

## 1.1 FEATURES OF THOUGHT

Thought can refer to the ideas or arrangements of ideas that result from thinking, the act of producing thoughts, or the process of producing thoughts. Despite the fact that thought is a fundamental human activity familiar to everyone, there is no generally accepted agreement as to what thought is or how it is created. Thoughts are the result or product of spontaneous acts of thinking.

Because thought underlies many human actions and interactions, understanding its physical and metaphysical origins, processes, and effects has been a longstanding goal of many academic disciplines including artificial intelligence, biology, philosophy, psychology, and sociology.

Thinking allows humans to make sense of, interpret, represent or model the world they experience, and to make predictions about that world. It is therefore helpful to an organism with needs, objectives, and desires as it makes plans or otherwise attempts to accomplish those goals. Thoughts are the keys which determine one's goal.

### **Biology**

A neuron (also known as a neurone or nerve cell) is an excitable cell in the nervous system that processes and transmits information by electrochemical signaling. Neurons are the core components of the brain, the vertebrate spinal cord, the invertebrate ventral nerve cord, and the peripheral nerves. A number of specialized types of neurons exist: sensory neurons respond to touch, sound, light and numerous other stimuli affecting cells of the sensory organs that then send signals to the spinal cord and brain. Motor neurons receive signals from the brain and spinal cord and cause muscle contractions and affect glands.

Interneurons connect neurons to other neurons within the brain and spinal cord. Neurons respond to stimuli, and communicate the presence of stimuli to the central nervous system, which processes that information and sends responses to other parts of the body for action. Neurons do not go through mitosis, and usually cannot be replaced after being destroyed,[dubious – discuss] although astrocytes have been observed to turn into neurons as they are sometimes pluripotent.

## **Psychology**

Psychologists have concentrated on thinking as an intellectual exertion aimed at finding an answer to a question or the solution of a practical problem. Cognitive psychology is a branch of psychology that investigates internal mental processes such as problem solving, memory, and language.

The school of thought arising from this approach is known as cognitivism which is interested in how people mentally represent information processing. It had its foundations in the Gestalt psychology of Max Wertheimer, Wolfgang Köhler, and Kurt Koffka and in the work of Jean Piaget, who provided a theory of stages/phases that describe children's cognitive development.

In developmental psychology, Jean Piaget was a pioneer in the study of the development of thought from birth to maturity. In his theory of cognitive development, thought is based on actions on the environment. That is, Piaget suggests that the environment is understood through assimilations of objects in the available schemes of action and these accommodate to the objects to the extent that the available schemes fall short of the demands.

As a result of this interplay between assimilation and accommodation, thought develops through a sequence of stages that differ qualitatively from each other in mode of representation and complexity of inference and understanding. That is, thought evolves from being based on perceptions and actions at the sensorimotor stage in the first two years of life to internal representations in early childhood.

Subsequently, representations are gradually organized into logical structures which first operate on the concrete properties of the reality, in the stage of concrete operations, and then operate on abstract principles that organize concrete properties, in the stage of formal operations. In recent years, the Piagetian conception of thought was integrated with information processing conceptions.

Thus, thought is considered as the result of mechanisms that are responsible for the representation and processing of information. In this conception, speed of processing, cognitive control, and working memory are the main functions underlying thought. In the neo-Piagetian theories of cognitive development, the development of thought is considered to come from

increasing speed of processing, enhanced cognitive control, and increasing working memory.

It seems that, before one experiences a conscious thought, unconscious brain processes work behind the scenes to generate the thought. During this opaque process, unconscious representations and calculations seem to be involved. The great Hermann von Helmholtz referred to these behind-the-scenes processes as "unconscious inferences," and Wilhelm Wundt, the father of experimental psychology, referred to conscious thought as a high-level "apperception," because it involves more unconscious analyses and interpretations than does what he considered to be normal "perception," which, to him, could transpire unconsciously.

**1.2 CONVERGENT AND DIVERGENT THINKING:** Convergent thinking is a term coined by Joy Paul Guilford as the opposite of divergent thinking. It generally means the ability to give the "correct" answer to standard questions that do not require significant creativity, for instance in most tasks in school and on standardized multiple-choice tests for intelligence.

Convergent thinking is the type of thinking that focuses on coming up with the single, well-established answer to a problem. It is oriented toward deriving the single best, or most often correct answer to a question. Convergent thinking emphasizes speed, accuracy, and logic and focuses on recognizing the familiar, reapplying techniques, and accumulating stored information.

It is most effective in situations where an answer readily exists and simply needs to be either recalled or worked out through decision making strategies. A critical aspect of convergent thinking is that it leads to a single best answer, leaving no room for ambiguity. In this view, answers are either right or wrong. The solution that is derived at the end of the convergent thinking process is the best possible answer the majority of the time.

Convergent thinking is also linked to knowledge as it involves manipulating existing knowledge by means of standard procedures. Knowledge is another important aspect of creativity. It is a source of ideas, suggests pathways to solutions, and provides criteria of effectiveness and novelty. Convergent thinking is used as a tool in creative problem solving. When an individual is using critical thinking to solve a problem they consciously use standards or

probabilities to make judgments. This contrasts with divergent thinking where judgment is deferred while looking for and accepting many possible solutions.

Convergent thinking is often used in conjunction with divergent thinking. Divergent thinking typically occurs in a spontaneous, free-flowing manner, where many creative ideas are generated and evaluated. Multiple possible solutions are explored in a short amount of time, and unexpected connections are drawn.

After the process of divergent thinking has been completed, ideas and information are organized and structured using convergent thinking to decision making strategies are used leading to a single-best, or most often correct answer.

