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1. Learning Outcomes

After studying this module, you shall be able to

- Understanding of what is cognitive psychology
- Describe Different approaches through which cognitive psychology could be better understood
- Explain Historical background
- Learn Current scenarios of cognitive psychology

2. Introduction

Cognitive psychology is referred as the study of human mental processes and their further role in thinking, feeling and on the behavior of humans. The core focus of cognitive psychology is on perception, thinking, and acquisition of knowledge, judgment, comprehension and production of language, problem solving and decision making. This branch of psychology came to life at some point in after the fall of behaviorism. It also emerged immediately after the use of new technology, application of abstract concepts, and neuroscience (Willingham, 2007). The cognitive approach has permeated existing psychology with its scientific representation of the complex human psyche. It has helped to use and apply this knowledge in the treatment of human disease and dysfunction (Eysenck, 2004).

3. DEFININING COGNITIVE PSYCHOLOGY

Cognitive psychology concerns with the scientific understanding of how people may perceive, understand, evaluate and think in relation to the complexities and significance of mind. The focuses of cognitive psychology have always been to assess the science of mental life. Cognitive psychology exerts a strong influence on psychology as a whole and its more inclusive partner is cognitive science, which is a unified program for studying the mind. Mind is the processor of information from our senses and helps in understanding and transmission of information to others. If this processing is not allowed then the information may not be processed in meaningful ways. For example, in dyslexia, a child who might struggles in school because of its impairment in ability to fluently read the English text, a disorder which is called dyslexia. It is a learning disorder that does not allow transforming printed characters into meaningful pieces of information. Cognitive psychologists measure the behaviors in laboratory so that they can reach to concrete conclusions about the covert mental processes. Therefore experimental method is the heart of cognitive psychology. The main goal of cognitive psychology has always been to explain how humans transform input into thoughts and actions with the use of complex and often-mysterious process of cognition (Eysenck, 2004, Willingham, 2007). Thus human psychology may not be possible to understand without focusing on cognitive psychology.

With the use of computational metaphors, cognitive psychology greatly benefited in its research domain by work in the area of artificial intelligence.This further led to the development of

another subject for study cognitive science, which attempts to integrate a range of approaches in research on the mind and mental processes.

The key milestones in the development of cognitive psychology would really help in understanding its journey. It would help in understanding its crumbling behaviorism, computer metaphors and information processing, abstract intelligence or other schools of thought.

4. APPROACHES OF COGNITIVE PSYCHOLOGY

4.1 INFORMATION PROCESSING APPROACH

It is the way by which the information from the environment is processed by series of stages or processing systems. For example, when a stimulus is presented, our basic perceptual processes occur, which is further followed by our attentional processes. The information which has been the focus through our attentional processes get transferred to our short term memory, this information is further transferred to the long term memory store (perception, attention and memory). This model has been used by cognitive psychologist since decades, as it makes sense and is essay to understand.

Three assumptions of information processing approach:

- Cognition can be understood by analyzing it into series of sequential stages, with the help of processing systems.
- The system alters the incoming information, which can lead to unique processing in each stage. For example, at the perceptual stage: coding of information takes place, in the memory stage: recall of information, which further enhances our concept formation, judgment etc.
- The goal of this model is to specify the processes and structures. Since each component is related to the next stage therefore it becomes difficult to identify which stage comes at an initial level. It should be very clear that the initial stage is always the incoming information, which is processed into stages for unique functions.

There is also a very crucial limitation towards this approach. It has been observed that processing is often affected substantially by the individual's past experiences and its expectations. Therefore the stimuli intrude the organism that is inactive or either not prepared to process the incoming information.

