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## Cognitive Psychology and It's Impact

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**ABSTRACT:** Cognitive psychology is the scientific study of mental processes such as attention, language use, memory, perception, problem solving, creativity, and reasoning.<sup>[1]</sup>

Cognitive psychology originated in the 1960s in a break from behaviourism, which held from the 1920s to 1950s that unobservable mental processes were outside the realm of empirical science. This break came as researchers in linguistics and cybernetics, as well as applied psychology, used models of mental processing to explain human behavior. Work derived from cognitive psychology was integrated into other branches of psychology and various other modern disciplines like cognitive science, linguistics, and economics. The domain of cognitive psychology overlaps with that of cognitive science, which takes a more interdisciplinary approach and includes studies of non-human subjects and artificial intelligence.

**KEYWORDS**-cognitive psychology, mental, reasoning, cybernetics, behavior, intelligence

### I.INTRODUCTION

Philosophically, ruminations on the human mind and its processes have been around since the times of the ancient Greeks. In 387 BCE, Plato had suggested that the brain was the seat of the mental processes.<sup>[2]</sup> In 1637, René Descartes posited that humans are born with innate ideas and forwarded the idea of mind-body dualism, which would come to be known as substance dualism (essentially the idea that the mind and the body are two separate substances).<sup>[3]</sup> From that time, major debates ensued through the 19th century regarding whether human thought was solely experiential (empiricism), or included innate knowledge (nativism). Some of those involved in this debate included George Berkeley and John Locke on the side of empiricism, and Immanuel Kant on the side of nativism.<sup>[4]</sup>

With the philosophical debate continuing, the mid to late 19th century was a critical time in the development of psychology as a scientific discipline. Two discoveries that would later play substantial roles in cognitive psychology were Paul Broca's discovery of the area of the brain largely responsible for language production,<sup>[3]</sup> and Carl Wernicke's discovery of an area thought to be mostly responsible for comprehension of language.<sup>[5]</sup> Both areas were subsequently formally named for their founders, and disruptions of an individual's language production or comprehension due to trauma or malformation in these areas have come to commonly be known as Broca's aphasia and Wernicke's aphasia.

From the 1920s to the 1950s, the main approach to psychology was behaviorism. Initially, its adherents viewed mental events such as thoughts, ideas, attention, and consciousness as unobservables, hence outside the realm of a science of psychology. One pioneer of cognitive psychology, who worked outside the boundaries (both intellectual and geographical) of behaviorism was Jean Piaget. From 1926 to the 1950s and into the 1980s, he studied the thoughts, language, and intelligence of children and adults.<sup>[6]</sup>

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In the mid-20th century, three main influences arose that would inspire and shape cognitive psychology as a formal school of thought:

- With the development of new warfare technology during WWII, the need for a greater understanding of human performance came to prominence. Problems such as how to best train soldiers to use new technology and how to deal with matters of attention while under duress became areas of need for military personnel. Behaviorism provided little if any insight into these matters and it was the work of Donald Broadbent, integrating concepts from human performance research and the recently developed information theory, that forged the way in this area.<sup>[4]</sup>
- Developments in computer science would lead to parallels being drawn between human thought and the computational functionality of computers, opening entirely new areas of psychological thought. Allen Newell and Herbert Simon spent years developing the concept of artificial intelligence (AI) and later worked with cognitive psychologists regarding the implications of AI. This encouraged a conceptualization of mental functions patterned on the way that computers handled such things as memory storage and retrieval,<sup>[4]</sup> and it opened an important doorway for cognitivism.<sup>[1,2,3]</sup>
- Noam Chomsky's 1959 critique<sup>[7]</sup> of behaviorism, and empiricism more generally, initiated what would come to be known as the "cognitive revolution". Inside psychology, in criticism of behaviorism, J. S. Bruner, J. J. Goodnow & G. A. Austin wrote "a study of thinking" in 1956. In 1960, G. A. Miller, E. Galanter and K. Pribram wrote their famous "Plans and the Structure of Behavior". The same year, Bruner and Miller founded the Harvard Center for Cognitive Studies, which institutionalized the revolution and launched the field of cognitive science.
- Formal recognition of the field involved the establishment of research institutions such as George Mandler's Center for Human Information Processing in 1964. Mandler described the origins of cognitive psychology in a 2002 article in the Journal of the History of the Behavioral Sciences<sup>[8]</sup>

Ulric Neisser put the term "cognitive psychology" into common use through his book Cognitive Psychology, published in 1967.<sup>[9][10]</sup> Neisser's definition of "cognition" illustrates the then-progressive concept of cognitive processes:

The term "cognition" refers to 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. ... Given such a sweeping definition, it is apparent that cognition is involved in everything a human being might possibly do; that every psychological phenomenon is a cognitive phenomenon. But although cognitive psychology is concerned with all human activity rather than some fraction of it, the concern is from a particular point of view. Other viewpoints are equally legitimate and necessary. Dynamic psychology, which begins with motives rather than with sensory input, is a case in point. Instead of asking how a man's actions and experiences result from what he saw, remembered, or believed, the dynamic psychologist asks how they follow from the subject's goals, needs, or instincts.<sup>[9]</sup>

## Cognitive processes

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The main focus of cognitive psychologists is on the mental processes that affect behavior. Those processes include, but are not limited to, the following three stages of memory:

1. Sensory memory storage: holds sensory information
2. Short-term memory storage: holds information temporarily for analysis and retrieves information from the Long-term memory.