Examples of divergent thinking include using brainstorming, free writing and creative thinking at the beginning of the problem solving process to generate possible solutions that can be evaluated later. Once a sufficient amount of ideas have been explored, convergent thinking can be used. Knowledge, logic, probabilities and other decision-making strategies are taken into consideration as the solutions are evaluated individually in a search for a single best answer which when reached is unambiguous.

## **CONVERGENT VS. DIVERGENT THINKING:**

### **Personality**

The personality correlates of divergent and convergent thinking have been studied. Results indicate that two personality traits were found to be significantly associated with divergent thinking. These traits, namely Openness and Extraversion, were found to facilitate divergent thinking production. Openness assesses intellectual curiosity, imagination, artistic interests, liberal attitudes, and originality.

The fact that Openness was found to be the strongest personality correlate of divergent thinking is not surprising, as previous studies have suggested that Openness be interpreted as a proxy of creativity. Although Openness conceptualizes individual differences in facets other than creativity, the high correlation between Openness and divergent thinking is indicative of two different ways of measuring the same aspects of creativity. Openness is a

self-report of one's preference for thinking "outside the box". Divergent thinking tests represent a performance-based measure of such.

No personality effects on convergent thinking were found, suggesting that the Big Five personality traits are a better predictor of divergent thinking than convergent thinking or that all types of individuals engage in convergent thinking regardless of their personality.

### **Brain activity**

The changes in brain activity was studied in subjects during both convergent and divergent thinking. To do this, researchers studied Electroencephalography (EEG) patterns of subjects during convergent and divergent thinking tasks. Different patterns of change for the EEG parameters were found during each type of thinking.

When compared with a control group who was resting, both convergent and divergent thinking produced significant desynchronization of the Alpha 1, 2 rhythms. Meanwhile, convergent thinking induced coherence increases in the Theta 1 band that was more caudal and right-sided. On the other hand, divergent thinking demonstrated amplitude decreases in the caudal regions of the cortex in Theta 1 and 2 bands. The large increase in amplitude and coherence indicates a close iterations between both hemispheres in the brain.

The successful generation of the hypothesis during divergent thinking performance seems to induce positive emotions which, in part, can be due to the increase of complexity and performance measures of creative thinking, Psycho-inter-hemispheric coherence. Finally, the obtained dominance of the right hemisphere and 'the cognitive axis', the coupling of the left occipital – right frontal in contrast to the right occipital – left frontal 'axis' characterizing analytic thinking, may reflect the EEG pattern of the unconscious mental processing during successful divergent thinking.

### **INTELLECTUAL ABILITY**

A series of standard intelligence tests were used to measure both the convergent and divergent thinking abilities of adolescents. Results indicate that subjects who classified as high on divergent thinking had significantly higher word fluency and reading scores than subjects who classified as low on divergent thinking.[9] Furthermore, those who were high in divergent thinking also demonstrated higher anxiety and penetration scores. Thus, those subjects who are high in divergent thinking can be characterized as

having their perceptual processes mature and become adequately controlled in an unconventional way.

Conversely, subjects in the high convergent thinking group illustrated higher grade averages for the previous school year, less difficulty with homework and also indicated that their parents pressed them towards post-secondary education. These were the only significant relationships regarding the convergent thinking measures. This suggests that these cognitive dimensions are independent of one another. Future investigations into this topic should focus more upon the developmental, cognitive and perpetual aspects of personality among divergent and convergent thinkers, rather than their attitude structures.

### **CREATIVE ABILITY**

Creative ability was measured in a study using convergent tasks, which require a single correct answer, and divergent tasks, which requires producing many different answers of varying correctness. Two types of convergent tasks used were, the first being a remote associates tasks, which gave the subject three words and asked what word the previous three words are related to. The second type of convergent thinking task were insight problems, which gave the subjects some contextual facts and then asked them a question requiring interpretation.

For the remote associates tasks, the convergent thinkers correctly solved more of the five remote associates problems than did those using divergent thinking. This was demonstrated to be significantly different by a one-way ANOVA. In addition, when responding to insight problems, participants using convergent thinking solved more insight problems than did the control group, however, there was no significant difference between subjects using convergent or divergent thinking.

For the divergent thinking tasks, although together all of the divergent tasks demonstrated a correlation, they were not significant when examined between conditions.

### **Mood**

With increasing evidence suggesting that emotions can affect underlying cognitive processes, recent approaches have also explored the opposite, that cognitive processes can also affect one's mood. Research indicates that

preparing for a creative thinking task induces mood swings depending on what type of thinking is used for the task.

The results demonstrate that carrying out a task requiring creative thinking does have an effect on one's mood. This provides considerable support for the idea that mood and cognition are not only related, but also that this relation is reciprocal. Additionally, divergent and convergent thinking impact mood in opposite ways. Divergent thinking led to a more positive mood, whereas convergent thinking had the opposite effect, leading to a more negative mood.

### **PRACTICAL USE**

Multiple choice questions requiring convergent thinking

Convergent thinking is a fundamental tool in a child's education. Today, most educational opportunities are tied to one's performance on standardized tests that are often multiple choice in nature. When a student contemplates the possible answers available, they use convergent thinking to weigh alternatives within a construct. This allows one to find a single best solution that is measurable.

### **Critiques**

The idea of convergent thinking has been critiqued by researchers who claim that not all problems have solutions that can be effectively ranked.

Convergent thinking assigns a position to solution over another. The problem is that when one is dealing with more complex problems, the individual may not be able to appropriately rank the solutions available to them. In these instances, researchers indicate that when dealing with complex problems, other variables such as one's gut feeling or instinctive problem solving abilities also have a role in determining a solution to a given problem.