There are different ways by which one can investigate cognitive psychology. They are termed as traditional ways of obtaining evidence about human cognition. These include Experimental cognitive psychology, cognitive neuropsychology and cognitive neurosciences (which is explained in the next modules). Let us focus on the other two, which follows as:

4.1.1 Experimental cognitive psychology

Experimental methods measure the behaviors that have always been the strong point of cognitive psychology. If one would measure the behavior of humans it can help to explain about the cognitive processes which are involved in it. During a *true* experiment, a researcher manipulates one of the variable in order to see its effect on another variable. For example, we would like to know whether background noise affects performances on math's problems or not. In this two different groups would be randomly assigned to either a *no-noise* group or to *with-noise group*. The initial group will be asked to solve math's problems in a quiet environment and whereas the second group tries to solve the problems when they are being exposed to some sound, let say a bell that would be termed as with-noise. In this example, the presence/absence of noise is referred to as the *independent variable*. Our end result measure is referred to as the *dependent variable.*

Physiological methods or cognitive neuropsychology

Besides measuring the behaviour of individuals, physiological measures are also very important. Bodily systems such as brain activity, eye movements, blood pressure and heart rate etc., are also being used in experiments to understand the cognitive processes. Some of the methods which are relevant in understanding it are Electroencephalogram (EEG), Neuro-imaging and Brain lesions.

Electroencephalogram (EEG) is a multichannel recording of the uninterrupted electrical activity of the brain. It is measured with the multichannel recorder that helps in detecting the voltage changes which are being generated by the large numbers of neurons. A large number of electrodes are placed on the scalp. The frequency will depend on the activity of the brain, whether it is awake and alert, relaxed and even the different stages of sleep. The problem with this method is that it does not specify the exact location of neural activity that generates the evoked potentials. For this other methods are required.

Neuroimaging begins where EEG is not able to help in specifying the exact locations. Neuroimaging measures the location of neural activity generated during a cognitive task. There are different techniques which can provide an indirect measure of more localized brain activity as compared with electrical scalp recordings. ***Magnetic Resonance Imaging (MRI)*** is a strong magnetic pulse that causes molecules in the brain to move. Motion of these molecules are picked up as radio frequencies and reconstructed in 3-D images. MRI has better resolution than CT scans. No structure-function relationship can be seen in it though. Another technique is ***Positron emission tomography (PET).*** In this method increased radio-labeled glucose activity is scanned in the brain while subjects engage in different cognitive processes. Spatial Resolution is seen to be good whereas temporal resolutions are not at a better side. Third technique for assessment of localized areas is through ***Functional Magnetic Resonance Imaging (fMRI).*** It helps to detect changes in blood flow to particular areas of the brain when these areas are active. It provides both an anatomical and a functional view of the brain. Unlike the PET scan, it is non- invasive and provides a better spatial and temporal resolution.

Brain Lesions is a very old technique for studying the diverse functions of the brain. It helps to observe individuals who have suffered damage to the brain tissue through accidents, strokes and also some of the brain diseases such as Alzheimer's and Parkinson's diseases. Lesions provide a different way to study the cognitive functions provided by the brain. It was not until World War II

that physicians started to document disorders that were caused by damage to certain regions of the brain. Which brain region engages in what kind of cognitive function is helpful in understanding the exact causes of dysfunctions.

4.2 CONNECTIONIST MODEL

An alternative approach to more traditional information processing approach is Connectitionism. It is intended to capture the fundamental cognitive processes as they might be instantiated by brain. Neurons are the elementary units of the brain which are further interconnected with each other neurons in the brain. Connectionist networks are the models of neural networks as they might exist in the brain.

The two basic connectionist ideas are that information can be broken down into elementary units or neurons, and that they are connections between these neurons. They can be of different strengths which can be further modified with the units. The connection is only possible if both the neurons are firing at the same time.

Another assumption of connectionist models is that many connections can be active at the same time. This is a clear example of parallel processing as opposed to serial processing, which is restricted to only one connection operating at a time. Thus, another name for connectionist model is parallel distributed processing (Detailed discussion in memory module).

5. HISTORY OF COGNITIVE PSYCHOLOGY

5.1. EARLY COGNITIVE RESEARCH

Experiments in cognitive psychology were being carried out over a century ago. Philosophers were also showing keen interest in the cognitive processes, but until late nineteen century only that first attempts were made to bring cognitive processes into the laboratory. This helped in studying these concepts in the light of scientific stream. Important discoveries emerged especially in the fields of perception and attention (Wundt, 1874), memory (Ebbinghaus, 1885) and learning (Thorndike, 1914). The work carried at this juncture was mainly focusing on the basic cognitive processes, which in turn led to the development of theories and experimental design of today.

