in STM
(v) Storing information in LTM for possible later useThus it can be said that the product has the potential of the above activities. The product is a potential solution. The solution of a simple problem is the retrieval of the correct solution from long term memory. Whereas for complex problems like matching problem, chess etc., solution strategies are required.

There are two methods for solution methods. **Algorithms and Heuristics are used-** Algorithms and Heuristics Algorithms are those methods which when used guarantee to get a solution (EFCTA, EFCAT, EFTCA, EFTCA, EFACT, EFATC, EFCTA, ECTFA..... FACET) while the heuristic method is called "Rules of Thumb". The investigators are selected or restricted which reduces cognitive strain.

Judgment- This step is relatively simple. Although at the beginning of the solution the decision is complex and uncertain. It involves evaluating the

solutions generated. The following activities are found in it-

(1) Comparing the generated solutions criteria
(2) Choosing a decision rule for deciding that a sufficient match exists,
(3) Outcome! Decision that the problem is solved or that more work is needed.

Incubation- All the three stages mentioned above are logically necessary for problem solving but it has been accepted as the fourth stage of incubation. In this stage when the person fails to find a solution in his primary attempt, he diverts his attention from the problem and focuses on other tasks and when after a while he again focuses on the problem, he sometimes succeeds in finding a solution. In this way the problem is solved through incubation (Dominowski & Jenvick, 1972, Murray & Denny, 1969). Incubation is the stage when the person is not actively or consciously working on the problem and the work has started but the solution has not been found. The incubation effect is different for all problems.

Mechanism of Problem Solving Theoretical Explanation

The main focus of experimental work on thinking is problem solving. The reason for this is that through this the experimenter gets the opportunity to define the behavior of the subject properly. The important question in this regard is how different types of problems are solved? What is its mechanism? Three approaches are found in the explanation of problem solving-

(i) **Behavioral approach:** In this associative arousal is considered necessary for problem solving.

(ii) **Gestaltists approach:** Again, emphasizes on perceptual organisation.

(iii) **Information processing approach:** This emphasizes on the nervous system of the organism in problem solving.

There is no real difference in some parts of these mechanisms. But in general, they are different from each other and opposed to each other but their theoretical classification can be done by stimulus-response learning theories (behaviorist) and cognitive.

Associative Mechanism: Behavioristic Explanation

The associative approach emphasizes the role of prior experience. If the results of the individual's prior experience establish inappropriate behavioral tendencies, then a new task will become a problem for the individual because there is a negative transfer of the subject's prior experience (learning) to new situations (Schulz, 1960). The special feature of the associative approach is the response hierarchy. This concept means that a stimulus is associated with many responses and the strength of association keeps changing. We can divide the responses on the basis of their strength which develops a hierarchy of its own. Thus, the problem will arise when the strongest response fails and for its solution it will be necessary to evoke the next responses in the hierarchy so that the correct response can be elicited. In this way, behaviorist psychologists explain behaviour through the establishment of associations between stimulus and response.

1. Behavioristic Approach

Stimulus response generally explains behaviour in the form of associations or links of associations i.e. the relation between stimulus and response is in the form of establishment of association. They also explain problem solving processes through associative mechanisms.

For this explanation, they have collected more experimental data by experimenting on animal subjects. In this regard, the experiments of Thorndike (1911) are important. Behaviorist approach is effectively explained through his experiments.

Thorndike (1911) developed the techniques of Puzzle Box and Maze learning for problem solving behaviour in animals. For the Puzzle Box problem, he took cats as subjects. He kept a hungry cat in a cage which was open from one side. But it had iron rods fitted in it through which the cat could not come out. It had a small door. Which could be opened by pulling the rope hanging in the cage. The cat could see the plate of fish kept outside these rods. There were many types of stimulating signals for it in this cage. The cat makes many types of responses, like clawing the rods or trying to get out between them. After trying like this for some time, the door opened when its paw fell on the hanging rope. On repeating the experiment, it was found that gradually the useless responses ended and the correct response of pulling the rope got strengthened. Thorndike also developed the maze as a tool. The animal is kept in a box in which there is only one way out. To get food, the animal had to learn the maze in a sequence. After many attempts, the correct habit is developed and remains effective there.

Behavioral psychologists explain problem solving through the concepts of response hierarchy, implicit trial and error, mediating generalization and coordination of behavior segments.

2. Gestaltist Approach

Gestaltist approach is opposite to the behaviorists approach. It considers insight as the main mechanism of problem solving. Kohler and other Gestaltists have criticized Thorndike's approach on several grounds-

(1) The achievement of pure responses by cats is unnatural. For the cat, the puzzle box creates an artificial problem situation, the cats have to behave in such a way which they do not do normally like normally they do not pull the rope or press the button to get out of the box. Rather they try to get out by entering the narrow passages (between the bars). If there is any obstacle then they claw at it, they do every such action which has not been encouraged. In such a situation, the correct response also happens by chance.

(2) The necessary parts were hidden in the situation like the cat does not see the mechanical arrangement which is connecting the rope and the door.

Gestalt psychologists consider problem solving to be the result of perceptual reorganization. According to them, a problem arises only when a person is unable to perceive a situation properly. In other words, correct perception of a situation is the solution to the problem. This is what Gestalt psychologists call insight. A strong perceptual aspect is found in their problem solving. In the experiment that Kohler did on orangutans, he studied problem solving by creating natural problems. In one experiment, an orangutan was kept in a cage and tied to a tree. There was a stick lying there which it picked up, bit with its teeth and threw it away, then a banana was kept which was so far away that it could not get it with its hands. The orangutan tried to pick up the stick with his hand, then picked up the stick and looked at the banana and immediately pulled the banana towards himself. The stick was used as a medium. In this way the ape understood the means end relation.

3. Information Processing Theory

This is a popular theory of thinking that considers a being as a complex information institution. This theory generally uses a computer as a model. It is said that people act in a way according to the calculator. The input to the calculator is the same as the environmental stimulus is for

the being, its execution is according to the output of the being. The internal and functional information processing responses of the computer are exactly like the internal thought processes in the being. The general saying is that if the actual performance in an animal or human can be experienced according to the output of the computer, then computerized programming can be considered an adequate theory of its behavior. Many human capabilities can also be projected at the computer level. It is essential that the operations on the computer are done quickly. The reason for this is that the calculator is made by man and its purpose is to perform quickly. There is no doubt that as a tool, the calculator has achieved such results which are impossible to achieve by man, such as large calculations can be done in seconds. The development of calculators started from 1950 itself and the most complex problems were solved by them. Artificial intelligence was introduced by calculators, since the methods used by humans in solving problems are different from the methods used by computers. Therefore, the work done related to artificial intelligence was not completely related to human psychology because different methods are used in the calculator than the methods used by humans in studying problems. The effect of calculator stimulation has a significant impact on the psychology of human cognitive processes. Newell . & Simmon, 1972; Raphel, 1976 have initially worked on artificial intelligence. These researchers used computer stimulation and developed the information processing view of problem solving.

While solving a problem, he generates a coordinated sequence of his operations. In generating such a coordinated sequence, a person uses many mechanisms, such as-

a. **Search-scan schemes-** A person visualizes many sub-objectives through exploration, such as rope, chalk, rod, clamp, then finds the direction of the investigation through microscopic analysis, and compares it. That is, at the time of problem solving, those mechanisms keep getting activated one after the other. If this does not happen, one keeps happening for a long time, and the other does not happen, then the problem becomes difficult.

b. **Means-end-analysis-** In this, there are two situations of problem-solving in particular-

- Situation before the solution.
- Situation after the solution.

There is a difference in both these situations. When a person solves a problem, he differentiates the difference between the two sides. Removing the difference is problem solving. Many operations are used to bridge this gap. A person can bridge this gap by using relevant operations through the means-end-action.

The problems which are solved, their solutions have rules which indicate us what we should do and what we should not do. In daily life, we get these rules from society and tradition, but in formal problems, these are part of the problem itself. Two rules are used to solve problems. One of them is algorithm and the other is heuristic. These are all rules by following which a problem is solved. For example, if we are asked to multiply two numbers, we immediately think of the rule of multiplication and then use the same algorithm. These are all fixed rules in which no change can be brought.

For example, 2×2=4 will always be 5 No. Similarly, in mathematics and statistics, the solution can be found by using the special algorithms for solving the problems, but there are no algorithms bound to the problems. In such a situation, we use heuristic strategies which depend on the prior

experience of the problems, for example, a common strategy is to divide a problem into small hypotheses, each of which leads us towards the goal.

The material of problems for humans and animals can be divided into different categories.

Experimental Material for Animal Subjects

1. **Multiple Problems-** These problems are used for problem solving behaviour of rats. In this, a special type of stimulating situation is presented. Rats are given the option of more than one response. Such stimulating situations (U maze, T maze, Y maze) are called mazes. There are two options in T maze, to turn right or to turn left. The problem of the rat is that in which direction it should go so that it can achieve the goal. It is placed at the goal place and it is observed how and in how much time the rat reaches the goal.
2. **Puzzle Box Problems-** These problems were first used by Thorndike. Later Guthrie and Galton used them. In this, a box is made such that the animal can come out only when it can open the door. The reward remains outside, for example, the door of the Skinner box or Thorndike box opens only on pressing a button or pulling a rope.
3. **Detour Problems -** Such material is used on dogs, cats and apes. Kohler has used it in his experiment. In such problems, the way to reach the goal is hidden in the stimulating situation. The animal subject has to perceive the situation properly only then he can find the path to solve the problem.
4. **Double Alternative Problems -** In this, the solution behavior is observed by using a temporal maze. The structure of this maze is such that there are two stupas after a short distance around it. The goal can be achieved after the animal goes round those stupas in a sequence. This material was used by Hunter (1928) to experiment on rats.

Experimental Material for Human Subjects

Many types of experiments have been used to study the problem-solving process in humans, such as anagrams, picture puzzles, word puzzles, construction problems, mathematical problems, etc. Since humans have problems in every type of situation, the problems and materials in the laboratory are also of different types. One important thing is that we have obtained some facts about different situations through experiments, but the way the problem-solving process of animals has been studied well and extensively, the study related to human problem solving behaviour has not been done so extensively. Therefore, very few general rules have been quoted. Frank Gedard has pointed out the thoughts of William James which he had expressed about this ideology, "It would be like a painter's first charcoal sketch upon his convex in which no nice ties appears." This was the situation at the time of James, and still is. There has been no special development to show the complexities of human thinking and problem-solving behaviour, yet the problems which are used are described one by one.

1. Anagrams- When the order of letters of a word is disturbed, then its changed form is called anagrams like KOBO, LHGIT

2. Word puzzles- Such puzzles are found more in our languages. Although they are used for entertainment, they have also been used in experimental studies of problem solving.

(i) Indu is faster in studies than her sister Rekha but not as fast as Vinod, Vinod is faster than Indu's sister but not as fast as Bandana is than Vinod, so tell me who is faster in studies (Indu).

(ii) (Jitendra, Nitendra, Satendra and Gajendra were playing cards in a room. Jitendra was on the right of Nitendra and Gajendra was on the left of Satendra. So tell who among those four was the partner of each other. (Gajendra and Satendra).

(iii) A young man and a young woman were sitting in a garden. Someone asked, 'What is the relation between you two?' The young woman replied, 'The father of the person whose father is my father-in-law is my father-in-law.' What is the relation between the two? (Brother-sister)

3. Construction Problems - In this, the user solves the problem by doing something, like, Mayor's two ropes problem, hat peg problem, water pot problem etc.

Bourne & Dominowaski (1971) while reviewing the above problem tasks in experimental studies of problem solving behaviour, stated that till now the following three types of tasks have been mentioned-

(i) Search problems

(ii) Insight problems

(iii) Word problems

Search problems are those in which alternatives to solve the problem have to be found. In such alternatives, the solution is definite. The experimenter sees how much time it took to find the correct solution and what was the working method of the subject. In insight problems, the perceptual ability of the subject is tested and it is observed to what extent the subject can use a thing. Similarly, in word problems, the perceptual ability, ability of reorganization and interpersonal relations of the subject are tested.

Factors Affecting Problems Solving

When the experimenter presents a problem to the subject, he either solves that problem or experiences difficulty in solving it. Both these conditions can be measured experimentally.

(i) Time taken for solution.

(ii) Priority of response in a given time.

The first is called solution time and the second is called solution probability. Different types of variables are studied using these two methods, we can divide those variables into three categories.

(i) First variable- which are related to the problem.

(ii) Second variable- which are related to the characteristics of the solution.

(iii) Third variable- which are related to the characteristics of the solver.

Effects of Characteristics of Problematic Situation

1. Size of the Problems - Every problem has some characteristics such as the size of the problem. The problem can be small as well as big. When the size of the problem is big, it becomes difficult

to solve it. Nemark & Wagner (1964) asked human subjects to sort pictures similar to standard pictures. The more the number of pictures, the more time it took to solve. Caplan & Karvallas (1968) presented anagrams of 3 sizes - 3, 6, 10 letters. The more the letters in the anagrams, the more time it took to solve.

2. Similarity of Problematic Situation and Solution Situation - This characteristic has been expressed by Gestalt and Information Processing theories. The more similar the state of the material at the time of presenting the problem and the state of the material after getting the solution, the less time will be taken in solving it. Dominowaski (1966) studied anagrams (OWARDC, ROWNB) in his experiment and got the result that on changing one, two and three letters, the average value of the solution was 154, 3.1 and 5.4 respectively.

3. Organization of Problematic Situation - The more organized the nature of the problematic situation is, the more difficult the perceptual organization will be. Research shows that Gestalt psychologists have considered this factor important. Anagrams are actually a series of letters which have no organization from above but if we take a well-organized word ENTER, then its reorganization in the form of ERTEN is difficult. ENTER is organized, while ERTEN is unorganized. It is clear from this that it is difficult to reorganize a meaningful group of letters.

4. Influence of Instruction- An important variable in problem solving is related to the preparation of the subject. Prior instruction is necessary for this. Without any instruction, the subject may take more time to solve the problem, such as if the experimenter tells him that 'he has to make a word from the letters that will be presented', or 'if the problem is of light and switch then it is necessary to turn the switch until the third or seventh bulb is lit'. By such instructions many possible events in the experimental area are limited and the subject does not have to think about many possible methods.

5. Characteristics of Problematic Situation

To solve a problem, the subject uses those methods of which he already has experience. Mayzner & Tresslett (1961) studied this and observed that high and low frequency words were used and found that subjects solved the problems faster only when they were familiar with the words.

Effects of the Characteristics of Solution

1. Complexity of Solution - Simple solutions have fewer steps. The more steps there are to reach the solution, the more complex the solution will be. Complex problems are more difficult than simple problems. They can be measured in terms of the amount of time, number of clues and amount of information presented. Hayes (1965) using the spy problem found that the bigger the problem, the more time it took to solve it. Gagne & Smith (1962) presented a wooden stool with three circles A, B, C in the pyramid puzzle. Circle 'A' had circular flat pieces of wood. The largest at the bottom was the smallest at the top. Like 'A', they had to do the same in circle 'B' and pick up only one piece at a time. With the increase in the number of circles, the speed of the subjects also increased.

2. Familiarity with the Problem - Familiarity of the subjects with the various steps of the solution makes the solution easy. Mayzner & Tresslet (1959) took four types of anonyms whose frequency in one million words was 100 times, 50-99 times, 1 time and less than 1 time. The subjects took 76, 96, 138 and 148 seconds respectively to solve the problem. Thus, the solution was facilitated due to the prior familiarity of the subjects.