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3. Long-term memory: holds information over an extended period of time which receives information from the short-term memory.

## Attention

The psychological definition of attention is "a state of focused awareness on a subset of the available sensation perception information".<sup>[11]</sup> A key function of attention is to identify irrelevant data and filter it out, enabling significant data to be distributed to the other mental processes.<sup>[4]</sup> For example, the human brain may simultaneously receive auditory, visual, olfactory, taste, and tactile information. The brain is able to consciously handle only a small subset of this information, and this is accomplished through the attentional processes.<sup>[4]</sup>

Attention can be divided into two major attentional systems: exogenous control and endogenous control.<sup>[12]</sup> Exogenous control works in a bottom-up manner and is responsible for orienting reflex, and pop-out effects.<sup>[12]</sup> Endogenous control works top-down and is the more deliberate attentional system, responsible for divided attention and conscious processing.<sup>[12]</sup>

One major focal point relating to attention within the field of cognitive psychology is the concept of divided attention. A number of early studies dealt with the ability of a person wearing headphones to discern meaningful conversation when presented with different messages into each ear; this is known as the dichotic listening task.<sup>[4]</sup> Key findings involved an increased understanding of the mind's ability to both focus on one message, while still being somewhat aware of information being taken in from the ear not being consciously attended to. For example, participants (wearing earphones) may be told that they will be hearing separate messages in each ear and that they are expected to attend only to information related to basketball. When the experiment starts, the message about basketball will be presented to the left ear and non-relevant information will be presented to the right ear. At some point the message related to basketball will switch to the right ear and the non-relevant information to the left ear. When this happens, the listener is usually able to repeat the entire message at the end, having attended to the left or right ear only when it was appropriate.<sup>[4]</sup> The ability to attend to one conversation in the face of many is known as the cocktail party effect.

Other major findings include that participants cannot comprehend both passages when shadowing one passage, they cannot report the content of the unattended message, while they can shadow a message better if the pitches in each ear are different.<sup>[13]</sup> However, while deep processing does not occur, early sensory processing does. Subjects did notice if the pitch of the unattended message changed or if it ceased altogether, and some even oriented to the unattended message if their name was mentioned.<sup>[13]</sup>

## Memory

The two main types of memory are short-term memory and long-term memory; however, short-term memory has become better understood to be working memory. Cognitive psychologists often study memory in terms of working memory.

## Working memory

Though working memory is often thought of as just short-term memory, it is more clearly defined as the ability to process and maintain temporary information in a wide range of everyday activities in the face of distraction. The famously known capacity of memory of 7 plus or minus 2 is a combination of both memories in working memory and long-term memory.

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One of the classic experiments is by Ebbinghaus, who found the serial position effect where information from the beginning and end of the list of random words were better recalled than those in the center.<sup>[14]</sup> This primacy and recency effect varies in intensity based on list length.<sup>[14]</sup> Its typical U-shaped curve can be disrupted by an attention-grabbing word; this is known as the Von Restorff effect.

Many models of working memory have been made. One of the most regarded is the Baddeley and Hitch model of working memory. It takes into account both visual and auditory stimuli, long-term memory to use as a reference, and a central processor to combine and understand it all.

A large part of memory is forgetting, and there is a large debate among psychologists of decay theory versus interference theory.

### Long-term memory

Modern conceptions of memory are usually about long-term memory and break it down into three main sub-classes. These three classes are somewhat hierarchical in nature, in terms of the level of conscious thought related to their use.<sup>[15]</sup>

- Procedural memory is memory for the performance of particular types of action. It is often activated on a subconscious level, or at most requires a minimal amount of conscious effort.<sup>[16]</sup> Procedural memory includes stimulus-response-type information, which is activated through association with particular tasks, routines, etc. A person is using procedural knowledge when they seemingly "automatically" respond in a particular manner to a particular situation or process.<sup>[15]</sup> An example is driving a car.<sup>[4,5,6]</sup>
- Semantic memory is the encyclopedic knowledge that a person possesses. Knowledge like what the Eiffel Tower looks like, or the name of a friend from sixth grade, represent semantic memory. Access of semantic memory ranges from slightly to extremely effortful, depending on a number of variables including but not limited to recency of encoding of the information, number of associations it has to other information, frequency of access, and levels of meaning (how deeply it was processed when it was encoded).<sup>[15]</sup>
- Episodic memory is the memory of autobiographical events that can be explicitly stated. It contains all memories that are temporal in nature, such as when one last brushed one's teeth or where one was when one heard about a major news event. Episodic memory typically requires the deepest level of conscious thought, as it often pulls together semantic memory and temporal information to formulate the entire memory.<sup>[15]</sup>