It was seen that the research carried during this time could be applied to real life settings, but their main purpose of their research was not meant to be this. For example, Ebbinghaus (1885), carried out experiment on spaced learning and massed learning, where it was shown through experiment that learning can be improved if some rest in provided. It leads to less fatigue and better concentration. This then became a widely used strategy to improve the efficiency of leaning. However, cognitive researchers were mostly concerned with pure research and any practical application were considered to be largely incidental.

Figure 1- Ebbinghaus carried research on learning
Source- http://www.marisolcollazos.es

Bartlett (1932) challenged this approach of cognitive psychology and argued that cognitive researchers should focus on the relevance of the real world also. He further suggested that cognitive researchers should make use of more naturalistic experimental designs and test those materials which are based on situations or even resemble real life situations. He contributed his thought by using pictures and stories in the research work of memory, such as the testimony of courtroom witnesses (discussed in later module). Therefore his research had a lasting impact in the stream of cognitive psychology.

5.2 POST WAR DEVELOPMENT OF COGNITIVE PSYCHOLOGY

The modern era of cognitive psychology started due to World War 2. The war produced major changes on the technology side and extraordinary efforts from humans to deal with these changes. Therefore introduction of new or advanced equipments made the need to understand the capabilities and limitations of human operators' more important. A new goal emerged then to assess the performance and attention of humans, and also lead to the development of artificial intelligence during this phase.

Figure 2- Donald Broadbent, explored information processing capabilities of humans.
Source- http://www.mrc-cbu.cam.ac.uk

A British psychologist Donald Broadbent, who was a pilot trainer during the war and therefore had firsthand experience of the cognitive problems encountered at that time by most of the pilots was referred as pioneer of new wave of applied research. Broadbent (1958) became more interested in exploring the information processing capabilities of human being. The abilities to deal with two or more competing perceptual inputs faced by humans simultaneously were especially focused on. To investigate further on this he established a technique to assess the basic limitation of human attention, and he was able to apply his findings to assisting the performance of the pilots.

The year 1956 was critical in the development of cognitive psychology. According to Anderson (1995), cognitive psychology first emerged in the two decades between 1950 and 1970. The field of artificial intelligence was founded in 1956 by Chomsky. It was this year which witnessed the emergence of both cognitive psychology and cognitive science.

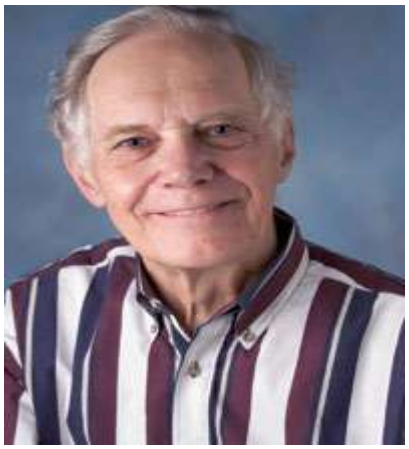

Figure 3- Ulric Neisser 'father of cognitive psychology'.
Source- http://www.psychologicalscience.org

In 1967 the word "cognitive psychology" was first used by American psychologist Ulric Neisser in his book Cognitive Psychology. Neisser is termed as the "father of cognitive psychology". According to Neisser, cognition involves "all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used. It is concerned with these processes even when they operate in the absence of relevant stimulation, as in images and hallucinations". Thus it is apparent that all psychological phenomena are related to cognitive aspects. Neisser always explained that Cognitive Psychology is as an assault on behaviorism. He was uncomfortable with behaviorism because he considered behaviorist assumptions to be wrong.

Psychophysics, structuralism, functionalism and behaviorism all contributed to the development of cognition. They had their own strengths and weaknesses attached to them. One of the major schools of psychology that had major impact on cognitive psychology is the thought of behaviorism.

