COGNITIVE PROCESSES

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MODULE 6

COGNITIVE PROCESSES

6.1: IMAGES

Mental image can be defined as a mental representation that has picture-like qualities.

Almost everyone has visual and auditory images. More than half of the people have imagery for movement, touch, taste, smell, and pain. Thus, mental images are sometimes more than just "pictures." For example, individual's image of a bakery may also include its delicious odor. Some people have a rare form of imagery called synaesthesia. **Synaesthesia can be defined as the form of mental image in which an individual experiencing one sense in terms normally associated with another sense.** For eg. "seeing" colours when sound is heard. For these individuals, images cross normal sensory barriers (Kadosh & Henik, 2007).

Despite such variations, most of the people use images to think, remember and solve problems.

6.1.1. Uses of Mental Images

The following are the common uses of mental images.

- Make a decision or solve a problem. (Choosing what cloathes to wear; figuring out how to arrange furniture in a room etc)
- Change feelings. (Thinking of pleasant images to get out of a bad mood)
- Improve a skill or prepare for some action. (Mental rehearsal)
- Aid memory (Picturing Mr. Cook wearing a chef's hat, so one individual can remember his name)

6.1.2: The Nature of Mental Images

Mental images are not flat like photographs. The nature of mental images are described below.

6.1.2.1: Reverse Vision

Information from the eyes normally activates the brain's primary visual area and creating an image. Other brain areas then help individuals to recognize the image by relating it to stored knowledge. When an individual form a mental image, the system works in reverse. Brain areas where memories are stored send signals back to the visual cortex, where once again, an image is created (Ganis, Thompson, & Kosslyn, 2004; Kosslyn, 2005). For example, if an individual visualize a friend's face right now, the area of his/her brain that specializes in perceiving faces will become more active (O'Craven & Kanwisher, 2000).

6.1.2.2: Kinesthetic Imagery

Kinesthetic images are created from muscular sensations (Holmes & Collins, 2001). Such images help us think about movements and actions. For example, if an individual try to tell a friend how to make bread, he may move his hands as if preparing the bread.

Kinesthetic images are especially important in music, sports, dance, skateboarding, martial arts, and other movement oriented skills. People with good kinesthetic imagery (or high bodily-kinesthetic intelligence) learn such skills faster than those with poor imagery (Glisky, Williams, & Kihlstrom, 1996).

6.2: CONCEPTS

Concepts can be defined as the generalized idea representing a category of related objects or events.

A concept is an idea that represents a category of objects or events. Concepts help individuals to identify important features of the world. That's why experts in various areas of knowledge are good at classifying objects.

6.2.1: Concept Formation

Concept formation can be defined as the process of classifying information into meaningful categories.

At its most basic, concept formation is based on experience with positive and negative instances.

Positive instance: An object or event that belongs to the concept class in concept formation.

Negative instance: An object or event that doesn't belong to the concept class in concept formation.

As adults, we often acquire concepts by learning or forming rules. A conceptual rule is a guideline for deciding whether objects or events belong to a concept class. For example, a triangle must be a closed shape with three sides made of straight lines. Rules are an efficient way to learn concepts.

Conceptual rule: A formal rule for deciding whether an object or event is an example of a particular concept.

6.2.2: Types of Concept

Mainly there are three types of concepts, namely; **conjunctive concepts, relational concepts and disjunctive concept.**

Conjunctive concept can be defined as a class of objects that have two or more features in common. Conjunctive concepts are also called**'and concepts**'. In other words, an item must have "this feature and this feature and this feature". For example, a motor cycle must have two wheels and an engine and handle bars.

Relational concepts can be defined by the relationship between features of an object or between an object and its surroundings. (for example, greater than, beside etc.). Relational concepts are based on how an object relates to something else, or how its features relate to one another. All of the following are relational concepts: larger, above, left, north and upside down. Another example is the word; sister is defined as "a female considered in her relation to another person having the same parents."

Disjunctive concepts can be defined by the presence of at least one of several possible features. Disjunctive concepts are also called **"either / or concepts".** To belong to the category, an item must have "this feature or that feature or another feature".

6.2.3: Prototypes

An ideal model used as a prime example of a particular concept.

When we think of the concept bird, probably we won't mentally list the features that birds have. In addition to rules and features, we use prototypes, or ideal models, to identify concepts (Burnett et al., 2005; Rosch, 1977). A robin, for example, is a prototypical bird; an ostrich is not. In other words, some items are better examples of a concept than others.