### Perception

Perception involves both the physical senses (sight, smell, hearing, taste, touch, and proprioception) as well as the cognitive processes involved in interpreting those senses. Essentially, it is how people come to understand the world around them through the interpretation of stimuli.<sup>[17]</sup> Early psychologists like Edward B. Titchener began to work with perception in their structuralist approach to psychology. Structuralism dealt heavily with trying to reduce human thought (or "consciousness", as Titchener would have called it) into its most basic elements by gaining an understanding of how an individual perceives particular stimuli.<sup>[18]</sup>

Current perspectives on perception within cognitive psychology tend to focus on particular ways in which the human mind interprets stimuli from the senses and how these interpretations affect behavior. An example of the way in which modern psychologists approach the study of perception is the research being done at the Center for Ecological Study of Perception and Action at the University of Connecticut (CESPA). One study at CESPA concerns ways in which individuals perceive their physical environment and how that influences their navigation through that environment.<sup>[19]</sup>

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## Language

Psychologists have had an interest in the cognitive processes involved with language that dates back to the 1870s, when Carl Wernicke proposed a model for the mental processing of language.<sup>[20]</sup> Current work on language within the field of cognitive psychology varies widely. Cognitive psychologists may study language acquisition,<sup>[21]</sup> individual components of language formation (like phonemes),<sup>[22]</sup> how language use is involved in mood, or numerous other related areas.

Significant work has focused on understanding the timing of language acquisition and how it can be used to determine if a child has, or is at risk of, developing a learning disability. A study from 2012 showed that, while this can be an effective strategy, it is important that those making evaluations include all relevant information when making their assessments. Factors such as individual variability, socioeconomic status, short-term and long-term memory capacity, and others must be included in order to make valid assessments.<sup>[21]</sup>

## Metacognition

Metacognition, in a broad sense, is the thoughts that a person has about their own thoughts. More specifically, metacognition includes things like:

- How effective a person is at monitoring their own performance on a given task (self-regulation).
- A person's understanding of their capabilities on particular mental tasks.
- The ability to apply cognitive strategies.<sup>[23]</sup>

Much of the current study regarding metacognition within the field of cognitive psychology deals with its application within the area of education. Being able to increase a student's metacognitive abilities has been shown to have a significant impact on their learning and study habits.<sup>[24]</sup> One key aspect of this concept is the improvement of students' ability to set goals and self-regulate effectively to meet those goals. As a part of this process, it is also important to ensure that students are realistically evaluating their personal degree of knowledge and setting realistic goals (another metacognitive task).<sup>[25]</sup>

Common phenomena related to metacognition include:

- Déjà Vu: feeling of a repeated experience
- Cryptomnesia: generating thought believing it is unique but it is actually a memory of a past experience; also known as unconscious plagiarism.
- False Fame Effect: non-famous names can be made to be famous
- Validity effect: statements seem more valid upon repeated exposure
- Imagination inflation: imagining an event that did not occur and having increased confidence that it did occur

## II.DISCUSSION

Modern perspectives on cognitive psychology generally address cognition as a dual process theory, expounded upon by Daniel Kahneman in 2011.<sup>[26]</sup> Kahneman differentiated the two styles of processing more, calling them intuition and reasoning. Intuition (or system 1), similar to associative reasoning, was determined to be fast and automatic, usually with strong emotional bonds included in the reasoning process. Kahneman said that this kind of reasoning was

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based on formed habits and very difficult to change or manipulate. Reasoning (or system 2) was slower and much more volatile, being subject to conscious judgments and attitudes.<sup>[26]</sup>

### Applications

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#### Abnormal psychology

Following the cognitive revolution, and as a result of many of the principal discoveries to come out of the field of cognitive psychology, the discipline of cognitive behavior therapy (CBT) evolved. Aaron T. Beck is generally regarded as the father of cognitive therapy, a particular type of CBT treatment.<sup>[27]</sup> His work in the areas of recognition and treatment of depression has gained worldwide recognition. In his 1987 book titled *Cognitive Therapy of Depression*, Beck puts forth three salient points with regard to his reasoning for the treatment of depression by means of therapy or therapy and antidepressants versus using a pharmacological-only approach:

1. Despite the prevalent use of antidepressants, the fact remains that not all patients respond to them. Beck cites (in 1987) that only 60 to 65% of patients respond to antidepressants, and recent meta-analyses (a statistical breakdown of multiple studies) show very similar numbers.<sup>[28]</sup>
2. Many of those who do respond to antidepressants end up not taking their medications, for various reasons. They may develop side-effects or have some form of personal objection to taking the drugs.<sup>[7,8,9]</sup>
3. Beck posits that the use of psychotropic drugs may lead to an eventual breakdown in the individual's coping mechanisms. His theory is that the person essentially becomes reliant on the medication as a means of improving mood and fails to practice those coping techniques typically practiced by healthy individuals to alleviate the effects of depressive symptoms. By failing to do so, once the patient is weaned off of the antidepressants, they often are unable to cope with normal levels of depressed mood and feel driven to reinstate use of the antidepressants.<sup>[29]</sup>