5.3 BEHAVIOURISM

The work of Pavlov, Skinner and Watson contributed a lot in the growth of this area from 1930s to 1960s. Watson focused more on observable behavior and was keen to move psychological research from laboratory into the real world. He disliked the approach of introspection and functionalist approach and recommended that thoughts and feelings must be dropped from study of psychology as they are not directly observed. He was very much interested in how people react in everyday life and what can influence them. The main focus of psychology thus should be scientific and objective, and by this they meant that its subject matter should be publicly observable. Therefore the emphasis of psychology should be on scientific basis.

On the other hand Skinner was focusing on the relationship of stimuli, response and reinforcement as its critical issues of psychology. Skinner focused his attention mainly on schedules of reinforcement and demonstrated that related learning curves could be obtained for an array of different Animals. The principles of reinforcement could further explain aspects of human learning and behavior. For Skinner, this history of reinforcement determined the behavior of human's beings as that of laboratory rats. Skinner was later criticized on his book Verbal behaviour (1957) by the linguist Noam Chomsky (1959). The debate was about the extent to which language was an innate ability and how the environment might shape language development. Therefore Skinner drastically failed to account for the Generativity of language, which is the creation of novel utterance.

Another limitation for Behaviorism was the failure to consider intervening mental processes. Behaviorists were focusing on the stimulus response relationship. On the other hand cognitive psychology was addressing the mental processes which are attached to any stimulus. For example memorize a list of words; next step would be recall of those words but if mental processes are playing a role it would lead to grouping, organizing and categorization of information. Cognitive psychology makes inferences about mental processes.

Behaviorism

STIMULUS---------- RESPONSE

STIMULUS----------MENTAL PROCESSES----------RESPONSE

5.4 STRUCTURALISM

Structuralism described the components of consciousness which were aimed to describe the elemental components such as sensation, images and feelings. According to this school of thought consciousness was considered to be the proper subject matter of psychology. Therefore structuralism was based on the method of introspection which was initiated by Wundt and developed by Tichner. Introspection is a rigorous, controlled procedure for discovering sensations and feelings experienced consciously. It was believed that consciousness could best be accessed through self observation. The fundamental problem with this method, of course, is that it is (by definition) subjective, and perception of the same visual stimulus might be different for two persons.

Tichner the student of Wundth advanced his research in structuralism. He intended to determine basic building blocks of human experiences. Tichner felt introspection was the only appropriate procedure for psychology. Structuralism was soon considered to be an invalid approach. Insistence on introspective method was problematic as the data was inherently subjective, because the results were invalid. Such biases resulted in problems with reliability, as there was no agreement between the laboratory and observers. Results were considered to be non-reliable.

5.5 FUNCTIONALISM

Functionalism was a philosophy opposing the prevailing structuralism of psychology of the late 19th century. One of the major proponents of Functionalism was Thorndike, who has been ever popular for puzzle box. He was considered to study the primary issues of functionalism. This school of thought also focused on observable events as opposed to unobservable events (like what goes on in someone's mind).

William James is considered to be the founder of functional psychology. Functionalism concentrated on the mind rather than its structural components. It emerged as a replacement to deal with the problems of structuralism. It was based on the scientific approach that everything existed because it serves some function or another. Thus the practical application of this knowledge was considered to be very important. This was the major contribution of functionalism to cognitive psychology. It focused on mental process and its relationship with the environment and how individuals adapt to the situations within the environment. It also helped translate the relevance of experimental psychology to other human endeavors. Behaviorists also discarded the method of introspection but also criticized functionalism for the reason that it was not based on controlled experiments.. Functionalist also influenced the educational system, especially with regards to John Dewey's belief that children should learn at the level for which they are developmentally prepared.

6. NEW MILESTONES IN DEVELOPMENT OF COGNITIVE PSYCHOLOGY

World War II brought about many changes in understanding the human psychology. It inspired towards presenting dissatisfaction against the behaviouristic approach, as there was a need to solve the problems being encountered by the military at a practical base. If one has to understand, it was seen that many of the problems were of cognitive nature e.g. fatigue, demands of constant vigilance etc. During the war and the post war years, technology development had a large impact on psychology. There was a constant need for resurgence in research and theories focusing on human attention. Telephone conversations were also seen to be important in understanding the human information processing.