Effect of Characteristics of Problem Solver

1. **Effect of Motivational Variables-** A person cannot do any work without being motivated. Its level can be high or low. According to the Ywerks-Dodson rule, the desired level of motivation should be present in a person for any work. If it is less or more than this, the performance becomes weak. For example, anxiety is a motivational attitude. Some people are more anxious and some less. The effect of anxiety on problem solving has been studied according to the above rule. According to Harleston & Russell (1965), some people are very anxious in a testing situation. Due to this excessive anxiety, there are more errors in problem solving, as a result of which the performance is not done properly. While thinking is determined by motivational elements, but when the applicant is emotionally very anxious about a problem, then his chances of success are reduced. For success, he has to perform averagely. One should be worried. Excessive worry, irritation, anger etc. disturb the balance and disrupt the integrity. On the other hand, indifference and overconfidence also do not have good results.

2. **Effects of Practice or Past Experience-** Previously learnt sequence of responses makes problem solving easy but Gestaltists want to know whether previous experience helps or hinders in restructuring the problem. As a result, they have pointed towards the effects of past habit. Maier (1931) wanted to see what effect previous experience has by giving two ropes problem. He got the result that among Maier's subjects, there were very few who could solve the problem without prompting.

3. **Effect of Set** Readiness is a tendency, just like a runner becomes more ready before starting a race. It helps in doing the work. But it also has a blocking effect. As an intermediate variable, the set is related to the same processes on the output side. Whereas on the input side, it is affected by the inputs of the experimenter. The advantage of the set is found in the ease of appropriate response and inappropriate responses are blocked by it.

Solving Simple and Multistep Problems

1. **Solving Simple Problems** Some problems are fully defined, simple and do not require detailed construction of sub-problems or solution instructions. In this, the person is given information which clearly describes the problem and only the solution has to be obtained. Some steps are also required in these problems. But their number is less and they are simple. Research in such problems shows that many factors affect the problem difficulty, the description of which is given below-

(i) Problem Presentation The first step in problem solving is the interpretation of the information presented. Research on a variety of problems shows that the way in which the problem is initially presented affects a person's solution-seeking behaviour because the clues in the problem as initially presented may be helpful as well as confusing to the person. LeMay (1972) has given a good example. It is easier to present the word BACON as a solution when ACONB is presented rather than NOBCA because BACON and ACONB have 4 letter positions in common while NOBCA has no similarity.

(ii) Hints Giving hints to the person solving the problem is to introduce new elements. Generally the main purpose of giving hints is to help the person solving the problem. Although sometimes the hints have no effect and they are also misleading. It is essential to differentiate between the perception of the person giving the hint and the person receiving the hint. The one

giving the hint knows the solution to the problem while the one solving it does not. As a result the one giving the hint knows the problem and its relations but the one solving it does not know this relation. Hints are ignored or followed. Different incorrect solutions are also attempted or these hints reveal the solution.

(iii) Solution Familiarity - The material related to this can be seen in the subheading 'Effect of practice or prior experience' under the heading 'Effect of characteristics of the solver'.

(iv) Problem Size - The material related to this is described in the subheading 'Effect of characteristics of the problematic situation' under the heading 'Size of the problem' in this chapter.

2. Solving Multistep Problems

Playing chess or solving pyramid problems is more complex than simple problems because it requires following many steps to get the solution because the solution is found only after solving many subproblems. There are many characteristics of multistep problem solving-

(i) Problem Size The size of a multistep problem is larger than that of a simple problem. For example, in a chess problem or pyramid problem, the solver has to calculate many pieces. When complex problems are large, the solver has to use more steps to solve them. The more complex the human maze, the more blind alleys it has. The more complex the problem, the more steps it has. Gagne & Smith (1962) in their experiment found that on using the problems of pyramid puzzle, 3.4.5 coins, the subjects needed 7, 15 and 31 movements. Polich & Schwarty (1974) used matching problems in their study. Car, pet, profession, hobbies etc. were taken and 2, 3, 4 information was given about them. As the number of matches increased, the difficulty was also increased.

(ii) Strategies: While solving multi-step problems, a person has to use many types of strategies. By doing means-end-analysis, the number of strategies gets reduced. When the solver finds the difference between the current state and the desired state, i.e., the goal state, then selectivity can be found in his speed. When he reduces the strategies, then his solution is as follows - AC>AD, CA>CE, EC>EJ, LM>LK, NO>NL. As examples of these multi-step problems, multi-step (multiple choice point) maze, double permutation problem, word puzzle, etc. can be taken.

(iii) Memory, Knowledge and Problem Solving While retrieval from short-term memory takes place in solving complex problems, processing and maintenance of information is also found in long-term memory. Both types of memories affect short-term and long-term problem solving in different ways. In a multi-step problem, a person has to select several 'Next Steps' for which 'Scanning' and 'Searching' are necessary. The immediate goal of the organism is to select the 'Best Move' and it obtains the best information through scanning and searching. All these activities take place in short-term memory. Before selecting a particular solution, organisms remember less of the intermediate steps taken and they return to the initial or early state and they consider it "Good Enough" (Newell & Simon 1972).

iv) Using Algorithms: Even large problems can be solved in less time, but for this the solver will have to use a specific method. Thus, the solution of any type of pyramid puzzle can be easily obtained by using a specific method (Simon, 1975). When a specific method is known to solve a problem and it is not complex, then its solution is easily obtained. But this specific

method is stored in long-term memory. For example, the experiment of Luchings (1964) can be cited.

(v) Structure of Knowledge: The solution of the person solving the problem is affected by his store of knowledge. For example, if a coin is tossed 11 times, then what will be the improbability of getting Heads 9 times? We can give it on the basis of propositional knowledge (Meyer & Greeno, 1972). The person knows the rules that he thinks of for finding a solution and in addition to that he also knows some other information and can also combine them (Anthony, 1973). When people are given direct instructions, they find solutions to problems even if they have low interest in them (Meyer et. al., 1975). People who have increased knowledge, get many step-by-step benefits in problem solving. He can present problem-related information properly, he can use special methods for finding a solution, not only this, he can also use exploratory methods.

Creative Problem Solving

There are some tasks for which it is difficult to decide on a specific answer. The solution criteria are so broad and vague that they often seem unknown. For example, when a person has to decide the title of a prose piece or a story, he uses original or creative ideas. Original ideas are infrequent which can be given by only 7 out of 50 people and only one of those people presents an original and unique idea. Creative ideas are defined as both original and practical in a situation. The degree of originality and practicality is found to vary among individuals. The researcher usually uses only the minimum level of originality and practicality so that creative ideas can easily achieve originality. Extremely creative ideas usually do not occur often and are difficult to study. Therefore, researchers have used very simple forms of creative thinking and asked questions about the titles of stories or the uses of objects.

Generating Ideas

When subjects are asked to generate ideas about the use of objects, they first generate familiar uses of the object, followed by unusual uses. Familiar ideas are generated quickly, while unusual ideas are generated more slowly. To eliminate common ideas, the subject may be asked to generate only unusual ideas. In a given situation, only a few familiar or common ideas are generated. But unusual ideas are more likely to be generated and as a rule, when subjects are asked to generate original ideas, they tend to do so. There is a strong correlation between original ideas and the total number of ideas (Christensen, Guilford & Wilson, 1957). Since creative ideas are original, we can expect that the subject may produce many creative ideas but only a few of them will be correct. When the subject produces creative ideas, there is no relationship between the order of output and the goodness of the ideas (Johnson Parrott & Stratton, 1968). With continued effort, the subject can produce a greater number of good creative ideas. As the number of good ideas increases, bad ideas will also be obtained in greater numbers. (Continued effort results in the production of ideas of all levels of quality: as more ideas are generated. there will be an increase in the number of good (creative) ideas but also an increase in the number of poor ideas-Johnson et. al. 1968) Mancke & Davis (1968) are of the view that "when the instructions like "Give uses", (Neutral), "Be Practical", Be Original and Practical" are given to the subject, then difference is also obtained in the ideas presented. When the instruction of "Be Practical" is given, the least number of ideas have been obtained while when the instruction of "Be practical and original" is given, the maximum number of ideas have been obtained.

Vinacke (1972) has described several problems of creative problem solving-

(i) Personality of the creator
(ii) Development of creative ability
(iii) Artist and non-artist
(iv) Psychological principles applied to artistic products
(v) Experimental aesthetics
(vi) Mental activities in creative thoughts

Very Short Questions/True Facts

1. **Algorithm:** problem-solving strategy characterized by a specific set of instructions
2. **Anchoring Bias:** faulty heuristic in which you fixate on a single aspect of a problem to find a solution
3. **Availability Heuristic:** faulty heuristic in which you make a decision based on information readily available to you
4. **Confirmation Bias:** faulty heuristic in which you focus on information that confirms your beliefs
5. **Functional Fixedness:** inability to see an object as useful for any other use other than the one for which it was intended
6. **Heuristic:** mental shortcut that saves time when solving a problem
7. **Hindsight Bias:** belief that the event just experienced was predictable, even though it really wasn't
8. **Mental Set:** continually using an old solution to a problem without results
9. **Problem-Solving Strategy:** method for solving problems
10. **Representative Bias:** faulty heuristic in which you stereotype someone or something without a valid basis for your judgment
11. **Trial And Error:** problem-solving strategy in which multiple solutions are attempted until the correct one is found
12. **Working Backwards:** heuristic in which you begin to solve a problem by focusing on the end result.

Short Questions:

1. If this problem-solving thing is so important to daily life, what is it?

Problem-solving is the process of observing what is going on in your environment; identifying things that could be changed or improved; diagnosing why the current state is the way it is and the factors and forces that influence it; developing approaches and alternatives to influence change; making decisions about which alternative to select; taking action to implement the changes; and observing impact of those actions in the environment. Each step in the problem-solving process employs skills and methods that contribute to the overall effectiveness of influencing change and determine the level of problem complexity that can be addressed. Humans learn how to solve simple problems from a very early age (learning to eat, make coordinated movements and communicate) – and as a person goes through life, problem-solving skills are refined, matured and become more sophisticated (enabling them to solve more difficult problems).

2. **What are the components of any problematic situation according to Andreas (1959)?**
(Refer to the content of Unit III)

3. **Differentiate between well-defined problem and ill-defined problem.**
Well-defined problems are the problem in which all aspects of the problem are clearly specified. This means that in the well-defined problems, the initial state or situation, the range of possible moves or strategies and the goal or solution are clearly given. The criteria for success of the goal are known to the solver. For example, Chess, tower of Hanoi, geometry problem are well-defined problem. Whereas, in ill-defined problems, there is ambiguous and incomplete specification of the problem. This means that the initial state, goal state and the methods available to solve the problem may be unspecified. For example, music composition, creativity, etc.

4. **What is Algorithm?**
Another type of strategy is an algorithm. An algorithm is a problem-solving formula that provides you with step-by-step instructions used to achieve a desired outcome (Kahneman, 2011). You can think of an algorithm as a recipe with highly detailed instructions that produce the same result every time they are performed. Algorithms are used frequently in our everyday lives, especially in computer science. When you run a search on the Internet, search engines like Google use algorithms to decide which entries will appear first in your list of results. Facebook also uses algorithms to decide which posts to display on your newsfeed. Can you identify other situations in which algorithms are used?

5. **What is a problem space?**
A problem space is the universe of all possible actions that can be applied to solving a problem, given any limitations or conditions that apply to the solution of the problem. A problem space is kind of a working space, in which we start from the initial state, use the operators so that to achieve or reach the goal state.

6. **What do you understand by Missionary-Cannibal Problem?**

One example of means-end analysis can be found by using the Tower of Hanoi paradigm. This paradigm can be modeled as a word problem as demonstrated by the missionary-Cannibal Problem:
Three missionaries and three cannibals are on one side of a river and need to cross to the other side. The only means of crossing is a boat, and the boat can only hold two people at a time. Your goal is to devise a set of moves that will transport all six of the people across the river, being in mind the following constraint: The number of cannibals can never exceed the number of missionaries in any location. Remember that someone will have to also row that boat back across each time.

7. **What do you understand by the "means-end analysis" heuristics?**
In means-end analysis heuristics, the problem solver analyzes the problem by viewing the end, the goal being sought, and then tries to decrease the distance between the current position in the problem space and the end goal in that space. In means-ends analysis, we solve a problem by taking into account the hurdles that come in between the initial problem state and the goal state. We can either eliminate the obstacles or we can establish subgoals (simpler than the goals). By achieving each subgoal, we ultimately reach the desired goal state.

8. **Briefly explain how incubation impacts problem-solving.**

When we find ourselves unable to solve a problem at some point, we take rest by removing our attention from the problem for a short time. This state is called incubation. When a person is in a relaxed state and consciously shifts attention away from the problem, their mind may continue working on it unconsciously. This process can provide unexpected insights, making incubation a beneficial factor in problem-solving.

9. Explain the objectives of Tower of Hanoi problem ?

The actual Tower of Hanoi problem consists of three rods sitting vertically on a base with a number of disks of different sizes that can slide onto any rod. The puzzle starts with the disks in a neat stack in ascending order of size on one rod, the smallest at the top making a conical shape. The objective of the puzzle is to move the entire stack to another rod obeying the following rules:

1. Only one disk can be moved at a time.
2. Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack or on an empty rod.
3. No disc may be placed on top of a smaller disk.

10. In what ways does brainstorming influence problem-solving?

In this approach, the individual is asked to generate as many potential solutions to the problem as possible within a set time limit. The advantage of this method is that, some excellent ideas emerge due to this, leading to a resolution of the problem. Psychologists believe this process works in two ways: first, by identifying the potential outcomes of specific behaviors or actions taken to solve the problem, and second, by revealing steps that, when followed, can help achieve the solution or goal.

Long/Extensive Questions:

1. Explain Problem-Solving.

In cognitive psychology, the term 'problem-solving' refers to the mental process that people go through to discover, analyze, and solve problems.1

A problem exists when there is a goal that we want to achieve but the process by which we will achieve it is not obvious to us. 2 Put another way, there is something that we want to occur in our life, yet we are not immediately certain how to make it happen.

Maybe you want a better relationship with your spouse or another family member but you're not sure how to improve it. Or you want to start a business but are unsure what steps to take. Problem-solving helps you figure out how to achieve these desires.The problem-solving process involves:

i. Discovery of the problem
ii. Deciding to tackle the issue
iii. Seeking to understand the problem more fully
iv. Researching available options or solutions
v. Taking action to resolve the issue

Before problem-solving can occur, it is important to first understand the exact nature of the problem itself. If your understanding of the issue is faulty, your attempts to resolve it will also be incorrect or flawed.

2. Discuss in detail the stages of problem-solving. (Refer to the content of Unit III)

3. Explain Problem-Solving Strategies.

When people are faced with a problem – whether it is a complex mathematical problem or a broken printer, how do you solve it? Before a solution can be found, the problem must first be clearly identified. After that, one of several problem solving strategies can be applied, which will hopefully lead to a solution.

Problems themselves can be classified into two different categories known as ill-defined and well-defined problems (Schacter, 2009). Ill-defined problems represent issues that do not have clear goals, solution paths, or expected solutions while well-defined problems have specific goals, clearly defined solutions, and clear expected solutions. Problem solving often involves pragmatism (logical reasoning) and semantics (interpretation of the meanings behind the problem), and in many cases also requires abstract thinking and creativity to find new solutions. Within psychology, problem solving refers to a motivational drive to read a certain "goal" from a current situation or condition that is either not moving toward that goal, is moving away from it, or requires more complex logical analysis to find the missing details of conditions or steps toward that goal. The processes related to problem solving include problem detection also known as problem analysis, where the organization of the problem occurs, generating alternative strategies, implementation of attempted solutions, and verification of the selected solution. Various methods of studying problem solving exist within the field of psychology including introspection, behavior analysis and behaviorism, simulation, computer modeling, and experiments.

