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PSYCHOLOGY

PAPER NO. 1: Cognitive Science
MODULE NO. 21: Thinking

1. Learning Outcomes

After studying this module, you shall be able to:

- Define ‘thinking’
- Identify the units of thought
- Understand different types of thinking
- State the stages in creative thinking

2. Introduction

While you read these words, are you thinking? Even when you stop thinking about what you are reading, will you still be thinking? It could be that you still think, perhaps of something else. We are thinking during most of our waking hours. It is hard not to think. Have you ever thought about what we do when we think? In this module we will address how thinking is conceptualised. You will be acquainted with different types of thinking and you will also know what is meant by creative thinking and what are the stages for creative thinking? Let us now try to familiarise ourselves with how is thinking defined.

3. Define

Psychologists have tried to find answers to one of the most fascinating and important questions: how do people think? We will begin our discussion on thinking by trying to unravel ‘how do cognitive psychologists understand thinking?’ Cognitive psychologists have been intrigued by the most fundamental question of ‘what is thought and how do we think’ for centuries. Early thoughts on thinking and knowledge, proposed two sides of the argument—the *empiricist* maintain that knowledge comes from experience. The *nativists* suggest that knowledge is based on the innate characteristics of the brain. These pre-existing categories exist inside the brain, which order sensory experience and make us think about it. These two arguments when viewed holistically suggest that experience leads to information and our brain must be receptive to these experiences to be able to think about it and make sense of it.

The foundations of cognitive psychology lie in the Gestalt psychology of Max Wertheimer, Wolfgang Kohler and Kurt Koffka and also in the work of Jean Piaget, who provided a theory of children’s cognitive development. Cognitive psychologists investigate various dimensions of thinking in terms of internal cognitive/mental processes such as reasoning, logic, problem solving, memory and language. The study also includes how people make decisions and choice and engage in creative discovery. Cognitive theory contends that solutions to problems take the form of algorithms (an *algorithm* is a rule that correctly generates the solution to a problem given that one can devote sufficient time and effort to applying the rule) and heuristics (*Heuristic* refers to a rule of thumb or a general strategy that may lead to a solution reasonably quickly with less computation cost) and solutions may also be found through insights, which involve sudden awareness of relationships. Advances in cognitive psychology on account of research on reasoning, logic, decision making and so forth have contributed in unfolding thinking. These concepts are closely tied to thinking and help us complete and understand the rubric of thinking.

Thinking is a process by which a new mental representation is formed through change, reorganization and transformation of information stored in the memory. It includes a complex

interaction of cognitive actions such as judgment, reason, imagination, logic, problem-solving and decision making. There are three basic ideas about thinking-

1. Thinking is cognitive, i.e. it occurs internally in the mind
2. Thinking is a process that involves manipulation of various cognitive processes in the brain
3. Thinking is directed and results in behaviour that “solves” a problem and leads one towards solution.

We will study some of these aspects of thinking in depth in this module and some in the subsequent modules.

4. Units of Thought

In this section we will try to understand the units of thoughts that help us cognize and think. Give yourself a minute and list down several ways in which you try to cognize information from your environment and represent that information in your mind. The processes of thought rely on the units of thought such as images, symbols, concepts, prototypes and rules.

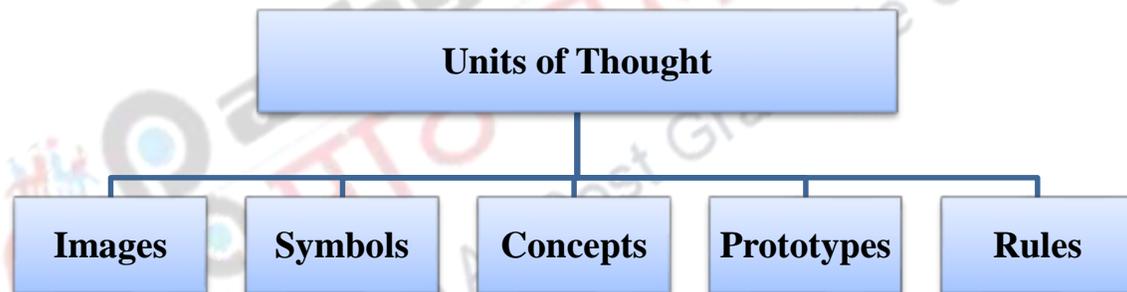


Figure 1: Units of Thought

The most primitive of all these units of thought is an image. An image is a visual mental representation of an event. Another important unit of thought is a symbol, a sound, object or design that represents an object of utility. The most common symbols in thinking are words. A characteristic of a word that separates it from an image is that it is a symbol that stands for something other than itself and a single symbol may have more than one meaning. The advantage of thinking symbolically is that symbols enable us to think about things that are not present in the immediate environment and may have been present either in the past or may be present in the future. In addition to that, symbols transcend boundaries of now and then and even make it possible to imagine things and situations that never were or never will be. You may have used numbers, letters, punctuations, icons and other mathematical signs for ideas that have no concrete existences.