#### Social psychology

Many facets of modern social psychology have roots in research done within the field of cognitive psychology.<sup>[30][31]</sup> Social cognition is a specific sub-set of social psychology that concentrates on processes that have been of particular focus within cognitive psychology, specifically applied to human interactions. Gordon B. Moskowitz defines social cognition as "... the study of the mental processes involved in perceiving, attending to, remembering, thinking about, and making sense of the people in our social world".<sup>[32]</sup>

The development of multiple social information processing (SIP) models has been influential in studies involving aggressive and anti-social behavior. Kenneth Dodge's SIP model is one of, if not the most, empirically supported models relating to aggression. Among his research, Dodge posits that children who possess a greater ability to process social information more often display higher levels of socially acceptable behavior; that the type of social interaction that children have affects their relationships.<sup>[33]</sup> His model asserts that there are five steps that an individual proceeds through when evaluating interactions with other individuals and that how the person interprets cues is key to their reactionary process.<sup>[34]</sup>

#### Developmental psychology



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Many of the prominent names in the field of developmental psychology base their understanding of development on cognitive models. One of the major paradigms of developmental psychology, the Theory of Mind (ToM), deals specifically with the ability of an individual to effectively understand and attribute cognition to those around them. This concept typically becomes fully apparent in children between the ages of 4 and 6. Essentially, before the child develops ToM, they are unable to understand that those around them can have different thoughts, ideas, or feelings than themselves. The development of ToM is a matter of metacognition, or thinking about one's thoughts. The child must be able to recognize that they have their own thoughts and in turn, that others possess thoughts of their own.<sup>[35]</sup>

One of the foremost minds with regard to developmental psychology, Jean Piaget, focused much of his attention on cognitive development from birth through adulthood. Though there have been considerable challenges to parts of his stages of cognitive development, they remain a staple in the realm of education. Piaget's concepts and ideas predated the cognitive revolution but inspired a wealth of research in the field of cognitive psychology and many of his principles have been blended with modern theory to synthesize the predominant views of today.<sup>[36]</sup>

### Educational psychology

Modern theories of education have applied many concepts that are focal points of cognitive psychology. Some of the most prominent concepts include:

- **Metacognition:** Metacognition is a broad concept encompassing all manners of one's thoughts and knowledge about their own thinking. A key area of educational focus in this realm is related to self-monitoring, which relates highly to how well students are able to evaluate their personal knowledge and apply strategies to improve knowledge in areas in which they are lacking.<sup>[37]</sup>
- **Declarative knowledge and procedural knowledge:** Declarative knowledge is a person's 'encyclopedic' knowledge base, whereas procedural knowledge is specific knowledge relating to performing particular tasks. The application of these cognitive paradigms to education attempts to augment a student's ability to integrate declarative knowledge into newly learned procedures in an effort to facilitate accelerated learning.<sup>[37]</sup>
- **Knowledge organization:** Applications of cognitive psychology's understanding of how knowledge is organized in the brain has been a major focus within the field of education in recent years. The hierarchical method of organizing information and how that maps well onto the brain's memory are concepts that have proven extremely beneficial in classrooms.<sup>[37]</sup>

### Personality psychology

Cognitive therapeutic approaches have received considerable attention in the treatment of personality disorders in recent years. The approach focuses on the formation of what it believes to be faulty schemata, centralized on judgmental biases and general cognitive errors.<sup>[38]</sup>

### Cognitive psychology vs. cognitive science

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The line between cognitive psychology and cognitive science can be blurry. Cognitive psychology is better understood as predominantly concerned with applied psychology and the understanding of psychological phenomena. Cognitive psychologists are often heavily involved in running psychological experiments involving human participants, with the goal of gathering information related to how the human mind takes in, processes, and acts upon inputs received from the outside world.<sup>[39]</sup> The information gained in this area is then often used in the applied field of clinical psychology.<sup>[10,11,12]</sup>

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Cognitive science is better understood as predominantly concerned with a much broader scope, with links to philosophy, linguistics, anthropology, neuroscience, and particularly with artificial intelligence. It could be said that cognitive science provides the corpus of information feeding the theories used by cognitive psychologists.<sup>[40]</sup> Cognitive scientists' research sometimes involves non-human subjects, allowing them to delve into areas which would come under ethical scrutiny if performed on human participants. For instance, they may do research implanting devices in the brains of rats to track the firing of neurons while the rat performs a particular task. Cognitive science is highly involved in the area of artificial intelligence and its application to the understanding of mental processes.