A problem-solving strategy is the action plan used to find a solution. Different strategies have different action plans associated with them (table below). For example, a well-known strategy is trial and error. The old saying, "If at first you don't succeed, try, try again" describes trial and error. In terms of your broken printer, you can try checking the ink levels, and if that doesn't work, you can check to make sure the paper tray isn't jammed. Or maybe the printer isn't actually connected to your laptop. When using trial and error, you'll continue to try different solutions until you solve your problem. Although trial and error isn't usually one of the most time-efficient strategies, it is a commonly used one.

Algorithms

An algorithm is a step-by-step procedure that, by following certain "rules" produces a solution. Algorithms are commonly used in mathematics to solve division or multiplication problems. But they can be used in other fields as well.

In psychology, algorithms can be used to help identify individuals with a greater risk of mental health issues. For instance, research suggests that certain algorithms might help us recognize children with an elevated risk of suicide or self-harm.3

One benefit of algorithms is that they guarantee an accurate answer. However, they aren't always the best approach to problem-solving, in part because detecting patterns can be incredibly time-consuming.

Heuristics

Heuristics are shortcut strategies that people can use to solve a problem at hand. These "rule of thumb" approaches allow you to simplify complex problems, reducing the total number of possible solutions to a more manageable set.

If you find yourself sitting in a traffic jam, for example, you may quickly consider other routes,

taking one to get moving once again. When shopping for a new car, you might think back to a prior experience when negotiating got you a lower price, then employ the same tactics.

While heuristics may be helpful when facing smaller issues, major decisions shouldn't necessarily be made using a shortcut approach.5 Heuristics also don't guarantee an effective solution, such as when trying to drive around a traffic jam only to find yourself on an equally crowded route.

Trial and Error

A trial-and-error approach to problem-solving involves trying a number of potential solutions to a particular issue, then ruling out those that do not work. If you're not sure whether to buy a shirt in blue or green, for instance, you may try on each before deciding which one to purchase.

This can be a good strategy to use if you have a limited number of solutions available. But if there are many different choices available, narrowing down the possible options using another problem-solving technique can be helpful before attempting trial and error.

Insight

In some cases, the solution to a problem can appear as a sudden insight. You are facing an issue in a relationship or your career when, out of nowhere, the solution appears in your mind and you know exactly what to do.

Insight can occur when the problem in front of you is similar to an issue that you've dealt with in the past. Although, you may not recognize what is occurring since the underlying mental processes that lead to insight often happen outside of conscious awareness.

Research indicates that insight is most likely to occur during times when you are alone—such as when going on a walk by yourself, when you're in the shower, or when lying in bed after waking up.

4. What do you mean by problem solving? Discuss the barriers to problem-solving.

Problem-solving is not a flawless process as it has many barriers that can hinder our ability to solve a problem quickly and efficiently. These barriers include:

Assumptions: When dealing with a problem, people may make assumptions about obstacles and constraints that prevent certain solutions. Thus, they may not even try out some potential options.

Functional fixedness: This term refers to the tendency to view problems only in their usual way. Functional fixedness prevents people from fully seeing all the different options available to find a solution.

Irrelevant or misleading information: When attempting to solve a problem, it is important to distinguish between information that is relevant to the problem and irrelevant data that may lead to faulty solutions. The more complex the problem, the easier it is to focus on misleading or irrelevant information.

Mental set: Mental set involves the tendency to use only solutions that have worked in the past rather than looking for alternative ideas. Mental set can serve as a heuristic, making it a

useful problem-solving tool. However, mental sets can also lead to inflexibility, making it more difficult to find effective solutions.

5. How to improve your problem-solving skills.

Finally, if a person want to become a better problem-solver, it is useful to remember that this is a process. Thus, if you want to improve your problem-solving skills, following these steps can help you reach your solution:

1. **Recognize that a problem exists.** If you are facing a problem, there are usually signs. For example, if you have a mental illness, you may experience extreme fear or sadness, mood swings, and changes in sleeping or eating habits.9 Recognizing these signs can help you realize that a problem exists.

2. **Decide to solve the problem**. Make a conscious decision to solve the problem. Commit to yourself that you will go through the steps necessary to find a solution.

3. **Try to fully understand the problem.** Analyze the problem you are facing from all sides. For example, if your problem is relationship-related, ask yourself how the other person is interpreting the problem. You might also consider how your actions are contributing to the situation.

4. **Research possible options.** Using the problem-solving strategies mentioned, research possible solutions. Make a list of options, then consider each one individually. What are some of the advantages and disadvantages of taking the available routes? What would you need to do to implement them?

5. **Take action.** Choose the best possible solution and take action. Action is one of the essential steps to change. So, take the necessary steps to solve the problem.

6. **If necessary, try another option**. If the solution you chose doesn't work, don't give up. Either go through the problem-solving process again or simply try another option.

6. Explain Heuristic in detail.

A heuristic is another type of problem-solving strategy. While an algorithm must be followed exactly to produce a correct result, a heuristic is a general problem-solving framework (Tversky & Kahneman, 1974). You can think of these as mental shortcuts that are used to solve problems. A "rule of thumb" is an example of a heuristic. Such a rule saves the person time and energy when making a decision, but despite its time-saving characteristics, it is not always the best method for making a rational decision. Different types of heuristics are used in different types of situations, but the impulse to use a heuristic occurs when one of five conditions is met (Pratkanis, 1989):

- **When one is faced with too much information**
- **When the time to make a decision is limited**
- **When the decision to be made is unimportant**
- **When there is access to very little information to use in making the decision**
- **When an appropriate heuristic happens to come to mind in the same moment**

Working backwards is a useful heuristic in which you begin solving the problem by focusing

on the end result. Consider this example: You live in Washington, D.C. and have been invited to a wedding at 4 PM on Saturday in Philadelphia. Knowing that Interstate 95 tends to back up any day of the week, you need to plan your route and time your departure accordingly. If you want to be at the wedding service by 3:30 PM, and it takes 2.5 hours to get to Philadelphia without traffic, what time should you leave your house? You use the working backwards heuristic to plan the events of your day on a regular basis, probably without even thinking about it.

Another useful heuristic is the practice of accomplishing a large goal or task by breaking it into a series of smaller steps. Students often use this common method to complete a large research project or long essay for school. For example, students typically brainstorm, develop a thesis or main topic, research the chosen topic, organize their information into an outline, write a rough draft, revise and edit the rough draft, develop a final draft, organize the references list, and proofread their work before turning in the project. The large task becomes less overwhelming when it is broken down into a series of small steps.

7. How do experts and novices differ in their approaches to solving problems?

According to Sternberg, some key differences are:

i) In terms of Schemas, Experts have large, rich schemas containing a great deal of declarative knowledge about the domain. Their chemas contain a great deal of procedural knowledge about problem-solving strategies relevant to a given domain. Whereas, novices, have relatively impoverished schemas containing relatively less declarative knowledge about the domain.Their schemas contain relatively little procedural knowledge about problem strategies relevant to the given domain.

ii) Experts have well-organized, highly interconnected units of knowledge in schemas, whereas novices have poorly organized, loosely interconnected and scattered units of knowledge in schemas.

iii) Experts spend proportionately more time determining how to represent a problem than in searching for and executing a problem strategy. On the other hand, novices spend proportionately more time searching for and executing a problem strategy than in determining how to represent a problem.

iv) Experts generally work forward from given information to implement strategies for finding unknown information. Whereas, novices work backward from focusing on the unknown to finding problem strategies that make use of given information

v) Experts develop sophisticated representation of problems problems based on structural similarities among problems. Whereas, novices develop relatively poor and naive representation of problems based on superficial similarities among problems.

vi) Experts show highly efficient problem solving. Whereas, novices show relatively inefficient problem solving.

vii)When time constraints are imposed, experts solve problems more quickly than novices.

viii) When confronting highly unusual problems problems with atypical structural features, experts take relatively more time than novices both to represent the problem and to retrieve appropriate problem strategies.

8. Describe Functional Fixedness with experiments.

Functional fixedness was first defined by the German psychologist Karl Duncker in 1945. Karl Duncker described functional fixedness as a mental block when using an object in a new way that is required to solve a problem. The block Karl emphasizes in his famous experiment demonstrates how an individual's ability to complete a task with specific components were limited, as they were unable to rationalize their use outside of their original purpose.

The famous experiment conducted by Karl Duncker is well-known in psychology for demonstrating functional fixedness. In this experiment, Duncker gave participants a book of matches, a candle and a box of thumbtacks, and asked them to attach the candle to the wall so that when it was lit, it would not drip onto the table below it. Initially, most of the participants attempted to attach the candle to the wall by directly using the tacks or by trying to glue the candle to the wall by melting it. Because the Duncker gave participants a box with thumbtacks in them, few of the participants thought of using the box as a candle-holder and attaching the box to the wall with the tacks. Since the experiment participants fixated on the functionality of the box being used to hold the thumbtacks, they were unable to conceptualize the box as a potential solution for holding the candle, thus solving the challenge.

Additionally, in 1952 the experiment was later conducted by giving one set of participants an empty box without the thumbtacks while giving the other set of participants the box with thumbtacks inside. Participants who were given the box without the thumbtacks inside of the box were two times as likely to solve the problem.6 The box no longer was used to hold the thumbtacks; therefore, its functionality was not tied to one single use.

Example 1 - PepsiCo leverages orthopedic experts

PepsiCo provides a notable example of functional fixedness and how companies attempt to curtail their own biases when developing products. In this example, PepsiCo's challenge was to reduce the amount of sodium in its potato chips, without altering the salty flavors that customers traditionally loved. PepsiCo first tried to identify a solution to their problem by looking at the food and snack industry for similar challenges faced by their competitors but found nothing notable to their challenge. PepsiCo then worked with a third-party consulting firm and shared their problem to a broad and diverse range of technical experts to find an innovative and feasible solution.

Experts called on included those from engineering services, energy companies, and those in medical fields. The most creative and applicable response came from the orthopedics department of a global research lab. Researchers had developed a method of creating nano-particles of salt, which was initially used to conduct advanced research on osteoporosis. The process provided a new perspective and partner for PepsiCo, which ultimately led to Pepsi being able to solve their challenge by overcoming functional fixedness.

Example 2 - Creatively designing power strips

Another example of functional fixedness showcases how individuals overcame the cognitive bias by simplifying their initial problem. The experiment conducted by researchers at Carnegie Mellon University required participants to design a power strip in which larger plugs would not block adjacent outlets. To promote creative design solutions, researchers gave one set of participants the initial design challenge, and the second set of participants an abstracted version of the problem. The second set of participants were asked to instead fit objects of different sizes into a container without blocking one another, and taking advantage of the container's full capacity. The challenge was reframed to avoid functional fixedness by stripping away the objects' details being power strips, plugs, and outlets. By doing this, researchers looked to see which set of participants would develop the most innovative results.

The researchers found that when participants given the abstracted challenge identified relevant but distant domains to aid in their problem-solving. The areas of comparison

included landscaping, carpentry, Japanese aesthetics, and contortionism. Participants who were able to gain inspiration from these distant domains found the most novel and practical solutions to the design problem. The study proves that when preventing functional fixedness, and promoting creativity, the best solutions are developed.

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UNIT IV

UNIT IV	Creativity: Nature and Measurement; Factors affecting Creativity.

Creativity can refer to the process of producing something that is original, useful and has a surprise element. Creativity can unfold in multiple stages. Creativity is a well-established concept, supported by various tests designed to assess it. It is also correlated with factors such as intelligence, motivation, and personality, among others.

Creativity involves the ability to develop new ideas or utilize objects or information in novel ways. It can involve large-scale ideas that have the potential to change the world, such as inventing tools that impact how people live, or smaller acts of creation such as figuring out a new way to accomplish a task in your daily life.

Two of the primary components of creativity include:

1. **Originality:** The idea should be something new that is not simply an extension of something else that already exists.
2. **Functionality:** The idea needs to actually work or possess some degree of usefulness.

:

Creativity happens when someone comes up with a creative idea. An example would be a creative solution to a difficult problem. But what makes an idea or solution creative? Creativity is the ability to generate, create, or discover new ideas, solutions, and possibilities. Very creative people often have intense knowledge about something, work on it for years, look at novel solutions, seek out the advice and help of other experts, and take risks. Although creativity is often associated with the arts, it is actually a vital form of intelligence that drives people in many disciplines to discover something new. Creativity can be found in every area of life, from the way you decorate your residence to a new way of understanding how a cell works.

THREE CRITERIA OF CREATIVITY

The first criterion is ***originality***. The idea must have a low probability. Indeed, it often should be unique. Albert Einstein's special theory of relativity certainly satisfied this criterion. No other scientist came up with the idea.

The second criterion is ***usefulness*****.** The idea should be valuable or work. For example, a solution must, in fact, solve the problem. An original recipe that produces a dish that tastes too terrible to eat cannot be creative. In the case of Einstein's theory, his relativity principle provided explanations for what otherwise would be inexplicable empirical results.

The third and last criterion is ***surprise*****.** The idea should be surprising, or at least nonobvious (to use the term used by the Patent Office). For instance, a solution that is a straightforward derivation from acquired expertise cannot be considered surprising even if it were original.

Types of Creativity

Experts also tend to distinguish between different types of creativity. The "four c" model of creativity suggests that there are four different types:

1. **"Mini-c" creativity** involves personally meaningful ideas and insights that are known only to the self.
2. "**Little-c" creativity** involves mostly everyday thinking and problem-solving. This type of creativity helps people solve everyday problems they face and adapt to changing environments.

3. **"Pro-C" creativity** takes place among professionals who are skilled and creative in their respective fields. These individuals are creative in their vocation or profession but do not achieve eminence for their works.
4. **"Big-C" creativity** involves creating works and ideas that are considered great in a particular field. This type of creativity leads to eminence and acclaim and often leads to world-changing creations such as medical innovations, technological advances, and artistic achievements.

STAGES OF CREATIVITY

The creative process takes place through five stages.

1. **Preparation**: The preparation stage is the first stage of creativity, and it starts with gathering information and data, such as resources and ideas.
2. **Incubation**: The second stage, incubation, is where the creative idea is incubated in an environment without any pressure or stress. It's a period where one can free their mind from any distractions, allowing their thoughts to flow freely.
3. **Illumination**: The third stage, illumination, is when the work done in the first two stages come together. This is where one can begin developing a plan of action and a more concrete idea of the end result.
4. **Evaluation**: The evaluation stage can actually take place before or after the project. One might even opt to evaluate both before and after the implementation phase. In short, the evaluation stage is when one weighs the success of the stages, and also how developed the creative idea is - and if it is ready for implementation or publication - or if the idea needs to be recast or scrapped altogether.

Implementation: The implementation stage is when all of the ideas, plans, and evaluations from the previous stages come together, and one begins and finishes the project.

Factors influencing Creativity

1. Being open to new ideas: Openness to experience is the personality trait that is most closely correlated with creativity. Focus on being willing to try new things and explore new ideas.

2. Be persistent: Creativity is not just about sitting around waiting for inspiration to strike. Creative people spend time working to produce new things. Their efforts don't always work out, but continued practice builds skills that contribute to creativity.

3. Make time for creativity: In addition to being persistent, you also need to devote time specifically toward creative efforts. This might mean setting aside a little time each day or each week specifically to brainstorm, practice, learn, or create.