6.1 COMPUTER METAPHORS

The remarkable increase of research in the area of cognition has been acclaimed since the revolution in the twentieth-century psychology (Baars, 1986; Gardner, 1985; Matlin, 1989). This further led to the development of digital computers, which made psychologist accessible to both a plausible metaphor i.e., the mind as a computational system and an also an innovative method for the investigation of the mind. The beginning of the computer and the ability by which it could store information and further transform this symbolic information is similar to that of cognitive processing (Neisser, 1976). A computer can be like a brain in that it can receive input, encode the material, and further helps in the storage and retrieval of the information. For cognitive psychology the mind was termed as computer. Therefore it has been observed that as the mind is managed by programs or sets of rules analogous is in the same manner to that of computers. Computers are termed as physical symbol system, which is further capable of having and manipulating symbols. This metaphor became a composite of characteristics shared by humankind and machine (Willingham, 2007). As a result computer became the heart for cognitive psychology.

Input

Sensory ---------- FILTER--------- PATTERN RECOGNITION ----- SELECTION
STM LTM
Store

6.2 Artificial intelligence

Machines or programs which use intelligence to solve complex problems are in the same manner as humans use in solving problems. Examples would be computers doing medical diagnosis, flying jet planes, playing chess etc. Artificial intelligence in essence involves making programmes and devices that are efficient, flexible and learn through experience. They may not be as similar in their approach as human consciousness. It influenced the contemporary thoughts on logic and behavior and greatly supported the idea that abstract constructs are very much useful in the scientific processes. Artificial intelligence offered a glimpse into how we can infer the existence of unobservable processes based on the product of behaviour.

There are two main objectives of Al research (Winston, 1984).
The first is to make computers more useful to people. The second is to explore the principles that helps to make intelligence possible. Phrased differently, Al researchers with the previous goal tend to be interested in developing intelligent *machines* whereas those with the latter aim seek to create *intelligent* machines.

Al and cognitive psychology are interlinked as Solso (1988) says "a kind of symbiotic relationship, each profiting from the development of the other" (p. 460). For example, cognitive psychology can direct Al in "the recognition of cognitive structures and processes that can ultimately be implemented as part of an AI-based model" (Polson et al., 1984, p. 280). Conversely, Al can provide "conceptual tools that are necessary to formalize assumptions about representation and process'' (Poison et al.. 1984, p. 290). Therefore it was seen that Glass et al. (1979) believed that whereas Al explores "the general question of how intelligent systems can operate, Cognitive Psychology therefore deals with an intelligent system which might be termed as human beings" (p. 44).

7. SUMMARY

- Cognitive psychology is referred as the study of human mental processes and therefore plays a major role in thinking, feeling and the behavior of humans.
- The information processing model has dominated cognitive psychology. Where cognition can be understood only by analyzing it into series of sequential stages, with the help of processing systems. They could further be investigated with the help of experimental methods and neuropsychological ways.
- Parallel distributed processing (PDP) is a model of cognition in which information is thought to be processed in a similar way as the neurological networks.
- Cognitive psychology has a relatively long history, and continues to make many connections with other disciplines. Bartlett emphasized the role of real life research and left a lasting impact in the stream of cognitive research. In the modern era Donald Broadbent investigated the impact of introduction of new technologies on perceptual processes in humans.
- The introduction of the word cognitive psychology came with the publication of a book in 1967 by American psychologist Ulric Neisser. He critically opposed the work of behaviorist.
- Different schools of psychology that had major impact on cognitive psychology at that time were behaviourist, structuralism and the functionalist. Each of these schools tried and explained the critical questions that need to be focused in cognitive psychology. The neocognitive revolution is influenced by modern developments in communication and computer technology.

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	MODULE No. : FOUNDATION OF COGNITIVE PSYCHOLOGY