## Criticisms

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### Lack of cohesion

Some observers have suggested that as cognitive psychology became a movement during the 1970s, the intricacies of the phenomena and processes it examined meant it also began to lose cohesion as a field of study. In *Psychology: Pythagoras to Present*, for example, John Malone writes: "Examinations of late twentieth-century textbooks dealing with "cognitive psychology", "human cognition", "cognitive science" and the like quickly reveal that there are many, many varieties of cognitive psychology and very little agreement about exactly what may be its domain."<sup>[3]</sup> This misfortune produced competing models that questioned information-processing approaches to cognitive functioning such as Decision Making and Behavioral Sciences.

## Controversies

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In the early years of cognitive psychology, behaviorist critics held that the empiricism it pursued was incompatible with the concept of internal mental states. However, cognitive neuroscience continues to gather evidence of direct correlations between physiological brain activity and mental states, endorsing the basis for cognitive psychology.<sup>[41]</sup>

There is however disagreement between neuropsychologists and cognitive psychologists. Cognitive psychology has produced models of cognition which are not supported by modern brain science. It is often the case that the advocates of different cognitive models form a dialectic relationship with one another thus affecting empirical research, with researchers siding with their favorite theory. For example, advocates of mental model theory have attempted to find evidence that deductive reasoning is based on image thinking, while the advocates of mental logic theory have tried to prove that it is based on verbal thinking, leading to a disorderly picture of the findings from brain imaging and brain lesion studies. When theoretical claims are put aside, the evidence shows that interaction depends on the type of task tested, whether of visuospatial or linguistic orientation; but that there is also an aspect of reasoning which is not covered by either theory.<sup>[42]</sup>

Similarly, neurolinguistics has found that it is easier to make sense of brain imaging studies when the theories are left aside.<sup>[43][44]</sup> In the field of language cognition research, generative grammar has taken the position that language resides within its private cognitive module, while 'Cognitive Linguistics' goes to the opposite extreme by claiming that language is not an independent function, but operates on general cognitive capacities such as visual processing and motor skills. Consensus in neuropsychology however takes the middle position that, while language is a specialized function, it overlaps or interacts with visual processing.<sup>[42][45]</sup> Nonetheless, much of the research in language cognition continues to be divided along the lines of generative grammar and Cognitive Linguistics; and this, again, affects adjacent research fields including language development and language acquisition.<sup>[46]</sup>



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## III.RESULTS

In psychology, cognitivism is a theoretical framework for understanding the mind that gained credence in the 1950s. The movement was a response to behaviorism, which cognitivists said neglected to explain cognition. Cognitive psychology derived its name from the Latin cognoscere, referring to knowing and information, thus cognitive psychology is an information-processing psychology derived in part from earlier traditions of the investigation of thought and problem solving.<sup>[1][2]</sup>

Behaviorists acknowledged the existence of thinking but identified it as a behavior. Cognitivists argued that the way people think impacts their behavior and therefore cannot be a behavior in and of itself. Cognitivists later argued that thinking is so essential to psychology that the study of thinking should become its own field.<sup>[2]</sup> However, cognitivists typically presuppose a specific form of mental activity, of the kind advanced by computationalism.

Cognitivism has more recently been challenged by postcognitivism.

### Cognitive development

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The process of assimilating and expanding our intellectual horizon is termed as cognitive development. We have a complex physiological structure that absorbs a variety of stimuli from the environment, stimuli being the interactions that are able to produce knowledge and skills. Parents process knowledge informally in the home while teachers process knowledge formally in school. Knowledge should be pursued with zest and zeal; if not, then learning becomes a burden.<sup>[3]</sup>

### Attention

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Attention is the first part of cognitive development. It pertains to a person's ability to focus and sustain concentration.<sup>[4]</sup> Attention can also be how focus minded an individual is and having their full concentration on one thing.<sup>[5]</sup> It is differentiated from other temperamental characteristics like persistence and distractibility in the sense that the latter modulates an individual's daily interaction with the environment.<sup>[4]</sup> Attention, on the other hand, involves his behavior when performing specific tasks.<sup>[4]</sup> Learning, for instance, takes place when the student gives attention towards the teacher. Interest and effort closely relate to attention. Attention is an active process which involves numerous outside stimuli. The attention of an organism at any point in time involves three concentric circles; beyond awareness, margin, and focus.<sup>[6]</sup> Individuals have a mental capacity; there are only so many things someone can focus on at one time.