4. Divergent Thinking: Guilford emphasized the importance of divergent thinking, which involves generating a wide range of possible solutions or ideas. It contrasts with convergent thinking, where you aim for a single correct answer.
5. Fluency: This factor relates to the quantity of ideas generated. Creative individuals tend to produce a large number of ideas during brainstorming sessions.
6. Flexibility: Flexibility refers to the ability to shift between different categories or types of thinking. Creative thinkers can switch between perspectives or approaches easily.

7. Originality: Originality focuses on the uniqueness of ideas. Creative ideas are often novel and different from existing concepts.
8. Elaboration: Elaboration involves developing and expanding upon ideas. Creative individuals can take a simple idea and enrich it with details and depth.

9. Sensitivity to Problems: Being attuned to problems or challenges in the environment is crucial for creativity. Recognizing issues that need solving is an essential aspect of creative thinking.

10. Motivation: Guilford believed that motivation played a significant role in creativity. When individuals are motivated to solve a problem or pursue a creative endeavor, they are more likely to engage in creative thinking.

11. Knowledge and Expertise: Having a solid base of knowledge and expertise in a particular field can enhance creativity. In many cases, creative breakthroughs are built upon existing knowledge.

12. Personality Traits: Certain personality traits, such as openness to experience, curiosity, and a willingness to take risks, can influence one's creative abilities.

13 Environmental Factors: The environment in which one works or lives can impact creativity. Factors like a supportive or challenging work environment, access to resources, and exposure to diverse perspectives can all affect creativity.

Guilford's model highlights that creativity is a multifaceted concept influenced by various cognitive, motivational, and environmental factors. Understanding these factors can help individuals and organizations foster and enhance creativity in various domains.

MEASURES OF CREATIVITY

When there is no consensus among psychologists in the context of the definition of creativity, how will there be consensus among them in the context of the methods of measuring creativity. Although many tests have been developed to measure creativity. Mansfield & Busse (1981) have described twenty such measures. Three different approaches are being presented here in the context of the measurement of creativity-

The first is the Remote Associates Test, or RAT, that was introduced by Mednick (1962). Mednick believed that the creative process requires the ability to associate ideas that are considered very far apart conceptually. The RAT consists of items that require the respondent to identify a word that can be associated to three rather distinct stimulus words. For example, what word can be associated with the words “widow, bite, monkey”? The answer is spider (black widow spider, spider bite, spider monkey). This particular question is relatively easy, others are much more difficult, but it gives you the basic idea.

Consensual Assessment Technique-

Teresa Ambile developed this method for measuring creativity. She believed that creativity is a property of products rather than people. According to this technique, a product should be considered creative if the inspectors feel that the product is new and genuinely creative (Amabile, 1983; 1990). Their research indicates that if the inspector is well acquainted with a particular field, he can agree with the other person in creative assessments. For example,

a trained painter can agree with the rating of art teachers in evaluating the artworks of his students (Amable, 1982). This technique has some direct advantages because in this, importance is given to the opinion of the subject expert (If experts think this work is creative then it is.)

Teachers and psychologists have to identify creative students for which they measure and evaluate the behavioral characteristics of the students and its quantity. There is variation in the characteristics found in students. Creativity includes many qualities like originality, fluency, flexibility, evaluation etc. Structural differences are found in highly creative students in terms of these abilities. On the basis of these individual differences, psychologists and educationists have created and standardized many tests to measure the existing creative ability. In this direction, many psychologists such as Thurstone (1938), Wilson (1954), Bergar (1957), Taylor (1962), Guilford (1961), Torrance (1950), C. R. Parmash (1971), B. B. Chatterjee (1972), M.K. Rain (1968), K.N. Sharma (1972), Baqar Mehandi (1972), B. K. Passi (1972) etc. have done commendable work.

Guilford's Creativity Test (1959)

This test was standardized to measure many creative abilities. There are three subtests for measuring flexibility-

(i) The Brick Use Test

(ii) The Hidden Figure Test

(iii) The Match Problem Test

Through this test, only creative abilities and flexibility are measured. But the following subtests were developed to measure originality-

(i) Plot-Title Test

(ii) The Symbol Production Test

For measuring fluency, associations are measured by presenting stimulus words.

One measure is the Unusual Uses Task (Guilford, 1967; Torrance, 1974). Here, the participant is asked to generate alternative uses for a common object, such as a brick. The responses can be scored on four dimensions: (a) *fluency*, the total number of appropriate uses generated; (b) *originality*, the statistical rarity of the uses given; (c) *flexibility*, the number of distinct conceptual categories implied by the various uses; and (d) *elaboration*, the amount of detail given for the generated uses. For example, using a brick as a paperweight represents a different conceptual category than using its volume to conserve water in a toilet tank. The capacity to produce unusual uses is but one example of the general cognitive ability to engage in **divergent thinking** (Guilford, 1967). Unlike **convergent thinking**, which converges on the single best answer or solution, divergent thinking comes up with multiple possibilities that might vary greatly in usefulness.

Test of Creativity for College Students (1960)

This test was created by Guilford & Merrifield (1960) through which abilities like divergent production, transformation and redefinition are measured. Through this test several subtests, such as Instrument Test, Seeing Problems, Cube fluctuation, Retinal rivalry reversals, Brick

use test were constructed to measure several components such as sensitivity for the problem, figural spontaneous flexibility, figural adaptive flexibility, word fluency, expressive fluency, semantic spontaneous flexibility, associative fluency, originality, semantic elaboration, figural redefinition, symbolic redefinition.

Torrance Test of Creative Thinking (1966)

Torrance (1960) has included many verbal and figural subtests in this test. He has considered the creative thinking process as the basis of his test construction. This test has the following 5 verbal and 3 figural tests-

(1) Verbal Test

(i) Ask and Guess test
(ii) Product improving test
(iii) Toy dog test
(iv) Unusual Use test
(v) Just suppose test

'Ask and Guess Test' is based on Guilford's test. In this, cause and effect relationships have to be estimated. In this test, marks are given on the basis of fluency and adequacy. Fluency marks are obtained by counting the above-mentioned marks, whereas for obtaining suitability marks, certain principles have to be followed. **'Production Improvement Test'** is related to fluency, flexibility, originality and invention. Toys are used for their measurement. Flexibility, novelty, difficulty, surprise, creativity etc. are measured by **'Toy Dog Test'**. Flexibility, originality, fluency, invention etc. are measured by **'Extraordinary Experiment Test'.** In **'Justified Expectation Test'**, the examinee is presented with improbable situations and is asked to think about them. He tells about all the stimulating things when such a situation occurs.

(2) Futuristic Test

(i) Picture construction test,

(ii) Picture completion test

(iii) Parallel lines test

In the 'picture formation test', the candidate is presented with colorful curved shapes and is asked to think about that picture and complete it. In the 'picture formation test', the candidate makes attractive objects and pictures from simple, incomplete and meaningless pictures. In the 'parallel line test', the candidate makes pictures using parallel lines.

Baker Mehandi Test of Creativity

This test was created by Baker Mehandi in 1973. It has two forms- verbal and nonverbal. Many subtests such as 'If it so happens test', 'Variety of experiment test', 'Tracing new relations test' and Product improvement test are used as verbal tests. Whereas 'Draw figure test', 'Picture completion test', 'Trangular and elliptical figure test' have been taken as nonverbal subtests.

Very Short Questions/True Facts:

1. **Convergent Thinking:** the opposite of divergent thinking, the capacity to narrow in on the single "correct" answer or solution to a given question or problem (e.g., giving the right response on an intelligence tests)
2. **Creativity:** ability to generate, create, or discover new ideas, solutions, and possibilities
3. **Divergent Thinking**: the opposite of convergent thinking, the capacity for exploring multiple potential answers or solutions to a given question or problem (e.g., coming up with many different uses for a common object)
4. **Analytical Intelligence:** aligned with academic problem solving and computations
5. **Creative Intelligence**: ability to produce new products, ideas, or inventing a new, novel solution to a problem
6. **Crystallized Intelligence:** characterized by acquired knowledge and the ability to retrieve it
7. **Cultural Intelligence:** ability with which people can understand and relate to those in another culture
8. **Emotional Intelligence:** ability to understand emotions and motivations in yourself and others
9. **Fluid Intelligence:** ability to see complex relationships and solve problems.
10. **Mini-c" creativity:** involves personally meaningful ideas and insights that are known only to the self.
11. **Creativogenic society:** A creativogenic society refers to a type of society that fosters and promotes creativity by emphasizing the influence of sociocultural factors.

Short Question:

1. What is Creativity?

Creativity is the capacity within individuals to develop ideas for the purpose of solving problems and exploiting opportunities. It is important to define creativity because it can mean a lot of different things to different people. Creativity is not art, it is not design and it most certainly is not the sole preserve of tortured geniuses and mad scientists. Creativity is a capacity – it is something that we can all learn to use more effectively. It allows us to develop ideas to solve problems in different ways and to spot, adapt to, embrace and capture opportunities.

2. What is Innovation?

Innovation is the application of creativity to give rise to a new concept, product, service or process delivering something new and better to the world. When we innovate, we work with the creative ideas we have developed and put them into practice. Innovation is NOT just about making new gadgets and fancy widgets. We can be innovative in New Product Design, but in many other ways too. New concepts, like how to lead and motivate people at work, as well as new services and processes.

3. How Are They Related?

Innovation depends on creativity. Individuals cannot innovate without first developing some

ideas. Creativity is the source of innovation. If individuals do not use their creativity to develop a range of ideas and possible solutions, we cannot select the most promising ideas and put them into practice. Every improvement at work starts with an idea.

4. What do you understand by Creativity and the Big Five?

Certain personality traits are also connected to creativity. According to the big five theory of personality, human personality is made up of five broad dimensions:

- ✔ **Openness**
- ✔ **Conscientiousness**
- ✔ **Extroversion**
- ✔ **Agreeableness**
- ✔ **Neuroticism**

Each dimension represents a continuum, so for each trait, people can be either high, low, or somewhere between the two.

5. How to Increase Creativity?

While some people seem to come by creativity naturally, there are things that you can do to increase your own creativity. Some strategies that can be helpful for improving creativity include:

a. **Being open to new ideas:** Openness to experience is the personality trait that is most closely correlated with creativity. Focus on being willing to try new things and explore new ideas.
b. **Be persistent:** Creativity is not just about sitting around waiting for inspiration to strike. Creative people spend time working to produce new things. Their efforts don't always work out, but continued practice builds skills that contribute to creativity.
c. **Make time for creativity:** In addition to being persistent, you also need to devote time specifically toward creative efforts. This might mean setting aside a little time each day or each week specifically to brainstorm, practice, learn, or create.

5. Explain Guilford Test of Creative Thinking.

Guilford Test of Creative Thinking. Based on his factor analytic model of the structure-of-intellect (SI), Guilford and his associates in the University of South-ern California Aptitudes Research Project developed tests of divergent thinking (Guilford & Hoepfner, 1971). Of the 13 tests in this battery, 9 require verbal (semantic) responses and 4 employ figural content. The 9 verbal response tests are: (1) Word Fluency; (2) Ideational Fluency; (3) Association Fluency; (4) Expressional Fluency; (5) Alternate Uses; (6) Simile Interpretations; (7) Plot Titles; (8) Consequences; and (9) Possible Jobs. The four figural tests are: (1) Making Objects; (2) Sketches; (3) Match Problems; and (4) Decorations. Recent research has partially confirmed his factor structure (Bachelor & Michael, 1991; Michael & Bachelor, 1990).

Scorer reliability and split-half reliability coefficients are satisfactory for these tests (Anastasi, 1982). Norms in terms of percentiles and standard scores are provided in the preliminary manuals (Anastasi, 1982, p. 387). Guilford and his associates have also developed a battery of creativity tests for children, with 5 verbal (semantic) and 5 figural tests in this battery. The authors have provided test norms for Grades 4 through 6. See Guilford and Hoepfner (1971) for detailed description and sample items of these tests.

6. Explain the Stages of the Wallas Stage Model.

Wallas was a proponent of the evolutionary school of thought in terms of cognitive behavior and considered creativity to be a legacy of the human evolution.

1. Preparation – mental preparatory work that analyzes the issues being addressed and organizes thoughts to favor the most probably solutions.

2. Incubation – the problem is internalized and reanalyzed based on probable solutions unconsciously where no action is being made.

3. Intimation – the feeling that a solution is on its way.

4. Illumination (also referred to as Insight) – the creative solution reveals itself from the subconscious and brought to conscious evaluation.

5. Verification – the solution is further evaluated, tested, verified to be correct in resolving the problem and then applied to other similar problems.

7. **What is your definition of creativity? (Refer to the content of Unit-IV)**
8. **Who do you think is creative? Please explain why. (Refer to the content of Unit-IV)**
9. **Was the way you express your creativity now always your ambition? If so, when did you know for sure? (Refer to the content of Unit-IV)**
10. **Is there a particular place where you feel most creative? (Refer to the content of Unit-IV)**
11. **What are the key sociocultural factors that characterize a creativogenic society?**

Arieti (1976) intoduced the term "creativogenic society" to describe a type of society that enhances creativity. He discussed about nine creativogenic socio-cultural factors:

1) availability of cultural (and certain physical) means (at least, for the elite of society), 2) openness to cultural stimuli (in various aspects of human life), 3) stress on becoming and not just on being, 4) free access to cultural media for all citizens, without discrimination, 5) freedom, or even the retention of moderate discrimination, after severe oppression or absolute exclusion, 6) exposure to different and even contrasting cultural stimuli, 7) tolerance for diverging views, 8) interaction of significant persons, and 9) promotion of incentives and awards.

12. **What do you mean by Synectics?**

Synectics was developed as a concept in the 1960s by W. J. J. Gordon. It involves combining diverse elements in novel ways. The word is derived from two Greek roots, syn and ectics. Synectics is a problem-solving approach that emphasizes fostering creative thinking, typically within small groups of individuals with varied experiences and skills. The Synectics method encourages "out of the box" thinking, making it especially helpful when a team is stuck and unable to see new solutions. It is effective for teams of any size, with smaller groups (7-10 people) being most ideal. For larger teams, you can divide them into smaller groups and later combine their results.

13. **Discuss in brief creativity test by B.K. Passi.**

B.K. Pasi designed this test series in 1972 to suit Indian conditions for school children. It is available in both English and Hindi. In this test, creative ability is measured by 6 sub-tests of verbal and non-verbal skills: i) Seeing Problem Test: assesses the ability to solve problems related to the use and handling of simple, commonly available everyday objects; ii) The Unusual Uses Test: In this test, names of objects are given which can be used for various purposes; iii) Consequences Test:This test measures the dimensions of fluency, originality and creativity. The score of creativity is the sum of fluency and originality.; iv) The Test of Inquisitveness: In this test an unfamiliar and novel situation is introduced by presenting the sound and speed of a metronome; v) The Square Puzzle Test: In this test a difficult situation is created in front of the examinee with the help of puzzle and is administered individually; vi) The Block Test of Creativity: This test is nonverbal and is administered individually. It is a performance test in which 19 identical cubes and 12 diagonally cut half cubes cut from 6 cubes are used.

14. **Provide a brief explanation of the theory of giftedness and the motivational theory of creativity.**

Theory of Giftedness: Spearman (1930) posited that the essence of all creative work lies in the ability to identify and establish meaningful correlations. He has considered intelligence to be the basis of creative thinking which he has called the 'G' component, which is the essence of all abilities. Similarly, Thurstone also interpreted creative thinking from an intellectual perspective. Thus, the theory of creative thinking is related to his theory of intelligence. According to him, the more a person engages with the prefocal and unconscious aspects of their work, the more creative they are likely to be.
Motivational Theory: A creative individual is driven to solve problems. According to Rogers (1961), when motivation is part of a person's creative inclination, they strive for self-actualization. He will experience his potential and try to achieve high performance. Reisman (1931) supported this and said that problem solving has its own internal reward system which is drawing from the observations of successful inventors.