When a symbol is used as a label for a class of objects or events with at least one common attribute-or for the attribute (class or category) itself-it is called a concept. Animals, liquid,

vehicle, are examples of concepts with common attributes. Concepts are helpful in organizing otherwise large amounts of information into chunks that are manageable to think about. Concept formation help us understand categories of thought and processes behind it. This will be taken up in detail in the other modules of cognitive science.

When we think of a concept, we think of a representative example. What comes to your mind, when you hear the word ‘noodles’? Or you think of a vehicle? The prototype is the most representative example of a concept. Most often it is simply an example that has most of the characteristics of the particular concept. In addition to that, say the idea of a “bird” may not be an individual but some combination of attributes that allows us to identify what is a bird and also helps us discriminate what is “not bird”. Besides this a rule is a more complex unit of thought that navigates us through the relations between concepts.

Images, symbols, concepts, prototypes and rules become the foundation blocks for thinking and cognitive activity to take place. They help to represent, manipulate and reorganize reality and also devise effective and efficient ways of acting on it. These help us reason and apply logic to engage in decision making processes. Logic and reason are shortly discussed in the next section while decision making will be taken up in the next module.

5. Types of Thinking

People think by different ways, some of these, form the unifying thread of the subsections that follow. You may have noticed that two people who may have been given a particular problem may come up with different solutions to the same problem. How is this possible? This is so because they may have worked on the problem with different logic-one may be logical and other may be illogical. Rational thinking and rational decision making is logical and makes an individual avoid wandering aimlessly and exploring odd-unachievable options. It channelizes energy in the doable and achievable terms and saves time and manpower. This thinking is called directed thinking while illogical thinking occurs when an individual is not goal directed and problems at hand are ill-defined. Let us read how we apply logic to the problem in hand and thereby reach possible solutions.

5.1 Deductive and Inductive Thinking

Thinking, logic and reasoning are intertwined and inseparable. Aristotle, introduced a system of reasoning or simply validating arguments by what is called syllogistic reasoning. A syllogism has the following three steps-

1. A major premise
2. A minor premise and
3. A conclusion.

To understand this better let us look at the example given below-

Major premise: All men are mortal.

Minor premise: Socrates is a man.

Conclusion: Therefore Socrates is mortal.

Here, it is possible to reduce the statements of facts to symbols and manipulate them, as in mathematical equations, without regard to the physical reality that they may represent. If the premise of a syllogism is true and the form correct, then the conclusion of the argument is valid, that is, the probability of the conclusion being correct is certain. Here the correctness of the thought process is based on the form rather than on the content of sentences.

Deductive thinking involves drawing conclusions by applying logic and reasoning from the general to the particular. You may start with a general theory of 'sun rises in the east' and apply this to the specific situation of your home or room, 'that the sun will rise to the east of my home or room'. However, in real life it may not be easy to accept the conclusions drawn from a particular syllogism, which may be true yet the effects of content in the judged validity of an argument, may render it unacceptable. This reminds us that the cognitive process is neither simple nor devoid of previous knowledge stored in the long-term memory. The information stored in our memory influences how any new piece of information is perceived, encoded, stored and transformed. All these determine how we think about that information.

In everyday life, ordinarily we do not make decisions based on well-reasoned syllogistic paradigm, but in terms of inductive reasoning. Inductive thinking or inductive reasoning is a form of thinking that involves drawing conclusions by applying logic and reasoning from the particular to the general. It is a process in which a person makes some simple observations of a certain kind and these observations are generalized to a different problem to make decisions, that is, one infers from a special case or observation to the general principle. Here the decisions are based on what is perceived as the best choice of a number of possible alternatives.

5.2 Convergent and Divergent Thinking

As mentioned above, people think in several ways. J. P. Guilford (1967) distinguished between two types of thinking as convergent and divergent thinking. To develop an understanding of the two, let us first think of the answer for the following-

- What is the capital of India?

You may have obtained the answer, 'New Delhi'. Is the answer given by you and the one given by your friends, the same? This question opens up the scope to understand different types of thinking.

Much of the pedagogy emphasizes this type of thinking called *convergent thinking*, in which there is a single correct solution and the students are encouraged to produce factual information only. Convergent thinking is a type of thinking that focuses on single, well established answers to problems. Convergent thinking generally means one's ability to give one "correct" answer to standard questions. It emphasizes accuracy, logic and is usually obtained by recognizing the familiar; by reapplying pre-existing or pre-mastered techniques. To come up with convergent responses, one needs to manipulate existing knowledge by means of standard procedure. Here, knowledge is considered fixed (at least for some point of time). It is usually a product of one's accumulated set of knowledge or simply, stored information and does not provide scope for any 'different' answer. It is most effective in situations where there exists an already established answer and one simply needs to recall it through various decision making strategies. Here there isn't space for ambiguous responses-the answers either fall into the category of 'right' or 'wrong'.