A theory of cognitive development called information processing holds that memory and attention are the foundation of cognition. It is suggested that children's attention is initially selective and is based on situations that are important to their goals.<sup>[7]</sup> This capacity increases as the child grows older since they are more able to absorb stimuli from tasks.<sup>[7]</sup> Another conceptualization classified attention into mental attention and perceptual attention. The former is described as the executive-driven attentional "brain energy" that activates task-relevant processes in the brain while the latter are immediate or spontaneous attention driven by novel perceptual experiences.<sup>[8]</sup>

### Process of learning

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Cognitive theory mainly stresses the acquisition of knowledge and growth of the mental structure. Cognitive theory tends to focus on conceptualizing the student's learning process: how information is received; how information is processed and organized into existing schema; how information is retrieved upon recall. In other words, cognitive

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theory seeks to explain the process of knowledge acquisition and the subsequent effects on the mental structures within the mind. Learning is not about the mechanics of what a learner does, but rather a process depending on what the learner already knows (existing information) and their method of acquiring new knowledge (how they integrate new information into their existing schemas).<sup>[9]</sup> Knowledge acquisition is an activity consisting of internal codification of mental structures within the student's mind. Inherent to the theory, the student must be an active participant in their own learning process. Cognitive approaches mainly focus on the mental activities of the learner like mental planning, goal setting, and organizational strategies.<sup>[10]</sup> In cognitive theories not only the environmental factors and instructional components play an important role in learning. There are additional key elements like learning to code, transform, rehearse, and store and retrieve the information. The learning process includes learner's thoughts, beliefs, and attitude values.<sup>[11][12]</sup>

## Role of memory

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Memory plays a vital role in the learning process. Information is stored within memory in an organised, meaningful manner. Here, teacher and designers play different roles in the learning process. Teachers supposedly facilitate learning and the organization of information in an optimal way. Whereas designers supposedly use advanced techniques (such as analogies and hierarchical relationships) to help learners acquire new information to add to their prior knowledge. Forgetting is described as an inability to retrieve information from memory. Memory loss may be a mechanism used to discard situationally irrelevant information by assessing the relevance of newly acquired information.<sup>[13]</sup>

## Process of transfer

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According to cognitive theory, if a learner knows how to implement knowledge in different contexts and conditions then we can say that transfer has occurred.<sup>[14]</sup> Understanding is composed of knowledge - in the form of rules, concepts and discrimination.<sup>[15]</sup> Knowledge stored in memory is important, but the use of such knowledge is also important. Prior knowledge will be used for identifying similarities and differences between itself and novel information.<sup>[16]</sup>

## Types of learning explained in detail by this position

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Cognitive theory mostly explains complex forms of learning in terms of reasoning, problem solving and information processing.<sup>[14]</sup> Emphasis must be placed on the fact that the goal of all aforementioned viewpoints is considered to be the same - the transfer of knowledge to the student in the most efficient and effective manner possible.<sup>[17]</sup> Simplification and standardization are two techniques used to enhance the effectiveness and efficiency of knowledge transfer. Knowledge can be analysed, decomposed and simplified into basic building blocks. There is a correlation with the behaviorist model of the knowledge transfer environment. Cognitivists stress the importance of efficient processing strategies.<sup>[18]</sup>

## Basic principles of the cognitive theory and relevance to instructional design

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A behaviorist uses feedback (reinforcement) to change the behavior in the desired direction, while the cognitivist uses the feedback for guiding and supporting the accurate mental connections.<sup>[19]</sup> For different reasons learners' task analyzers are critical to both cognitivists and behaviorists. Cognitivists look at the learner's predisposition to learning (How does the learner activate, maintain, and direct his/her learning?).<sup>[19]</sup> Additionally, cognitivists examine the learner's 'how to design' instruction that it can be assimilated. (i.e., what about the learners existing mental structures?) In contrast, the behaviorists look at learners how to determine where the lesson should begin (i.e., at what level the learners are performing successfully?) and what are the most effective reinforcements (i.e., What are the consequences that are most desired by the learner?).<sup>[13,14,15]</sup>

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There are some specific assumptions or principles that direct the instructional design: active involvement of the learner in the learning process, learner control, metacognitive training (e.g., self-planning, monitoring, and revising techniques), the use of hierarchical analyses to identify and illustrate prerequisite relationships (cognitive task analysis procedure), facilitating optimal processing of structuring, organizing and sequencing information (use of cognitive strategies such as outlining, summaries, synthesizers, advance organizers etc.), encouraging the students to make connections with previously learned material, and creating learning environments (recall of prerequisite skills; use of relevant examples, analogies).

## Structuring instruction

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Cognitive theories emphasize mainly on making knowledge meaningful and helping learners to organize and relate new information to existing knowledge in memory. Instruction should be based on students' existing schema or mental structures, to be effective. The organization of information is connected in such a manner that it should relate to the existing knowledge in some meaningful way. The examples of cognitive strategies are Analogies, metaphors. The other cognitive strategies include the use of framing, outlining, mnemonics, concept mapping, advance organizers and so forth.<sup>[20]</sup> The cognitive theory mainly emphasizes the major tasks of the teacher / designer and includes analyzing that various learning experiences to the learning situation which can impact learning outcomes of different individuals. Organizing and structuring the new information to connect the learners' previously acquired knowledge, abilities, and experiences. The new information is effectively and efficiently assimilated/accommodated within the learners' cognitive structure.<sup>[21]</sup>