Long/Extensive Questions:

1. **What are some notable definitions of creativity provided by various psychologists?**
   According to **Cole & Bruce**, "Creativity is an ability of man's mind to grasp, express and appreciate in the form of an original product."

   Robert Frost argued: "What is originality? It is free association—the coupling of poetic ideas that moves and strikes you. Originality lies in the association of two things you did not expect to see connected."

   According to **J.E. Drevahal**, "Creativity is that human ability by which he presents any novel work or ideas."

   According to **DeHaan & Havighurst (1961)**, "Creativity is the quality which leads to the production of something new and desirable. The new product may be new to society or new to the individual who creates it."

   Medinick defined Creative thinking as consisting of forming new combinations of associative elements, which combinations either meet specified requirements or is some way useful. The more mutually remote the elements of new combinations, the more creative is the process or solution.

   James Drever defined creativity as Producing an essentially new product, constructive (somewhat wider), use of imagination, where a new combination of ideas or images is constructed (strictly when it is self initiated rather than imitated) also of thought synthesis, where the mental product is not a mere summation.

   According to **C. V. Good**, Creativity is a quality of thought to be composed of broad continuum.

   According to **Barron (1961)**, By creativity we mean to make new combinations from the already existing objects and elements.

   According to **Morgan, King, Weirz & Schopler (1986)**, When thinking creatively, people

tend to think in a divergent manner thus having many varied thoughts about a problem.

2. How can we assess creativity in cognitive Psychology?

The two main processes of creativity assessment are based on **divergent thinking and associative thinking.**

Divergent thinking was mentioned by Guilford, a former psychologist and professor of psychology. Divergent thinking defines the ability to generate multiple solutions to an open problem during a defined period of time. The exploration of several solutions around this problem leads to multidirectional research where the result is a set of alternative solutions. The result is an organized sequence of words representative of a concept or element. Let's illustrate this concept with a simple task of finding different uses for a particular object. Imagine we have to find different uses of the object “Brick” (in addition to the basic function of construction): we can generate different solutions such as using a brick as a weapon or as a wedge. In this example, the goal of the divergent thinking process is to find as many uses as possible for this brick in a limited time. Then, we can engage a "convergent thinking" process in order to select one of our solutions.

The second process of creativity assessment is **associative thinking**, described by the psychologist Mednick (2). Associative thinking is the ability to link elements whose semantic concepts are distant. The further these elements have a long semantic distance, the more creative we are. For example, associating the word “Basket” with the word “Table” is more creative than associating the word “Chair” with the word “Table” because the semantic distance of the words "Table / Basket" is longer than that of the words " Table chair". Making creative associations means forgetting links with high semantic forces in order to find more original associations. Please note that these associations must meet the requirements of a context and/or be useful. In other words, to associate the word "Dream" with the word "Table" does not make any sense.

Thus, many research tests are based on divergent thinking and associative thinking to assess the creative capacity of people. However, since creativity is a complex process, we have to keep in mind that a complete assessment of creativity requires the use of several theories.

3. Explain the Creativity Test.

Creativity tests are typically divided into four main components: **Divergent thinking, Convergent thinking, Artistic assessments and Self assessments.**

Divergent thinking is the ability to consciously generate new ideas that branch out to many possible solutions for a given problem. These solutions or responses are then scored on four components:

i. Originality - statistical infrequency of response
ii. Fluency - number of responses
iii. Flexibility - the degree of difference of the responses, in other words do they come from a single domain or multiple domains
iv. Elaboration - the amount of detail of the response
   a. Guilford’s Alternative Uses Task (1967)
   b. Wallace and Kogan (1965)
   c. Torrance Test of Creative Thinking (TTCT) (1974)
   d. The Wallach-Kogan is out of print

Convergent thinking is the ability to correctly hone in the single correct solution to a problem. In creativity convergent thinking often requires taking a novel approach to the problem, seeing the problem from a different perspective or making a unique association between parts of the problem. These solutions are scored either correct or

incorrect .

a. Insight Problems
b. Remotes Associations Task (Mednick)

Artistic assessments are the evaluations of an artistic product (e.g., painting, story, poem, musical composition, collage, drawing etc.). Evaluations are typically done by two or more judges that must be in near agreement on the creativity of the product.

a. Barron-Welsh Art Scale

Self-assessments are person's responses to the amount of creativity a personal feels they exhibit. persons responses to the amount of creativity a person feels they exhibit.

a. Khatena-Torrance Creative Perception Inventory
b. How Do You Think (Davis)
c. Things Done on Your Own (Torrance, 1962)
d. The Creativity Behavior Inventory
e. Runco Ideation Behavior Scale (RIBS)
f. Creative Attitude Survey (Schaeffer)
g. Statement of Past Activities
h. NEO-PI-R (Openness to Experience component)
i. Gough Personality Scale
j. Other Assessments
k. Creativity Assessment Packet
l. Preschool and Kindergarten Interests Descriptors
m. Scales for Rating the Behavioral Characteristics of Superior Students (Renzulli, 1993)

4. Discuss the factors affecting creativity.

Individual level

i. Age – creativity decreases with age unless individual is intentionally creative
ii. Intelligence- certain level required for certain measures of creativity only.
iii. Personality- high valuation of aesthetic qualities in experiences, interests, attraction to complexity, independence of judgment, autonomy, intuition , self confidence, ability to resolve conflicting traits in self and belief that self is creative
iv. Dispositions- high level of intrinsic motivation, follow intrinsic interests, free from evaluations and constraints
v. Capabilities -- Insight is a result of integration of previously learned behaviors potential.

Demographic factors

i. Birth order
ii. Middle born children are more creative
iii. family size
iv. Number of siblings
v. Interval among siblings
vi. Family and school atmosphere
vii. Large families have authoritarian structures
viii. Freedom and autonomy facilitates creativity

Resources influencing creativity

i. Time

ii. Original ideas are remote with respect to original problem
iii. Creative ideas require time for incubation

Neurological factors

- Creativity reflects originality and appropriateness, intuition and logic. It requires **both hemispheres**
- Requires consistent communication among many areas in brain and increased **emotional expression**
- Defocused attention
- Knowledge –declarative, factual, tactics or procedural knowledge
- Intuition, ability to consider two different perspectives simultaneously, incubation, imagination

5. Explain Creativity in reference to convergent and Divergent thinking.

Creativity is sometimes broken up into divergent thinking and convergent thinking. Divergent thinking is measured using Torrance test of creative thinking (TTCT) TTCT consist of both verbal and figural parts. Divergent thinking is also measured by Guilford's Alternate uses task n which one has to come up with as many uses as possible for a common household item. These creativity test results are scored keeping in mind a number of different creativity criteria. The most common (common to all of the above) criteria are:

1. Fluency: which captures the ability to come up with many diverse ideas quickly. This is measured by the total number of ideas generated. I call this the speed of ideation
2. Flexibility: which captures the ability to cross boundaries and make remote associations. This is measured by number of different categories of ideas generated. I call this the breadth of ideation.
3. Originality: which measures how statistically different or novel the ideas are compared to a comparison group. His is measured as number of novel ideas. I call this the uniqueness /novelty of ideation.
4. Elaboration: which measure the amount of detail associated with the idea. This I think is not relevant to creativity per se (as per my limited definition of creativity) , but elaboration has more to do with focussing on each solution/idea and developing it further - perhaps a responsibility more in alignment with that of Intelligence. I call this depth of ideation.

Convergent thinking is measured by tests like remote associations test or insight problems. These problems are solved when you apply one of the methods below:

1. See problem from a different perspective. To me this looks like how quickly you can adopt multiple perspectives - the speed with which you can take alternate perspectives and is similar to fluency.
2. Make unique association between parts of the problem. This looks again similar to flexibility or how fluid is your categorisation schema enabling you to think out of the box and not be limited by typical categories or associations.
3. Take a novel approach (and not the typical approach) to problem solving. To me, this again looks similar to Originality.

Creativity is also defined as coming up with something that is both novel and useful.
Defining what is creative: creativity = utility + beauty+ novelty.

1. The first factor is of UTILITY: whether one produces something that is useful.
2. The second factor is BEAUTY: whether one produces something that is appealing

and aesthetically satisfying.

3. The third factor is NOVELTY: whether one produces something that is really unique and novel and unheard of before.

4. The fourth factor is VERIDCIALITY: whether what one has come up with is TRUE/ replicable/verifiable. Intelligence is the ability to see if the solution actually solves the problem.

6. Discuss the Torrance Tests of Creative Thinking.

The highly reliable Torrance® Tests of Creative Thinking are the most widely used tests of their kind since testing only requires the examinee to reflect upon their life experiences. These tests invite examinees to draw and give a title to their drawings (pictures) or to write questions, reasons, consequences and different uses for objects (words). These instruments have been used for identification of the creatively gifted and as a part of gifted matrices in states and districts in the USA, especially in multicultural settings, and for special populations around the world. Published in two equivalent forms, Forms A and B, the Figural and Verbal TTCT can be used for pre- and post testing.

Figural TTCT®: Thinking Creatively with Pictures

The Figural TTCT: Thinking Creatively with Pictures is appropriate at all levels, kindergarten through adult. It uses three picture-based exercises to assess five mental characteristics:

a. fluency
b. resistance to premature closure
c. elaboration
d. abstractness of titles
e. originality

The Figural TTCT can be scored locally or by STS. Both methods employ the streamlined scoring procedure. Streamlined scoring provides standardized scores for the mental characteristics listed above as well as for the following creative strengths:

a. emotional expressiveness
b. internal visualization
c. storytelling articulateness
d. extending or breaking boundaries
e. movement or action
f. humor
g. expressiveness of titles
h. richness of imagery
i. synthesis of incomplete figures
j. colorfulness of imagery
k. synthesis of lines or circles
l. fantasy
m. unusal visualization

With Figural TTCT Streamlined Scoring two different norm types are available: grade-related norms and age-related norms. Grade-related norms use one set of norms for each of the grades for which the test is appropriate, including the adult level. Age-related norms are based on the typical age for each of the grades in which the Figural TTCT

may be used.

7. Creativity: what is it and what are its criteria?

Creativity occurs when someone comes up with a creative idea. An example of this might be a creative solution to a difficult problem. But what makes an idea or solution creative? Creativity is the ability to generate, create, or discover new ideas, solutions, and possibilities. Very creative people often have in-depth knowledge about something, work on it for years, look for new solutions, seek advice and help from other experts, and take risks. Although creativity is often associated with the arts, it is actually an important form of intelligence that inspires people in many disciplines to discover something new. Creativity can be found in every area of life, from the way you decorate your home to new ways of understanding how a cell works.

Although psychologists have offered many definitions of creativity (Plucker, Beghetto, & Dow, 2004; Runco & Jaeger, 2012), perhaps the best definition was recently published by the U.S. Department of Education. The following is adapted from the three criteria used by the Patent Office to decide whether an invention can receive patent protection (Simonton, 2012).

The first criterion is originality. The idea must be unlikely. In fact, it must often be unique. Albert Einstein's special theory of relativity certainly met this criterion. No other scientist came up with this idea.

The second criterion is utility. The idea must be valuable or work. For example, a solution must actually solve a problem. An original recipe that makes a dish that tastes too terrible to eat cannot be creative. In the case of Einstein's theory, his relativity theory provided an explanation for things that would otherwise be empirical results.

The third and final criterion is surprise. The idea must be surprising, or at least unexplainable (to use the term used by the Patent Office). For example, a solution that is directly derived from acquired expertise cannot be considered surprising, even if it is original. Einstein's theory of relativity was not a step-by-step conclusion from classical physics, but rather a theory built on a new basis that challenged the basic premises of classical physics. When applying these three criteria, it is important to recognize that originality, usefulness, and surprise are all not qualitative properties of an idea but quantitative properties. In particular, we really have to talk about the degree to which an idea satisfies each of the three criteria. Furthermore, all three characteristics must have a zero point, that is, it must be possible to talk about an idea lacking any originality, usefulness, or surprise. Finally, we must recognize that if an idea scores zero on any one of the criteria, it must also have zero creativity. For example, someone who reinvents the wheel is certainly generating a useful idea, but the idea has zero originality and therefore no creativity. Similarly, if someone invents a parachute made entirely of steel reinforced concrete he will get a lot of credit for originality - and surprise! - But no credit will be given for utility.

8. **Which brain regions are involved in facilitating creative processes?**

The researches have suggested that the prefrontal regions of the brain are especially active during the creative process, regardless of whether the creative thought is effortful or spontaneous (Dietrich, 2004). The prefrontal cortex is not a single unit. It is functionally divided into ventromedial (VMPFC) and dorsolateral (DLPFC) aspects

(e.g., Fuster, 2002; Petrides, 1996). Lesion and functional imaging studies have shown that different prefrontal circuits, along with their respective cortical and subcortical connections, are implicated in specific cognitive abilities. The role of the prefrontal cortex in the creative process is threefold. First, to evaluate the appropriateness of a novel thought, one has to become conscious of it. Given the view that the working memory buffer of the prefrontal cortex holds the content of consciousness, a novel thought becomes an insight when it is represented in working memory. Second, insights are only the first step in converting novel combinations of information into creative work. Once an insight occurs, the prefrontal cortex can bring to bear the full arsenal of higher cognitive functions to the problem, including central executive processes such as directing and sustaining attention, retrieving relevant memories, etc. Third, the prefrontal cortex must implement the expression of the insight. The prefrontal cortex orchestrates action in accordance with internal goals (E. K. Miller & Cohen, 2001), such as aesthetic or scientific goals. In addition to the prefrontal area, other regions have also been identified as important for creativity. In one study, participants were given a list of words that were either semantically related or unrelated (Bechtereva et al., 2004). The participants were then asked to make up a story using all of these words. Forming a story from a list of unrelated words should require more creativity than using a list of semantically related words. These researchers observed that Brodmann's area (BA) 39 was active during the production of stories from unrelated word lists but not during the production of stories using related word lists. A selective thinning of cortical areas seems to correlate with intelligence and creativity as well. In particular, a thinning of the left frontal lobe, lingual, cuneus, angular, inferior parietal, and fusiform gyri is connected with high scores on creativity measures. These areas include several Brodmann's areas, including BA 39. Additionally, a relative thickness of the right posterior cingulate gyrus and right angular gyrus was related to higher creativity as well. These variations in cortical thickness, and especially a thinning in various areas, probably influence information flow within the brain (Jung et al., 2010).

9. Provide a detailed explanation of the Investment Theory of Creativity.

The investment theory was proposed by Sternberg and Lubart (1991). The theory identifies six resources for creativity– intellectual processes/intelligence, knowledge, intellectual style, personality, motivation, and environmental context. According to this theory, creative performance results from a confluence of these elements. The first resource for creativity is intelligence. Three types of intelligence are particularly important: (a) the synthetic intelligence to see problems from new perspectives and to think outside the box, (b) the analytical intelligence to recognize and decide which of one's ideas are worth pursuing and which are not, and (c) the practical intelligence to know how to persuade others of the value of the newly proposed ideas. The second resource for creativity is knowledge. Being knowledgeable about any subject or field has two aspects. On the one hand, without knowledge, one has nowhere to begin in being creative. Creative ideas and behaviors typically derive, in part, from something that one already has known from past knowledge or experience. Conversely, having excessive knowledge in a particular subject or field can sometimes hinder an individual's creativity—the individual may get so absorbed in a particular way of seeing things that he or she tends not to think in novel ways. The third resource for creativity is intellectual style. Intellectual styles are preferred ways of using one's abilities. Among the 13 intellectual styles described by Sternberg (1988, 1997), three are particularly important for creativity: the legislative, global, and liberal styles. The fourth resource for creativity is personality. To be creative, one needs to be willing to overcome obstacles, be willing to take reasonable risks, and be willing to grow. The fifth resource for creativity is

motivation. To be creative, one needs to have intrinsic, task-focused motivation. The sixth resource for creativity is environment. One could have all the internal resources needed to think creatively. However, without an environment that is supportive and rewarding of creative ideas, the creativity that an individual has within him or her might never be displayed. Thus, creativity needs to be nurtured.