6.3: LANGUAGE

Language can be defined as the words or symbols, and rules for combining them, that are used for thinking and communication.

Bilingualism: An ability to speak two languages.

Everyone has searched for a word to express an idea that exists as a vague image or feeling. Nevertheless, most thinking relies heavily on language, because words encode (translate) the world into mental symbols that are easy to manipulate. **The study of meaning in words and language is known as semantics.**

Language also plays a major role in defining ethnic communities and other social groups. Thus, language can be a bridge or a barrier between cultures.

6.3.1: Structure of Language

The structure of language consists of 4 components, namely; ***phonemes, morphemes, grammar and syntax.***

A language must provide symbols that stand for objects and ideas (Jay, 2003). The symbols we call words are built out of phonemes and morphemes

Phonemes are the basic speech sounds of a language.

Morphemes can be defined as the smallest meaningful units in a language, such as syllables or words.

A language must have a grammar, or set of rules for making sounds into words and words into sentences (Reed, 2007). **Grammar is a set of rules for combining language units into meaningful speech or writing.**

One part of grammar, known as syntax, concerns rules for word order. Syntax is important because rearranging words almost always changes the meaning of a sentence: “Dog bites man” versus “Man bites dog.” **Syntax can be defined as the rules for ordering words when forming sentences.**

6.4: REASONING

Reasoning is the process of thinking about something in a logical way in order to form a conclusion or judgment.

There are two types of reasoning, namely deductive and inductive reasoning.

6.4.1: Deductive Reasoning

Deductive reasoning applies a general set of rules to specific situations. For example, using the law of gravity to predict the behavior of a single falling object.

6.4.2: Inductive Reasoning

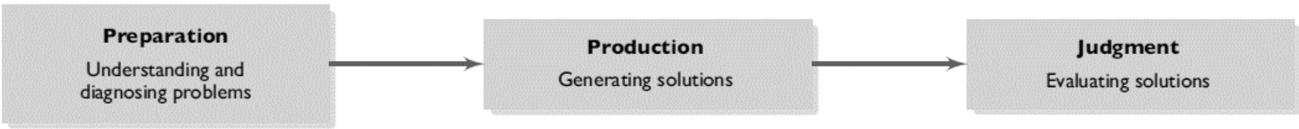
In inductive reasoning, a general rule or principle is gathered from a series of specific examples; for instance, inferring the laws of gravity by observing many falling objects.

6.5: PROBLEM SOLVING

Problem solving is the process of finding solutions to difficult or complex issues.

6.5.1: Steps involved in Problem Solving

Psychologists have found that problem solving typically involves the three steps such as preparing to create solutions, producing solutions, and evaluating the solutions that have been generated.



6.5.1.1: Preparation

When approaching a problem, most people begin by trying to understand the problem thoroughly. If the problem is a novel one, they probably will pay particular attention to any restrictions placed on coming up with a solution. If, by contrast, the problem is a familiar one, they are apt to spend considerably less time in this preparation stage.

Problems vary from well-defined to ill defined. In a well-defined problem —such as a mathematical equation or the solution to a jigsaw puzzle—both the nature of the problem itself and the information needed to solve it are available and clear. Thus, we can make straightforward judgments about whether a potential solution is appropriate. With an ill-defined problem, such as how to increase morale on an assembly line or to bring peace to the Middle East, not only may the specific nature of the problem be unclear, the information required to solve the problem may be even less obvious (Evans, 2004; Vartanian, 2009).

Typically, a problem falls into one of the three categories shown in Figure 3: arrangement, inducing structure, and transformation. Solving each type requires somewhat different kinds of psychological skills and knowledge (Spitz, 1987; Chronicle, MacGregor, & Ormerod, 2004).

- **Arrangement problems** require the problem solver to rearrange or recombine elements in a way that will satisfy a certain criterion. Usually, several different arrangements can be made, but only one or a few of the arrangements will produce a solution. Anagram problems and jigsaw puzzles are examples of arrangement problems (Coventry et al., 2003).

- In **problems of inducing structure**, a person must identify the existing relationships among the elements presented and then construct a new relationship among them. In such a problem, the problem solver must determine not only the relationships among the elements but also the structure and size of the elements involved.
- **Transformation problems** that consist of an initial state, a goal state, and a method for changing the initial state into the goal state.