## Theoretical approach

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Cognitivism has two major components, one methodological, the other theoretical. Methodologically, cognitivism has a positivist approach and says that psychology can be (in principle) fully explained by the use of the scientific method, there is speculation on whether or not this is true. This is also largely a reductionist goal, with the belief that individual components of mental function (the 'cognitive architecture') can be identified and meaningfully understood.<sup>[23]</sup> The second says that cognition contains discrete and internal mental states (representations or symbols) that can be changed using rules or algorithms.<sup>[22]</sup>

Cognitivism became the dominant force in psychology in the late-20th century, replacing behaviorism as the most popular paradigm for understanding mental function. Cognitive psychology is not a wholesale refutation of behaviorism, but rather an expansion that accepts that mental states exist. This was due to the increasing criticism towards the end of the 1950s of simplistic learning models. One of the most notable criticisms was Noam Chomsky's argument that language could not be acquired purely through conditioning, and must be at least partly explained by the existence of internal mental states.

The main issues that interest cognitive psychologists are the inner mechanisms of human thought and the processes of knowing. Cognitive psychologists have attempted to shed some light on the alleged mental structures that stand in a causal relationship to our physical actions.

## Criticisms of psychological cognitivism

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In the 1990s, various new theories emerged and challenged cognitivism and the idea that thought was best described as computation. Some of these new approaches, often influenced by phenomenological and postmodern philosophy, include situated cognition, distributed cognition, dynamicism and embodied cognition. Some thinkers working in the field of artificial life (for example Rodney Brooks) have also produced non-cognitivist models of cognition. On the other hand, much of early cognitive psychology, and the work of many currently active cognitive psychologists does not treat cognitive processes as computational. The idea that mental functions can be described as information processing models has been criticised by philosopher John Searle and mathematician Roger Penrose who both argue that computation has some inherent shortcomings which cannot capture the fundamentals of mental processes.

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- Penrose uses Gödel's incompleteness theorem (which states that there are mathematical truths which can never be proven in a sufficiently strong mathematical system; any sufficiently strong system of axioms will also be incomplete) and Turing's halting problem (which states that there are some things which are inherently non-computable) as evidence for his position.
- Searle has developed two arguments, the first (well known through his Chinese room thought experiment) is the 'syntax is not semantics' argument—that a program is just syntax, while understanding requires semantics; therefore programs (hence cognitivism) cannot explain understanding. Such an argument presupposes the controversial notion of a private language. The second, which Searle now prefers but is less well known, is his 'syntax is not physics' argument—nothing in the world is intrinsically a computer program except as applied, described, or interpreted by an observer, so either everything can be described as a computer and trivially a brain can but then this does not explain any specific mental processes, or there is nothing intrinsic in a brain that makes it a computer (program). Many oppose these views and have criticized his arguments, which have created significant disagreement.<sup>[24]</sup> Both points, Searle claims, refute cognitivism.

Another argument against cognitivism is the problems of Ryle's Regress or the homunculus fallacy. Cognitivists have offered a number of arguments attempting to refute these attacks[16,17,18]

## IV.CONCLUSION

Cognition is the "mental action or process of acquiring knowledge and understanding through thought, experience, and the senses".<sup>[2]</sup> It encompasses all aspects of intellectual functions and processes such as: perception, attention, thought, imagination, intelligence, the formation of knowledge, memory and working memory, judgment and evaluation, reasoning and computation, problem-solving and decision-making, comprehension and production of language. Cognitive processes use existing knowledge and discover new knowledge.

Cognitive processes are analyzed from different perspectives within different contexts, notably in the fields of linguistics, musicology, anesthesia, neuroscience, psychiatry, psychology, education, philosophy, anthropology, biology, systemics, logic, and computer science.<sup>[3]</sup> These and other approaches to the analysis of cognition (such as embodied cognition) are synthesized in the developing field of cognitive science, a progressively autonomous academic discipline.

Etymology

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The word cognition dates back to the 15th century, where it meant "thinking and awareness".<sup>[4]</sup> The term comes from the Latin noun *cognitio* ('examination', 'learning', or 'knowledge'), derived from the verb *cognosco*, a compound of *con* ('with') and *gnōscō* ('know'). The latter half, *gnōscō*, itself is a cognate of a Greek verb, *gi(g)nōsko* (γί(γ)νώσκω, 'I know,' or 'perceive').<sup>[5][6]</sup>

## Early studies

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Despite the word cognitive itself dating back to the 15th century,<sup>[4]</sup> attention to cognitive processes came about more than eighteen centuries earlier, beginning with Aristotle (384–322 BC) and his interest in the inner workings of the mind and how they affect the human experience. Aristotle focused on cognitive areas pertaining to memory, perception, and mental imagery. He placed great importance on ensuring that his studies were based on empirical evidence, that is, scientific information that is gathered through observation and conscientious experimentation.<sup>[7]</sup> Two millennia later, the groundwork for modern concepts of cognition was laid during the Enlightenment by thinkers such as John Locke and Dugald Stewart who sought to develop a model of the mind in which ideas were acquired, remembered and manipulated.<sup>[8]</sup>

During the early nineteenth century cognitive models were developed both in philosophy—particularly by authors writing about the philosophy of mind—and within medicine, especially by physicians seeking to understand how to cure madness. In Britain, these models were studied in the academy by scholars such as James Sully at University College London, and they were even used by politicians when considering the national Elementary Education Act of 1870.<sup>[9]</sup>

As psychology emerged as a burgeoning field of study in Europe, whilst also gaining a following in America, scientists such as Wilhelm Wundt, Herman Ebbinghaus, Mary Whiton Calkins, and William James would offer their contributions to the study of human cognition.