10. What is the Remote Association Test (RAT), and how does it measure creativity?

Remote Association Test (RAT) was developed by Mednick & Mednick in 1962 to measure creativity. This theory suggests that creativity is the ability to connect two ideas that are unrelated or distant from one another. Creative individuals can form new associations based on certain criteria by linking ideas that are distant from each other. Mednick and Mednick (1967) concluded from their studies that individuals with high remote association scores tend to hold higher occupational classifications and receive higher rankings in research work from their supervisors. Each question on the RAT test lists a group of words, and requires that we provide a single extra word that will link all the others together. The creative process in remote associates problem solving consists of two stages: an initial divergent stage for generating ideas, followed by a convergent stage for matching solutions and evaluating them. The Remote Associates Test (RAT) offers a quick and objective scoring process, unlike the time-consuming and subjective scoring of divergent thinking tasks. Moreover, RAT questions are relatively easy to create, facilitating the mass production of tests. This helps prevent prior exposure of test items, which can invalidate them—a common issue with insight problem-solving tasks. The RAT thus provides an efficient and reliable method for measuring creativity. The original 1962 version of the RAT by Mednick contained 30 questions. Participants receive one point for each correct answer and zero for incorrect responses. The total score reflects their remote associative ability. Mednick (1962) explained individuals' different creative abilities through the associative hierarchy, holding that highly creative people have a flat associative hierarchy and relatively good remote associative ability, through which they are able to produce unusual and novel ideas. On the other hand, less creative people have a steep associative hierarchy, through which they produce close associations.

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UNIT V

UNIT V	Logical Reasoning Conditioning and Syllogism, Decision Making: Representativeness and Availability Heuristics, Anchoring and Adjustment; The Framing Effect and Overconfidence in Decisions.

Logical reasoning is a form of thinking in which premises and relations between premises are used in a rigorous manner to infer conclusions that are entailed (or implied) by the premises and the relations. Different forms of logical reasoning are recognized in philosophy of science and artificial intelligence.

It is one of the best forms of controlled thinking consciously towards the solution of a problem. It is realistic in the sense that the solution is sought always in reference to the reality of the situation. We can solve many problems in our day-dreams, dreams and imaginations but they are unrealistic solutions.

As Sherman defined, **"reasoning is a process of thinking during which the individual is aware of a problem identifies, evaluates, and decides upon a solution".**
Reasoning is used not only when we want to solve an immediate problem but also when we anticipate future problems.
Reasoning plays a significant role in one's adjustment to the environment. It not only determines one's cognitive activities but also influences the behaviour and personality.

Definitions of Reasoning:
1. "Reasoning is a stepwise thinking with a purpose or goal in mind" —Garrett.
2. "Reasoning is the term applied to highly purposeful, controlled and selective thinking"—Gates.
3. "Reasoning is the word used to describe the mental recognition of cause-and-effect relationships, it may be the prediction of an event from an observed cause or the inference of a cause from an observed event"—Skinner.

Thus, reasoning is a highly specialized thinking which helps an individual to explore mentally the cause-and-effect relationship of an event or solution of a problem by adopting some well-organized systematic steps based on previous experience combined with present observation.

Types of Reasoning:
Reasoning may be classified into two types.

1. Inductive reasoning: It is a specialized thinking aimed at the discovery or construction of a generalized principle by making use of particular cases, special examples and identifying of elements or relations.

For example, Mohan is mortal, Radha is mortal, Karim is mortal; therefore, all human beings are mortal.

2. Deductive reasoning: It is the ability to draw some logical conclusions from known statement or evidences. Here one starts with already known or established generalized

statement or principle and applies it to specific cases. For example, all human beings are mortal you are a human being, therefore, you are mortal.

i. Conditioned reasoning: It is the reasoning tied down by some specific condition such as the following. **For example,** if there is a solar eclipse, the street will be dork. There is a solar eclipse... The streets are dark.

ii. Categorical reasoning: This type of reasoning is based on some categorical statements. **For example,** all Robins are birds.….All birds lay eggs.... All Robins lay eggs.

iii. Linear reasoning: This type of reasoning involves straight forward relationships among elements. For example, If Ram is taller than Mohan and Mohan is taller than Sohan, Ram is the tallest.

Logical Reasoning

Logical reasoning is a form of thinking in which premises and relations between premises are used in a rigorous manner to infer conclusions that are entailed (or implied) by the premises and the relations. Different forms of logical reasoning are recognized in philosophy of science and artificial intelligence.

In our daily life, we often do things like logical reasoning. But we do not do it spontaneously, rather many processes are responsible for it. According to Galotit (1989), 'Reasoning means transforming the given information in order to reach a conclusion.' Here we will describe two types of logical reasoning tasks, conditional reasoning and syllogistic reasoning. Although the specific operations of these two tasks differ, some common factors influence these processes, people make similar errors on both tasks, such as the inability to think of all possible interpretations of statements. In conclusion, it can be said that both tasks are challenging. College students have difficulty using these tasks because not all students are able to use the logical reasoning tasks consistently (Nunmedal, 1987).

Conditional Reasoning

Problems related to conditional reasoning or propositional learning throw light on the type of relations found between conditions. For example-

"If the moon is shining. I can see without a flash light.

I can not see without a flash light. Therefore, the moon is not shinning.

This example throws light on conditional reasoning because conditional reasoning is found in **'moon shining' and 'Need of a flash light'. In other words, we can say that "If... then..."** relation is found in conditional reasoning. Conditional reasoning situations are often found in our daily life. Although their exact solution is very

difficult. Formal principles have been propounded for the explanation of conditional reasoning but psychologists have expressed their opposition to them.

The Propositional Calculus

The Propositional Calculus is a system by which the type of reasoning used in propositions/statements is classified. There are 4 types of conditions of conditional reasoning, the explanation of which will help in understanding the propositional calculus. First, it is necessary to understand some psychological terminology. The word antecedent refers to the result that happens first. The 'If...' part of the result is called the antecedent condition. Whereas the word consequent refers to the resultant condition that follows the antecedent direction. The 'then...' part is found in the resultant condition. Sometimes we affirm that the sentence is correct and sometimes we deny that the sentence is wrong. The description of four types of conditional interpretation situations is as follows-

(1) Affirming the Antecedent - Affirming the antecedent means that the 'if...' part of the sentence is true. For example, **If today is Tuesday, then I have by bowling class. Today is Tuesday. Therefore, I have my bowling class.** Such reasoning leads us to a valid and correct conclusion.

(ii) Affirming the Consequent - In this situation, the 'then...' condition of the sentence is true. By this type of reasoning, we can reach an incorrect conclusion. For example, **If I have been at a buffet-style restaurant, then have gained five pounds. If I have gained five pounds.** Therefore, I have been at buffet style restaurant.

In the above example, 'Therefore, I have been at buffet style restaurant' is incorrect because a person can save five pounds by eating at his friend's house, but not in a restaurant. The question is, why do people affirm the 'consequent' more? In this regard, Bell & Staines (1981) Nickerson et al. (1985) are of the opinion that in real life

(iii) Denying the Antecedent- It means that we are often right when we make such inductive errors. We consider the 'If...' part to be false. By denying the antecedent we reach an incorrect conclusion. For example- **If I am a freshman, then I must register for next sentences classes today. I am not a freshman. Therefore, I must register for next semester's classes today**. The third conclusion is false because there is a possibility that the students of my class and the new students get themselves registered today.

(iv) Denying the Consequent- It means the statement of the person which contradicts the consequent condition ('then...'). On the basis of this type of inference we can reach the correct conclusion. Like**, If the judge is fair, then Yash is the winner. Yash is not the winner. Therefore, the judge is not fair.**

Factors Affecting Conditional Reasoning

The error rate of conditional reasoning problems is affected by two important factors- **abstractness of the problem and negative information**. When we use concrete examples in the problem, we are more precise. On the contrary, we experience more difficulty when there is abstract material. Wixson & Laird (1972-). An abstract reasoning problem is concise and difficult too. **For example, If an object is red, then it is rectangular. The object is not rectangular. Therefore, it is not red. (True or False).**

Other research in this context has highlighted the fact that performance is better if propositions have high imagery (Element & Falmagne, 1906). Some researchers have also found that people handle predicative information better than negative information. Thus, it can be said that negation affects conditional inference more. Several studies have shown that conditional inference becomes difficult when the premise contains the negation word 'not' (Evans, 1972; Galotti, 1989). **For example, 'If an object is not blue, then it is rectangular. This object is not recangular. Therefore, it is blue. (True or False)** One cannot easily decide whether the statement is true or not, whereas the reality is that the conclusion is true.

Errors in Conditional Reasoning

When people try to arrive at conclusions on conditional reasoning tasks, they make errors, even if they have studied logic (Cheng et. al., 1986). We will now describe the areas in which errors often occur:

(1) Making only one model of antecedent and consequent - Johnson-Laird & Byrne (1991) argue that people form mental images to represent premises. These mental images cannot represent all logical possibilities. For example: If she meets her friend, then she will go to play. She did not meet her friend.

Byrne (1989) found that 46% of college students arrived at the incorrect conclusion that "She will not go to a play". Clearly, it can be said that the students had constructed only one mental model that she will go to play if she meets her friend. In one such case, Byrne added an additional premise "If she meets her brother, then she will go to play". In this case, only 4% of the subjects arrived at the incorrect conclusion (She will not go to play).1 This shows that they construct an additional mental model that includes her brother. Hence, they arrived at the conclusion that she could go to play even if her friend was not there.

(ii) Making an illicit conversion - Another interpretive error can be taken as making an illicit conversion by the person. Illicit conversion means inappropriate conversion of a part of the problem into another form by the person. Wason & Johnson-Laird (1972) have shown how this transformation takes place when a person uses the method of denying the antecedent, which is an invalid method. The general form of this method is as follows:

If p. then q.

p is not true.

Therefore, q is not true.

The problem is that people use the invalid transformation when they first see the statement. They transform it inappropriately**: If q, then p.**
and enthusiastically accept it using the method of denying the consequent. They conclude that 'Therefore, q is not true', which, if used appropriately, is a valid method. We face such inductive situations in our day-to-day lives and we make the invalid transformation without any problem.

(iii) Trying to confirm a hypothesis, rather than trying to disprove it- Gellatly (1986b). Griggs & Cox (1982) are of the view that people show more preference towards confirming a hypothesis rather than disproving it. Although in conditional reasoning both the correct statements are used- confirming the antecedent and disproving the consequent, but in general the person is more inclined towards confirming the antecedent but is reluctant to disprove the consequent. They avoid such statements. Thus, it can be said that people show more preference towards affirmative information than negative information. We give importance to what is and not to what is not.

Some researchers have found that when the format of the task is concrete and familiar (Cheng & Holyonk, 1985; Cakhull & Johnson-Laird, 1985, Pollard & Evans, 1987). When the wording of the problem is changed, the results are found to change surprisingly (Jackson & Griggs, 1990). Griggs & Cox (1982) in their important study took college students and presented them with a modified selection task. They found that zero percent of the subjects attempted the selection task when it was abstract rather than concrete. The results obtained on presenting concrete and abstract sentences are surprising because there was a difference in the wording of the two types of sentences. (Cosmides, 1989, Gigerenzer & Huq, 1992) Cosmides (1989) has argued that the development of development encourages the development of special skills in the individual to understand important and prosecutable problems. As a result, suitable partners in society develop the ability to understand a variety of rules necessary for social interaction.

(iv) **Failure to transfer new knowledge to a new task** By now we have seen that people make errors in conditional reasoning because they develop only one set of premises, make invalid transformations, and avoid disproving hypotheses. Salmon (1991) has found that students who study formal logic in philosophy find it difficult to apply their knowledge in new situations. Klaczynski et. al., (1989) have found that people have difficulty appreciating the equivalence between two versions of a selection task. Matlin (1975) has found that people are not particularly precise when they solve an 'If ... then' problem.

Syllogistic Reasoning

Unfortunately, people are less accurate when performing logical tasks due to the use of syllogisms. Syllogism is pronounced "sill-owe-jizz-um". A syllogism is an argument in which there are two or more premises and a conclusion, the premises being assumed to be true. There are four types of premises used in syllogisms. These premises are constructed on the basis of 'All' (universal) or 'some' (particular). Each of these premises is either affirmative or negative. Here is an example of this:

Premises 1. **Universal Affirmative**
Example- All cats are animals.

Premises 2. **Particular Affirmative**
Example- Some cats are animals.

Premises 3. **Universal Negative**
Example-All cats are not animals.

Premises 4. **Particular Negative**
Example-Some animals are not cats.

If these are true or false, one necessarily arrives at a conclusion.

For example-

Premise I : All cats are animals.
Premise II: Some animals have tails.

Conclusion : Some cats have tails.

The evaluation of syllogisms involves determining whether the conclusions (some cats have tails) should be true or not, if the first and second premises are true. When given a syllogism, a person is not asked to determine whether the first or the second premise is actually true, but to assume them to be true. Nor is a person asked to determine whether the conclusion is factually correct, but to see whether the conclusion is consistent with the premises. The internal orientation of syllogism can be understood as follows.

Premise I: All dogs are airplanes.
Premise II: Some airplanes have leaves.
Conclusion: Some dogs have leaves.

Based on our knowledge about the world, it can be said that the first example (Cats are animals) is logical while the second example (Dogs have leaves) is incorrect and surprising. Although both the examples are similar from the point of view of logic, but on analysing the internal consistency of the argument, it is found that whether "Dogs really are airplanes" or "Airplanes really have leaves" is true or not is irrelevant. The main question is that if the premises are true, then is the conclusion consistent with them? For this, it is not necessary to use only familiar and meaningful words. For example-

Premise 1: All X's are Z's.
Premise II : Some Z's have Y.
Conclusion: Some X's have Y

Whether a person uses words or meaningless words or letters in the statement of a syllogism, it is unimportant from the point of view of logic because the assumption of the premises being true is made to determine whether the conclusion follows from the premises or not. Letters are generally used to describe the argument. The subject matter of the syllogism can be abstract as well as meaningful.

Factors Affecting Syllogism

Performance of syllogism is affected by many variables, of which linguistic factors and time pressure are important. When the format of sentences is linguistic, it creates problems in determining the difficulty of syllogisms. As we have seen, there is difficulty in solving problems in conditional reasoning tasks because negative words are used in them. Lippman (1972). Besides this, solving syllogisms becomes easier if active voice is used (Lippman, 1972). Like sentence format, time pressure also has a clear effect on the accuracy of solving syllogisms. Gsalo-Hi et. al. (1986) found that when the subjects were given only 20 seconds to solve each syllogism, they gave correct solutions. But immediately after, when the same syllogism was presented again without any time constraint, it was found that expertise affects reasoning ability. Whether they are given more or less time to solve the syllogism has no effect. The syllogism is challenging. When time is less, students of higher ability make more errors (Matlin, 1995).