6.5.1.2: Production

After preparation, the next stage in problem solving is the production of possible solutions. If a problem is relatively simple, we may already have a direct solution stored in long-term memory, and all we need to do is retrieve the appropriate information. If we cannot retrieve or do not know the solution, we must generate possible solutions and compare them with information in long- and short-term memory. ***(**Add strategies of problem solving in this session)**

6.5.1.3: Judgement

The final stage in problem solving is judging the adequacy of a solution. Often this is a simple matter: If the solution is clear—as in the Tower of Hanoi problem—we will know immediately whether we have been successful (Varma, 2007).

If the solution is less concrete or if there is no single correct solution, evaluating solutions becomes more difficult. In such instances, we must decide which alternative solution is best.

6.5.2: Strategies of Problem Solving

6.5.2.1: Algorithm

Algorithm can be defined as a learned set of rules that always leads to the correct solution of a problem.

An **algorithm** is a rule that, if applied appropriately, guarantees a solution to a problem. We can use an algorithm even if we cannot understand why it works. For example, almost everyone may know that it can find the length of the third side of a right triangle by using the formula $a^2+ b^2=c^2$, although they may not have the foggiest notion of the mathematical principles behind the formula.

6.5.2.2: Heuristics

Heuristics can be defined as the thinking strategies that may lead us to a solution to a problem or decision, but-unlike algorithms-may sometimes lead to errors. In other words, **heuristics can be defined as any strategy or technique that aids problem solving, especially by limiting the number of possible solutions to be tried.**

For many problems and decisions, however, no algorithm is available. In those instances, we may be able to use heuristics to help us. A heuristic is a thinking strategy that may lead us to a solution to a problem or decision, but-unlike algorithms-may sometimes lead to errors. Heuristics increase the likelihood of success in coming to a solution, but, unlike algorithms, they cannot ensure it.

6.5.2.3: Means to End Analysis

An analysis of how to reduce the difference between the present state of affairs and a desired goal.

Means-ends analysis involves repeated tests for differences between the desired outcome and what currently exists. Consider this simple example (Newell & Simon, 1972; Huber, Beckmann, & Herrmann, 2004; Chrysikou, 2006). In a means-end analysis, each step brings the problem solver closer to a resolution. Although this approach is often effective, if the problem requires indirect steps that temporarily increase the discrepancy between a current state and the solution, means-ends analysis can be counterproductive. For example, sometimes the fastest route to the summit of a mountain requires a mountain climber to backtrack temporarily; a meansend approach—that implies that the mountain climber should always forge ahead and upward—will be ineffective in such instances.

6.5.2.4: Backward Search

For some kinds of problems, the best approach is to work backward by focusing on the goal, rather than the starting point, of the problem.

6.5.2.5: Insightful Solution

A sudden mental recognition of a problem that makes the solution obvious.

Insight is so rapid and clear that we may wonder why we didn't see the solution sooner (Schilling, 2005). Insights are usually based on reorganizing a problem. This allows us to see problems in new ways and makes their solutions seem obvious (Robertson, 2001).

6.5.3: Barriers to Effective Problem Solving

6.5.3.1: Emotional barriers

Emotional barriers involve inhibition and fear of making a fool of oneself, fear of making a mistake, inability to tolerate ambiguity, excessive self-criticism

Example: An architect is afraid to try an unconventional design because she fears that other architects will think it is frivolous.

6.5.3.2: Cultural barriers

Cultural barriers involve values that hold that fantasy is a waste of time; that playfulness is for children only; that reason, logic, and numbers are good; that feelings, intuitions, pleasure, and humor are bad or have no value in the serious business of problem solving

Example: A corporate manager wants to solve a business problem but becomes stern and angry when members of his marketing team joke playfully about possible solutions.

6.5.3.3: Learned barriers

Learned barriers involve conventions about uses (functional fixedness), meanings, possibilities, taboos. **Functional fixedness can be defined as a rigidity in problem solving caused by an inability to see new uses for familiar objects.**

Example: A cook doesn't have any clean mixing bowls and fails to see that he could use a frying pan as a bowl.

6.5.3.4: Perceptual barriers

Perceptual barriers involve habits leading to a failure to identify important elements of a problem

Example: A beginning artist concentrates on drawing a vase of flowers without seeing that the "empty" spaces around the vase are part of the composition, too.

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