## Early theorists

Wilhelm Wundt (1832–1920) emphasized the notion of what he called introspection: examining the inner feelings of an individual. With introspection, the subject had to be careful to describe their feelings in the most objective manner possible in order for Wundt to find the information scientific.<sup>[10][11]</sup> Though Wundt's contributions are by no means minimal, modern psychologists find his methods to be too subjective and choose to rely on more objective procedures of experimentation to make conclusions about the human cognitive process.

Hermann Ebbinghaus (1850–1909) conducted cognitive studies that mainly examined the function and capacity of human memory. Ebbinghaus developed his own experiment in which he constructed over 2,000 syllables made out of nonexistent words (for instance, 'EAS'). He then examined his own personal ability to learn these non-words. He purposely chose non-words as opposed to real words to control for the influence of pre-existing experience on what the words might symbolize, thus enabling easier recollection of them.<sup>[10][12]</sup> Ebbinghaus observed and hypothesized a number of variables that may have affected his ability to learn and recall the non-words he created. One of the reasons, he concluded, was the amount of time between the presentation of the list of stimuli and the recitation or recall of the same. Ebbinghaus was the first to record and plot a "learning curve" and a "forgetting curve".<sup>[13]</sup> His work heavily influenced the study of serial position and its effect on memory (discussed further below).

Mary Whiton Calkins (1863–1930) was an influential American pioneer in the realm of psychology. Her work also focused on human memory capacity. A common theory, called the recency effect, can be attributed to the studies that she conducted.<sup>[14]</sup> The recency effect, also discussed in the subsequent experiment section, is the tendency for

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individuals to be able to accurately recollect the final items presented in a sequence of stimuli. Calkin's theory is closely related to the aforementioned study and conclusion of the memory experiments conducted by Hermann Ebbinghaus.<sup>[15]</sup>

William James (1842–1910) is another pivotal figure in the history of cognitive science. James was quite discontent with Wundt's emphasis on introspection and Ebbinghaus' use of nonsense stimuli. He instead chose to focus on the human learning experience in everyday life and its importance to the study of cognition. James' most significant contribution to the study and theory of cognition was his textbook *Principles of Psychology* which preliminarily examines aspects of cognition such as perception, memory, reasoning, and attention.<sup>[15]</sup>

René Descartes (1596–1650) was a seventeenth-century philosopher who came up with the phrase "Cogito, ergo sum", which means "I think, therefore I am." He took a philosophical approach to the study of cognition and the mind, with his *Meditations* he wanted people to meditate along with him to come to the same conclusions as he did but in their own free cognition.<sup>[16]</sup>

In psychology, the term "cognition" is usually used within an information processing view of an individual's psychological functions,<sup>[17]</sup> and such is the same in cognitive engineering.<sup>[18]</sup> In the study of social cognition, a branch of social psychology, the term is used to explain attitudes, attribution, and group dynamics.<sup>[17]</sup> However, psychological research within the field of cognitive science has also suggested an embodied approach to understanding cognition. Contrary to the traditional computationalist approach, embodied cognition emphasizes the body's significant role in the acquisition and development of cognitive capabilities.<sup>[19][20]</sup>

Human cognition is conscious and unconscious, concrete or abstract, as well as intuitive (like knowledge of a language) and conceptual (like a model of a language). It encompasses processes such as memory, association, concept formation, pattern recognition, language, attention, perception, action, problem solving, and mental imagery.<sup>[21][22]</sup> Traditionally, emotion was not thought of as a cognitive process, but now much research is being undertaken to examine the cognitive psychology of emotion; research is also focused on one's awareness of one's own strategies and methods of cognition, which is called metacognition. The concept of cognition has gone through several revisions through the development of disciplines within psychology.

Psychologists initially understood cognition governing human action as information processing. This was a movement known as cognitivism in the 1950s, emerging after the Behaviorist movement viewed cognition as a form of behavior.<sup>[23]</sup> Cognitivism approached cognition as a form of computation, viewing the mind as a machine and consciousness as an executive function.<sup>[19]</sup> However; post cognitivism began to emerge in the 1990s as the development of cognitive science presented theories that highlighted the necessity of cognitive action as embodied, extended, and producing dynamic processes in the mind.<sup>[24]</sup> The development of Cognitive psychology arose as psychology from different theories, and so began exploring these dynamics concerning mind and environment, starting a movement from these prior dualist paradigms that prioritized cognition as systematic computation or exclusively behavior<sup>[19,20]</sup>

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