Errors in Syllogistic Reasoning

People make two common errors in solving syllogisms. They make illicit conversions and they are affected by belief bias. Not only do illicit conversions occur in conditional reasoning, people also make illicit conversions in syllogisms. Newstead (1989. Newstead & Griggs (1983) opine that student of introductory classes of psychology were selected as subjects. Out of these subjects only 30% subjects used the consistent invalid transformation on the syllogism. Thus, it can be said that invalid transformation of the means is affected by the common errors in the context of the syllogism.

The belief-bias effect is found in syllogism-based reasoning which occurs when people make decisions based on prior beliefs and do not use the rules of logic. But not all people make these errors. Evans et. al. (1983) in their study have found that less than half of the conclusions in the syllogism were accepted correctly even though the conclusions were actually valid but not believable. When the conclusions are against common sense, people show interest in declaring a sentence to be valid.

Similarly, Markovitz & Nantel in their experiment presented a series of syllogisms to French and Canadian subjects such as-

1. Premise 1: All things that have a motor need oil.
   Premise 2: All automobiles need oil.
   Conclusion: Automobiles have motors.

2. Premise 1: All flowers have petals.
   Premise 2 : Lapidars have petals.
   Conclusion: Lapidars are flowers.

3. Premise 1 : All eastern countries are communist.
   Premise 2 : Canada is not an eastern country.
   Conclusion: Canada is not communist.

Some of these statements describe real objects and are logical conclusions contrary to the subjects' prior belief. In some syllogisms, inappropriate words have been replaced by other words. The results obtained show that people believe in conclusions more easily when the conclusions are in accordance with their prior beliefs. On the contrary, when meaningless words are used in a syllogism, they gain knowledge about the flaws on the basis of their logical ability. For example, we can take the above syllogisms.

Decision Making

To get a clear conclusion, we use established rules in reasoning. On the contrary, uncertainty is found in decision making. Important information is missing and other information is unreliable. In daily life, we have to face many such situations when we have to reach a decision. Psychologists have studied the decision-making process from many perspectives and have used many approaches for the study. We can find descriptions of various approaches used in the context of decision making in the books of Dawes (1980), Hogarth (1990), Rachlin (1989), Yates (1990). In the previous chapter, we have seen that heuristics are rules of thumb or such precepts which are likely to provide correct solutions. In reality, even decision making is not completely accurate because people are often not aware of the limitations of these precepts (Abelson & Levi, 1985). According to one theorist, "humans are sometimes systematically irrational" (Baron, 1991). Two researchers Daniel Kahneman and Ainos Tversky have proposed that a very small number of precepts guide human decision making. They have emphasized that the precepts which normally guide us in making decisions sometimes do not give any specific result. They mislead the person. Thus, we can say that errors are also found in decision making but these errors do not lead us to the conclusion that if a human is limited then he is a foolish creature of this world (Crandall, 1984). Rather, according to Nisbett & Ross (1980), it should be kept in mind that the decision-making skills of a person are helpful in handling many problems of daily life. When decisions are used on problems outside the limits/range, then these skills become a liability. Nisbett & Ross are of the opinion that psychologists interested in decision making are interested in the errors committed by the person.

In summary, it can be said that through self-research we can get accurate conclusions but errors are found when these are used inappropriately. **Decision making heuristic is of three types – Representativeness, Availability and Anchoring and Adjustment.**

History of Heuristic

Nobel-prize winning economist and cognitive psychologist Herbert Simon originally introduced the concept of heuristics in psychology in the 1950s. He suggested that while people strive to make rational choices, human judgment is subject to cognitive limitations. Purely rational decisions would involve weighing every alternative's potential cost and possible benefits.
However, people are limited by the amount of time they have to make a choice and the amount of information they have at their disposal. Other factors, such as overall intelligence and accuracy of perceptions, also influence the decision-making process.
In the 1970s, psychologists Amos Tversky and Daniel Kahneman presented their research on cognitive biases. They proposed that these biases influence how people think and make judgments.
Simon's research demonstrated that humans were limited in their ability to make rational decisions, but it was Tversky and Kahneman's work that introduced the study of heuristics and the specific ways of thinking that people rely on to simplify the decision-making process.

I. The **Representative Heuristic**, According to Nisbett et. al. (1983), representativeness is probably the most important for decision making heuristics. If representativeness is found in a sample, it means that there is similarity in important characteristics of the sample and the population.

The **conjunction fallacy** is a cognitive bias that occurs when someone mistakenly believes that two events occurring together are more likely than either of the two events alone. In other words, it's the mistaken belief that a precisely detailed, multifaced outcome is more likely to occur than a more generalized version of that outcome. This phenomenon often occurs when individuals concentrate on how two events are connected rather than evaluating the likelihood of each event independently. This focus on the interplay between events can result in flawed or misguided judgments, as it shifts attention away from considering the actual probabilities of the individual occurrences. The conjunction fallacy can significantly skew our judgment and decision-making processes. By leading us to overvalue the chances of simultaneous events, it might result in an inflated perception of their likelihood. This misjudgment can leave us ill-prepared for the outcomes, as our expectations don't align with the reality of the probabilities involved. A good description can be found here. The most famous example is due to Tversky and Kahneman (1983), where they gave the following scenario:

Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.
Which is more probable?
a) Linda is a bank teller.
b) Linda is a bank teller and is active in the feminist movement.

Amos Tversky and Daniel Kahneman first presented the Linda Problem, 85 percent of respondents chose the incorrect answer. (The users of this website have a better track record.) Although many people are drawn to the answer that it is more probable that Linda is a bank teller and a feminist, logically this cannot be true. It is a law of probability that a conjunction cannot be more likely than either of its constituents. The conjunction "bank teller and feminist" is included within the constituent "bank teller," so it cannot be more likely that a person falls into group 2 than group 1. Even if you believe that it is very likely that Linda is a feminist and not very likely that she is a bank teller, it is still not possible for it to be more likely that she is a bank teller and a feminist than that she is a bank teller.

II. The **Availability Heuristic** is a type of mental shortcut that involves estimating the probability or risk of something based on how easily examples come to mind. If we can think of many examples, then we assume it happens frequently.

Examples of the Availability Heuristic
Few scenarios where this could play out in your day-to-day life.

a) **After reading an article about lottery winners,** you overestimate your likelihood of winning the jackpot. You start spending more money than you should each week on lottery tickets.
b) **After seeing news reports about people losing their jobs**, you might start to believe that you are in danger of being laid off. You begin lying awake in bed each night worrying that you are about to be fired.
c) **After seeing news stories about high-profile child abductions,** you believe such tragedies are quite common. You refuse to let your children play outside alone and never let them leave your sight.
d) **After seeing several television programs on shark attacks**, you begin to think such incidences are relatively common. When you go on vacation, you refuse to swim in the ocean because you believe the probability of a shark attack is high.

III. The **Anchoring and adjustment Heuristic** refer to the cognitive bias whereby a person is heavily dependent on the information received initially (referred to as the "anchor") while making subsequent decisions. In other words, all the following choices are influenced and require adjustments to remain close to the initial anchor value, which can cause a problem if the anchor is too different from the true value. Typically, this bias is seen when individuals build future outcomes based on available information.

Anchoring and adjustment are related to a cognitive bias in which a person's decision-making is heavily influenced by the information they first gathered. In other words, if the anchor is too far from the actual value, all the following options will be impacted and require modifications to keep near the initial anchor value. This bias may be seen when people base their predictions of future outcomes on readily available data.

The anchoring and adjustment effect can be connected through suggestion and subliminal anchoring. If an analyst uses an economic forecasting or pricing model, one can observe financial anchoring and adjustment. A person exhibits anchoring and adjustment behavior during decision-making when the initial set of information heavily influences all their decisions. Typically, the individual would tend to integrate all those ideas that fall within the acceptable range of the anchor and reject those that are not in line with the anchor. So, only those values are discussed close to the anchor in all genuine arguments, negotiations, estimates, etc. The underlying principle of anchoring and adjustment is that an individual chooses a particular value or number as the starting point (a.k.a. the anchor), eventually becoming the target number. Subsequently, the individual adjusts the following information until it reaches within an acceptable range of the target value over the period.

The framing effect is a common form of cognitive bias. It occurs when people's decisions are influenced by how information, judgments, or decisions are presented rather than the inherent qualities of the options themselves. The framing effect focuses on how information is "framed" or presented. It can also take place when different aspects are emphasized in order to evoke particular responses or interpretations. In the example above, the proponents of gun laws have framed the debate as one over public safety and gun violence. Meanwhile, those opposed have framed it as a Constitutional rights issue.

Framing can take place whenever information is present. The nature of this bias makes it ubiquitous, with presence in everything associated with information from commercial activities to news, politics, and public affairs. It finds its way into virtually every decision that we make. If our decisions depend on external information, then we become vulnerable to how it has been framed. Not to mention when features or aspects of the matter in question have been intentionally amplified or de-emphasized to appeal to the target group.

Example 1: Framing effect

While doing your groceries, you see two different beef products. Both cost and weigh exactly the same. One is labeled "80% lean" and the other "20% fat." Comparing the two, you feel that 20% fat sounds like an unhealthy option, so you choose the 80% lean option. In reality, there is no difference between the two products, but one sounds more appealing than the other due to the framing effect.

Example 2: Framing effect and politics

"Tax relief" is a term often used to refer to "tax cuts." By framing taxes in this way, politicians emphasize their burdensome qualities, while any benefits coming from them, such as social programs, are ignored.

The popularization of the term has made it more difficult for opponents of tax cuts to get their argument across. "Tax cuts" is an emotionally neutral term, while "tax relief" is emotionally charged. It evokes the image of an oppressor burdening people with heavy taxes. Even though both terms mean the same thing, it is far more difficult to be against "tax relief".

The framing effect is different from advertising. The latter is a deliberate communication strategy that promotes products, services, or ideas by shaping consumer behavior.

Very Short Questions/True Facts:

1. **An anchoring bias** occurs when you focus on one piece of information when making a decision or solving a problem.
2. **The confirmation bias** is the tendency to focus on information that confirms your existing beliefs.
3. **Hindsight bias** leads you to believe that the event you just experienced was predictable, even though it really wasn't.
4. **Representative bias** describes a faulty way of thinking, in which you unintentionally stereotype someone or something; for example, you may assume that your professors spend their free time reading books and engaging in intellectual conversation, because the idea of them spending their time playing volleyball or visiting an amusement park does not fit in with your stereotypes of professors.
5. **Availability heuristic** is a heuristic in which you make a decision based on an example, information, or recent experience that is that readily available to you, even though it may not be the best example to inform your decision.
6. **Affect heuristic** refers to the use of emotional responses to guide quick judgments or decisions.
7. **Neuroeconomics** is defined as a field that seeks to investigate the physiological and neural basis of decision-making processes.
8. **Status quo bias** refers to the tendency to make a preference for maintaining the status quo (present state) rather than acting to change one's decision.
9. **Falsification** refers to proposing hypotheses and then attempting to falsify them by using experimental tests.
10. **Belief bias**, in syllogistic reasoning refers to the tendency to accept conclusions that are invalid but seem believable, while rejecting those that are valid but appear unbelievable.

Short Questions:

1. How are heuristics used in decision making?

Heuristics play an important role in both problem-solving and decision making, as we often resort to these mental shortcuts when we need a quick solution.

Psychologists have a few different concepts about why we rely on heuristics. They are as follows:

1. **Attribute substitution:** People substitute simpler but related questions in place of more complex and difficult questions.

2. **Effort reduction:** People use heuristics as a type of cognitive laziness to reduce the mental effort required to make choices and decisions.

3. **Fast and frugal:** People use heuristics because they can be fast and accurate in certain contexts. Some theories argue that heuristics are actually more accurate than they are biased.

2. Explain the difference Between Heuristics and Algorithm.

Though the terms are often confused, heuristics and algorithms are two distinct terms in psychology. Algorithms are step-by-step instructions that lead to predictable, reliable outcomes, whereas heuristics are mental shortcuts that are basically best guesses. Algorithms always lead to accurate outcomes, whereas, heuristics do not. Examples of algorithms include instructions for how to put together a piece of furniture or a recipe for cooking a certain dish. Health professionals also create algorithms or processes to follow in order to determine what type of treatment to use on a patient.

3. How Heuristics can lead to bias?

Heuristics can certainly help us solve problems and speed up our decision-making process, but that doesn't mean they are always a good thing. They can also introduce errors, bias, and irrational decision-making. As in the examples above, heuristics can lead to inaccurate judgments about how commonly things occur and how representative certain things may be. Heuristics can also contribute to stereotypes and prejudice. Because people use mental shortcuts to classify and categorize people, they often overlook more relevant information and create stereotyped categorizations that are not in tune with reality.

4. What is the cause behind the conjunction fallacy?

The conjunction fallacy reflects a flaw in humans' intuitive understanding of probability. This cognitive bias can be attributed to several psychological factors:

Lack of knowledge of statistics: Statistical principles aren't common knowledge, and most people aren't familiar with concepts like the conjunction rule.
Narrative bias: People are more likely to believe a detailed, coherent story than a more probable but less detailed scenario.
Representativeness heuristic: People often judge the probability of an event or condition by how much it resembles a stereotype (e.g., many people would feel surprised if their new English literature professor comes in wearing jeans and sneakers, because it doesn't match the stereotype).
Confirmation bias: People tend to seek out and remember information that

confirms their current beliefs, which can lead to overestimating the likelihood of conjunctions that fit with existing beliefs (e.g., assuming that a health-conscious individual is more likely to be a teacher and vegan rather than just a teacher).

5. Explain the Linda problem?

The Linda problem is a well-known illustration of the conjunction fallacy. It demonstrates how people tend to make judgments based on heuristics (i.e., mental shortcuts) and subjective impressions rather than objective probabilities. In a 1983 study by psychologists Amos Tversky and Daniel Kahneman, participants were presented with a description of Linda, a single 31-year-old woman who is passionate about social justice and anti-nuclear causes. When asked to guess which description matched Linda, many participants incorrectly judged it more likely that Linda is both a bank teller and an active feminist rather than solely a bank teller. The participants' answer to this question defies the statistical principle that it's more likely for conditions to occur separately than together. The Linda problem thus demonstrates the human tendency to commit the conjunction fallacy.

6. Explain Availability Heuristic vs. Representativeness Heuristic.

The brain uses all types of mental shortcuts, and some of them have a few things in common and may sometimes be confused with one another. The availability heuristic, for example, is sometimes confused with what is known as the representativeness heuristic. The representativeness heuristic is a shortcut in which we estimate the probability of an effect based on how well the current example matches an example we already have in mind. For example, we might base our impressions of a person in a professional role based on the representation of that role we already have in our mind. So, while representativeness relies on comparing an event to our existing expectations, availability relies on basing these estimates on how readily we can call similar events to mind.

7. Explain Anchoring and Adjustment Heuristic through Examples.

Example #1 - Let us take the example of a used car salesman to illustrate the concept of anchoring and adjustment. Usually, the salesman would quote a very high price to start the negotiations, which is undoubtedly well above the car's market value. Now, the initial price quoted by the salesman becomes the anchor, and as such, the buyer invariably would end up paying a final price much higher than the fair value. The car salesman only made it possible by creating an anchor with a higher quote.

Example #2 - Let us take another example of a hiring manager to illustrate the concept of anchoring and adjustment. During negotiations, a hiring manager might consider offering a very low compensation package to a prospective candidate. Now, because of the lower starting point, the candidate might join at a relatively lower initial salary even after several rounds of negotiation.