These answers do not require any creative thinking on the part of the person. Most of the standardized items on intelligence tests and other standardized multiple choice tests are based on convergent thinking. Now, try to answer the following question-

- What can be made out of a sheet of parachute cloth?

Compare your answers with other friends who answer the same questions. Are their answers more novel and creative as compared to yours or otherwise? Did you get new or novel responses on the first question also?

In contrast to convergent thinking, *divergent thinking* involves free flow of thoughts and there are many possible solutions. It typically occurs in a spontaneous, free flowing manner, where many creative ideas can be generated. In classrooms, learners are given tasks of free-writing, drawing; all of these promote generation of multiple and novel responses that ‘diverge’ from the standard normative responses. A divergent thinker may come up with creative and more flexible responses. They may utilize ideas and objects in more abstract ways and come up with a number of unusual ways of thinking. In the next section we will approach thinking with regard to creative problem solving and its stages.

6. Creative Thinking with Stages

We reasonably assume that human beings are creative beings and they are endowed with the capacity to solve problems creatively. Some of us may be more creative than the other. For this module, among widely used definitions of creativity, we choose to understand it as a cognitive activity that results in a new and novel way of viewing a problem or a situation. Restricting oneself to finding solutions to problems in habitual ways only and not attempting alternate ways of thinking about the same problems is termed *fixation* in problem solving.

Wallas (1926) described the four sequential stages of creative process which gave us a conceptual framework to revisit creative thinking. These stages are not supported by sound empirical evidence but the psychological literature finds its mention in the introspective reports from people who have given creative thoughts. These are mentioned in the section that follows-

Preparation	• Formulating the problem and making initial attempts to solve it
Incubation	• Leaving the problem while considering other things
Illumination	• Achieving insights to problem
Verification	• Testing or carrying out the solution

Stages of Creative Thinking

Figure 2: The four sequential stages of creative process

To achieve better clarity, let us read about these stages in detail-

Stage 1: Preparation

When we are confronted with a problem, we often spend a considerable amount of time preparing to deal with the problem. In this thinking time, we think about several tentative solutions, during which we try out or reason out possibilities based on our experiences in the past. These tentative thoughts lead us into specific direction that may later prove instrumental in finding solutions to the problem. However, the time for this preparation as mentioned by people may not be restricted to some hours or some days only. Indeed, the biographies of famous creative people are replete with instances where they mentioned that from their early childhood, ideas kept developing in their mind. These early ideas frequently shape the ultimate destiny of a creative person. But this thought may be challenged and debated as to why individuals who share similar environments have different degrees of creative thought.

Stage 2: Incubation

The second stage of creative thinking is termed as incubation period. Have you ever experienced that after a point of saturation, you stop thinking about the problem, which seemed so compelling at a point. Why is it that a creative breakthrough follows a period in which the problem is allowed to lie dormant. Posner (1973) suggested that these dormant periods allow us to recover from the fatigue associated with problem solving. This time lap may also help us forget inappropriate and unsuccessful approaches to the problem, which were used in the past experiences. It could also be possible that during this incubation period we may actually be working on the problem unconsciously. There may be a reorganization of the material for problem solving in the mind.

Stage 3: Illumination

The history of creative thought has numerous instances of creative breakthroughs. It is not mandatory that after a period of incubation, an illuminating thought will appear but in cases where it has happened, the bits and pieces of all the ideas fall into place. These ideas then seem to complement each other and all irrelevant thought almost become discarded hypothesis. The structure of a DNA molecule, the composition of benzene ring, the invention of the telephone is all examples of creative breakthroughs achieved after illumination.

Stage 4: Verification

After eureka of illumination, that sometimes accompanies an insightful discovery, the idea is tested. In this stage, the creative product is examined to verify its legitimacy. There stands a risk that the solution achieved after illumination may not be actually valid, hence, it becomes important to test, verify and validate it.

7. Summary

- Thinking is a process by which a new mental representation is formed through change, reorganisation and transformation of information stored in the memory.
- Cognitive psychologists investigate various dimensions of thinking in terms of internal cognitive/mental processes such as reasoning, logic, problem solving, memory and language.
- The processes of thought rely on the units of thought such as images, symbols, concepts, prototypes and rules.
- Deductive thinking involves drawing conclusions by applying logic and reasoning from the general to the particular.
- Inductive thinking involves drawing conclusions by applying logic and reasoning from the particular to the general.
- J. P. Guilford (1967) distinguished between two types of thinking as convergent and divergent thinking.
- In *convergent thinking*, there is a single correct solution and the students are encouraged to produce factual information only.
- In contrast to convergent thinking, *divergent thinking* involves free flow of thoughts and there are many possible solutions.
- Wallas (1926) described the four sequential stages of creative process which gives a conceptual framework to revisit creative thinking. The stages include-(1.) Preparation (2.) Incubation (3.) Illumination and (4.) Verification.