8. What is the Framing Effect?

The framing effect is when our decisions are influenced by the way information is presented. Equivalent information can be more or less attractive depending on what features are highlighted. The framing effect in psychology refers to the bias where people react differently to a particular decision depending on how it's presented, or "framed", emphasizing either the positive (gain) or negative (loss) aspects. The same information, when framed differently, can alter people's responses.

9. How to mitigate the framing effect?

Awareness: Being aware of the framing effect can help individuals make more objective decisions by consciously considering the underlying content rather than being swayed solely by how it's presented.

Critical Thinking: Practice critical thinking when making decisions. Analyze the information presented from different angles to understand the implications of each option.

Consider Multiple Frames: When presented with a choice, try to reframe the information in different ways to gain a more comprehensive understanding of the decision's implications.

Focus on Core Content: Try to focus on the core content or information presented rather than getting caught up in the way it's presented.

Recognizing and understanding the framing effect can enable individuals to make more informed and rational decisions by evaluating options based on their actual content rather than being overly influenced by the presentation style.

10. The different types of framing effect

1. **Positive vs. Negative Framing:** As shown in the medical treatment example, positive framing emphasizes gains and benefits, while negative framing emphasizes losses and risks.
2. **Gain-Loss Framing:** This type of framing focuses on what can be gained or lost by choosing a particular option. People tend to be more risk-averse when choices are framed in terms of gains and more risk-seeking when choices are framed in terms of losses.
3. **Attribute Framing:** This involves emphasizing different attributes or qualities of an option to influence perception. For instance, highlighting the fat content of a food product can make it appear less healthy, even if the overall nutritional value is acceptable.
4. **Temporal Framing:** This involves presenting information in terms of time, such as short-term gains versus long-term gains, which can influence decision-making based on time preferences.
5. **Mental Set**-continually using an old solution to a problem without results
6. **Problem-Solving Strategy**-method for solving problems
7. **Representative Bias**-faulty heuristic in which you stereotype someone or something without a valid basis for your judgment
8. **Trial And Error-Problem-Solving** strategy in which multiple solutions are attempted until the correct one is found

Long/Extensive Questions:

1. **Discuss the different types of Heuristics.**

There are many different kinds of heuristics. While each type plays a role in decision-making, they occur during different contexts. Understanding the types can help you better understand which one you are using and when.

Availability

The availability heuristic involves making decisions based upon how easy it is to bring something to mind. When you are trying to make a decision, you might quickly remember a number of relevant examples. For example, imagine you are planning to fly somewhere on vacation. As you are preparing for your trip, you might start to think of a number of recent airline accidents. You might feel like air travel is too dangerous and decide to travel by car instead. Because those examples of air disasters came to mind so easily, the availability heuristic leads you to think that plane crashes are more common than they really are.

The availability heuristic is a heuristic in which you make a decision based on an example, information, or recent experience that is that readily available to you, even though it may not be the best example to inform your decision**.** Biases tend to "preserve that which is already established—to maintain our preexisting knowledge, beliefs, attitudes, and hypotheses" (Aronson, 1995; Kahneman, 2011).

Familiarity

The familiarity heuristic refers to how people tend to have more favorable opinions of things, people, or places they've experienced before as opposed to new ones. In fact, given two options, people may choose something they're more familiar with even if the new option provides more benefits.

Representativeness

The representativeness heuristic involves making a decision by comparing the present situation to the most representative mental prototype.6 When you are trying to decide if someone is trustworthy, you might compare aspects of the individual to other mental examples you hold. A soft-spoken older woman might remind you of your grandmother, so you might immediately assume she is kind, gentle, and trustworthy. However, this is an example of a heuristic bias, as you can't know someone trustworthy based on their age alone.

This bias describes a faulty way of thinking, in which you unintentionally stereotype someone or something; for example, you may assume that your professors spend their free time reading books and engaging in intellectual conversation, because the idea of them spending their time playing volleyball or visiting an amusement park does not fit in with your stereotypes of professors.

Anchoring

The anchoring bias involves the tendency to be overly influenced by the first bit of information we hear or learn. This can make it more difficult to consider other factors and lead to poor choices. For example, anchoring bias can influence how much you are willing to pay for something, causing you to jump at the first offer without shopping around for a better deal.

An anchoring bias occurs when you focus on one piece of information when making a decision or solving a problem. In this case, you're so focused on the amount of money you are willing to spend that you may not recognize what kinds of houses are

available at that price point.

2. Explain how to Make Better Decisions.

While heuristics can be a useful tool, there are ways you can improve your decision-making and avoid cognitive bias at the same time.

Slow Down
We are more likely to make an error in judgment if we are trying to make a decision quickly or are under pressure to do so. Taking a little more time to make a decision can help you see things more clearly—and make better choices. Whenever possible, take a few deep breaths and do something to distract yourself from the decision at hand. When you return to it, you may find a fresh perspective or notice something you didn't before.

Identify the Goal
We tend to focus automatically on what works for us and make decisions that serve our best interest. But take a moment to know what you're trying to achieve. Consider some of the following questions:

Are there other people who will be affected by this decision?
What's best for them?
Is there a common goal that can be achieved that will serve all parties?

Thinking through these questions can help you figure out your goals and the impact that these decisions may have.

Process Your Emotions
Fast decision-making is often influenced by emotions from past experiences that bubble to the surface. Anger, sadness, love, and other powerful feelings can sometimes lead us to decisions we might not otherwise make. Is your decision based on facts or emotions? While emotions can be helpful, they may affect decisions in a negative way if they prevent us from seeing the full picture.

Recognize All-or-Nothing Thinking
When making a decision, it's a common tendency to believe you have to pick a single, well-defined path, and there's no going back. In reality, this often isn't the case. Sometimes there are compromises involving two choices, or a third or fourth option that we didn't even think of at first. Try to recognize the nuances and possibilities of all choices involved, instead of using all-or-nothing thinking.

Takeaways
Heuristics are common and often useful. We need this type of decision-making strategy to help reduce cognitive load and speed up many of the small, everyday choices we must make as we live, work, and interact with others.

But it pays to remember that heuristics can also be flawed and lead to irrational choices if we rely too heavily on them. If you are making a big decision, give yourself a little extra time to consider your options and try to consider the situation from someone else's perspective. Thinking things through a bit instead of relying on your mental shortcuts can help ensure you're making the right choice.

3. **Discuss conjunction fallacy in detail with Example.**

The conjunction fallacy is the human tendency to mistakenly assume that multiple specific conditions are more probable than a single general condition (in this context, "conjunction" refers to the co-occurrence of multiple events or conditions).

In reality, the probability of any two events occurring together is always less than or equal to the probability of either event occurring independently. This principle is known as the conjunction rule in probability theory. Despite its name, the conjunction fallacy is a cognitive bias (a pattern of irrational decision-making) rather than a logical fallacy. However, the same line of reasoning can also lead to flawed arguments.

The narrative fallacy is another cognitive bias that sometimes contributes to the conjunction fallacy. It reflects the human inclination towards coherent stories over statistical realities. This bias makes detailed narratives seem more credible than simple descriptions, despite statistical evidence to the contrary.

Conjunction fallacy example in statistics

A researcher predicts that a certain gene variant in lab mice protects against a disease and also predicts increased longevity. However, statistical analysis of the data reveals that the gene variant only protects against the disease; it has no significant correlation with longevity.

This example illustrates how the conjunction fallacy can sometimes be debunked by statistical data. The researcher made the mistake of assuming that two conditions (i.e., both protection against a disease and longevity) would be associated with a certain genotype. Yet, the statistical data contradicted this assumption, highlighting the importance of empirical evidence in debunking such misconceptions.

4. **Discuss Overconfidence Bias in detail.**

Overconfidence bias is the tendency to overestimate our knowledge and abilities in a certain area. As people often possess incorrect ideas about their performance, behavior, or characteristics, their estimations of risk and success often deviate from reality. Overconfidence bias is a type of cognitive bias that causes us to think we are better in some areas than we really are. Most people believe that they are more intelligent, more honest, or that they have a brighter future than the average person. For example, 93% of American drivers claim to be better than average, which is statistically impossible.

Because human judgment is highly susceptible to overconfidence bias, it is one of the most common types of bias. It is also a very serious one, as it reinforces other decision-making biases, such as hindsight bias, optimism bias, and action bias. Excessive faith in ourselves and our abilities makes it harder for us to see how prone we are to errors and biases.

Example: College students often overestimate how quickly they can finish writing a paper and are forced to pull an all-nighter when they realize it takes longer than expected. This is overconfidence bias at play.

Overconfidence bias causes us to lose objective perspective about our abilities or knowledge. This can create unrealistic expectations and make us more

vulnerable to disappointment. For example, overconfidence often leads students to poor study decisions, such as causing them to choose subjects they don't really have an aptitude for. Overconfidence bias can also impede our learning if we don't accurately assess the gap between what we currently know and what we need to know.

However, overconfidence bias does not only lead to poor decisions. Depending on the context, it can sometimes be the source of the right decision. For example, overconfident managers tend to push for innovation more frequently, and they are better at persuading investors to invest in higher-risk projects, which can enable further growth.

Overall, overconfidence bias is a double-edged sword: successful people show overconfidence, but overconfidence is not the determinant of success.

There are three distinct types of overconfidences. Each one has different psychological origins, occurs under different conditions, and has different consequences.

a. **Overestimation** refers to the overestimation of one's true ability, performance, level of control, or chance of success. For example, doctors may overestimate the accuracy of their diagnoses, employees may overestimate the speed with which they can finish a task, and people tend to overestimate the level of control they have over situations.
b. **Over placement** (or "better-than-average") occurs when a majority of people rate themselves better than average, even though it is statistically impossible for most people to have better-than-average abilities. For example, in one study, 37% of a firm's engineers ranked themselves among the top 5% of performers at the firm.
c. **Over precision** is the false belief that the individual knows more than they know. It manifests as excessive certainty regarding the accuracy of one's beliefs. This certainty is expressed using numbers, usually with unrealistic percentages or confidence intervals. For instance, gamblers exhibit over precision when they assume that they can accurately predict what will appear next on the roulette.

5. What is syllogistic reasoning? Discuss the factors affecting syllogistic reasoning. (Refer to the content of Unit V)

6. Discuss the various types of errors that can occur in syllogistic reasoning. (Refer to the content of Unit V)

7. What is conditional reasoning, and what are the common errors associated with it? Discuss. (Refer to the content of Unit V)

8. Differentiate between formal reasoning tasks and everyday reasoning tasks.
Galotti (1989) outlined the distinction between formal reasoning tasks and everyday reasoning tasks as follows:
i) In formal reasoning tasks, all premises are explicitly provided. In contrast, everyday

reasoning tasks often involve some implicit premises, with others not supplied at all.
ii) Formal reasoning tasks are self-contained, providing all the information needed to solve the problem within a defined structure. Whereas, everyday reasoning tasks are not self-contained.
iii)In formal reasoning tasks, there is a single correct answer. In contrast, everyday reasoning tasks can have several possible answers.
iv) Formal reasoning tasks have established methods of inference that apply to the problem often exist. On the other hand, established procedures for solving the problem rarely exist.
v) In formal reasoning tasks,when the problem is solved the solution is typically unambiguous. In contrast, everyday reasoning tasks often leave uncertainty about whether the current "best" solution is good enough.
vi) In formal reasoning tasks, the content of the problem is often of limited, academic interest. On the other hand, in everyday tasks, the content of the problem typically has potential personal relevance.

9. Which areas of the brain are actively involved in decision-making and reasoning?

Researches have suggested that, during decision-making, the prefrontal cortex, especially the anterior cingulate cortex, becomes active, similar to its role in problem-solving. According to a study by Platt et.al. 1999, on decision-making in monkeys have indicated activation in the parietal regions of the brain. The study also revealed that the amount of gain associated with a decision also affects the amount of activation observed in the parietal region. Research on decision-making in drug abusers identified several brain areas involved in making risky decisions. The researchers focused on drug abusers because drug abuse inherently leads to risky decision-making. They found decreased activation in the left pregenual anterior cingulate cortex of drug abusers (Fishbein et al., 2005). These findings indicated that during decision making, the anterior cingulate cortex is involved in the consideration of potential rewards.Prado et al. (2011) conducted a meta-analysis of 28 neuroimaging studies on deductive reasoning. They obtained evidence for a brain system centred in the left hemisphere involving frontal and parietal areas. The specific brain areas activated during deductive reasoning were found to include the inferior frontal gyrus, the middle frontal gyrus, the medial frontal gyrus, the precentral gyrus and the basal ganglia. The left-hemisphere dominance identified by Prado et al. (2011) has also been supported by patient data. Goel et al. (2007) examined patients with damage to either the left or right parietal cortex. They found that individuals with left-side damage performed worse than those with right-side damage on reasoning tasks where complete information was provided.

10. What is group decision-making, and what are its advantages and disadvantages?

Group decision-making refers to the process of making decisions within a group setting, drawing on a broaderr range of expertise and perspectives to reach a solution.
Advantages: Teaming up as a group can improve the effectiveness of decision-making, much like it enhances the effectiveness of problem-solving. In an organizational setting, individuals are combined into teams to enhance decision-making. By forming decision-making teams, the group is benefitted from the expertise of each of the members. Another advantage of group decision making is enhanced group memory over individual memory (Hinsz, 1990). Shelton (2006) suggested that groups that are successful in decision-making exhibit a number of similar characteristics, like: small

group, having open communication, members sharing a common mind-set, members identifying with the group, and members agreeing on acceptable group behavior.

Disadvantages: There can be disadvantages associated with group decision making. One of them is groupthink. Groupthink refers to a phenomenon that is characterized by premature decision making that is generally the result of group members attempting to avoid conflict (Janis, 1971). Groupthink leads to poor decision-making by discouraging unconventional ideas. Janis outlined the conditions leading to groupthink as: 1) an isolated, cohesive, and homogeneous group is empowered to make decisions; 2) objective and impartial leadership is absent, within the group or outside it; and 3) high levels of stress impinge on the group decision-making process. Janis (1971) identified six key symptoms of groupthink: closed-mindedness, rationalization, suppression of dissent, the creation of a "mindguard" to protect the group, a sense of invulnerability, and the illusion of unanimity. Defective decision-making arises from groupthink, which occurs when alternatives are insufficiently examined, risks are inadequately assessed, and information about alternatives is gathered incompletely.

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Model Paper
M.A. I (Sem I) EXAMINATION, 2024
(New Course)
HIGHER MENTAL PROCESSES
(A090701T)

Time:3 Hours **Max. Marks: 75**

Section-A **3 Marks each question**

Short answer type questions only

1.

A. Structure of Constituent

B. Logical reasoning

C. Parallel Transmission.

D. Problem -Solving and Creativity

E. Speaking in Reference

F. Gesture and body posture.

G. Word Recognition.

H. Language production.

I. Reading and writing.

Section-B **12 Marks each question**

Long answer type questions

(2 out of 4 Question)

2. Explain bilingualism? Describe their advantages and disadvantages in detail.

3. Provide a detailed explanation of the factors influencing problem-solving.

4. What is reading and speaking? Give a brief description of the speech error that occurs while speaking.

5. Present a comparative study between speaking and writing also throw light on the relationship found between speaking and writing.

Section-C **12 Marks each question**

Long answer type questions

(2 out of 4 Question)

6. Throw light upon the important factors affecting creativity in problem solving.

7. Explain the application of reasoning and its types.

8. What do you understand by Decision making? Throw light on the role of heuristics in decision making.

9. Explain the steps involved in creativity. Describe the various measurement techniques use for Creativity.