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BRAIN: THE STOREHOUSE OF MEMORY

A. Krishnarathi[1*] and B. William Dharma Raja[2]

Biological Science Education, Dr. Sivanthi Aditanar College of Education, Tiruchendur, Tuticorib District, Tamilnadu, India. Pin.No:628215
Department of Education, Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu, India. Pin No: 627012

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ABSTRACT

We always have an innate curiosity about how our brains function, how we learn and how we remember. It's not surprising to discover throughout hundreds of years of history, theories have been generated to explain the elusive qualities of the human brain. Aristotle thought that the heart was the source of memory and the brain served to cool the blood. In the mid 1660s, Descartes proposed that fluids in the ventricles of the brain controlled motor activity but human mental capabilities existed outside the brain in the mind. And as late as 1850, Franz Joseph Gall "reading" the innate propensities of people by feeling the lumps and bumps on their skulls, was all the rage. We may smile at the naivete of Plato, Aristotle, Descartes, or Gall but we have our own modern myths. The brain is the organ of memory (learning) but we haven't understood how it works for memory. The study of human brain and memory is vast, and this article helps to orient knowledge of memory to the lay the land in memory research. Complete coverage of the entire world of memory studies would be impossible in a single article. This article focuses primarily on the review of human brain and memory within the field of cognitive psychology.

INTRODUCTION

The best definition of Memory is an active system that receives information from the senses, organizes and alters it as it stores it away and then retrieves the information from storage (Baddeley, 1996, 2003). In the recent decades, marriage represents a marriage between cognitive psychology and neuroscience, called cognitive neuroscience. Cognative psychology was concerned only with function, only with characterizing mental activity (Neisser, 1967). Our memory is located not in one particular place of the brain. Several different areas of the brain act in conjunction with one another (sometimes referred to as distributed processing). Procedural memory seems to be stored in the cerebellum (Bedy & Winstein, 2004; Dawn & Schugencs, 1996). Each element of a memory (sights, sounds, words, emotions) is encoded in the same part of the brain that originally created that fragment (visual cortex, motor cortex, language area, etc), and recall of the memory effectively reactivates the neural patterns generated during the original encoding. Thus, a better image might be that of a complex web, in which the threads symbolize the various elements of a memory, that join at nodes or intersection points to form a whole rounded memory of a person, object or event.

In all vertebrates, the brain is the centre of the nervous system. The nervous system is considered to have two major parts, the central nervous system (CNS) and Peripheral system (PNS). The CNS consists of the brain and spinal card, the PNS consists of the skeletal nervous system and autonomic nervous system. It allows them to collect information (sensory system), act on that information (motor system) and store the result for future reference (memory), thus effectively making life possible. The human brain is perhaps the most complex living structure known in the universe (Smith & Kosslyn, 2007). The interior white matter provides most of the brain's structure and communications, while the grey matter that surrounds the white matter provides most of the actual computation and thinking functions.

Brain's Role in Memory

The human brain is hugely interconnected but three major components can be identified: the cerebrum, the cerebellum and the brain stem. The cerebral cortex plays a key role in memory, attention, perceptual awareness, thought, language and consciousness.

Cerebrum

The cerebrum (or forebrain), which makes up 75% of the brain by volume and 85% by weight, is divided by a large groove,

known as the longitudinal fissure, into two distinct hemispheres. The left and right hemispheres are linked by a large bundle of nerve fibres called the corpus callosum, and also by other smaller connections called commissures.

The cerebrum is covered by a sheet of neural tissue known as the cerebral cortex, which envelops other brain organs such as the thalamus and the hypothalamus and pituitary gland which control visceral functions, body temperature and behavioural responses such as feeding, drinking, sexual response, aggression and pleasure. The cerebral cortex itself is only 2 - 4 mm thick and contains six distinct but interconnected layers.
The occipital lobes process only visual input, both from the eyes and from memory. The visual effect occurs because the impact causes compression of the neurons in the occipital lobes. Curiously, if you stare straight ahead, the left occipital lobe receive input from the right side of space and the right occipital lobe receives inputs from the left side space .The back of the eye ,the retina is actually part of the brain that's been pushed forward during development (Dowling, 1992). If the occipital lobes are damaged, partial or complete blindness results.

The temporal lobes are involved in many different sorts of functions. One of them is the retention of visual memories. In addition, they receive input from the occipital lobes and match visual input to visual memories. The temporal lobes also process input from the ears and the posterior portion of the left temporal lobe contains Wernick's area which is crucial for comprehending language. At the anterior portion of the temporal lobes are a number of areas that are critical for storing new information in memory and areas involved in deriving meaning and in emotion (Smith & Kosslyn, 2007).

The parietal lobes are crucially involved in representing space and our relationship to it. The most anterior of the parietal lobes represent sensations on different parts of the body. It also important for consciousness, attention and mathematical thinking.eg: Albert Einstein after his death, researchers discovered that his parietal lobes were about 15 percent larger than normal (Witelson *et al*., 1999).

The frontal lobes are generally involved in managing sequences of behavior or mental activities. They play a major role in producing speech. The frontal lobes are also involved in looking up specific information stored in memory, in planning and reasoning, in some emotions and even in personality (Davidson, 1998). The frontal lobes obviously are crucial in helping to decide what sort of job to pursue and will play crucial roles in allowing to do choosen career.

Cerebellum

The cerebellum is concerned with physical coordination. It plays an important role in balance, motor control, but is also involved in some cognitive functions such as attention and emotional functions (such as regulating fear and pleasure responses) and in the processing of procedural memories.

Brainstem

The brainstem which includes the medulla, the pons and the midbrain. A set of small structure collectively known as the reticular formation, is involved in sleep and alertness. The pons connects the midbrain to the cerebellum and contributes to function that both structures perform, such as controlling sleep and facial expression. The medulla controls breathing, digestion, heart rate and other autonomic processes, as well as connecting the brain with the spinal cord and the rest of the body.

Processes of Memory in the Brain

Information transmission within the brain, which takes place during the processes of memory such as encoding and retrieval, is achieved using a combination of chemicals and electricity. It is a very complex process involving a variety of interrelated steps (Ciccarell & Meyer, 2007).

The electro-chemical signal released by a particular neurotransmitter may be encourage to the receiving cell to also fire, or to inhibit or prevent it from firing. Different neurotransmitters tend to act as excitatory (e.g. acetylcholine, glutamate, aspartate, noradrenaline, histamine) or inhibitory (e.g. GABA, glycine, seratonin), while some (e.g. dopamine) may be either. Subtle variations in the mechanisms of neurotransmission allow the brain to respond to the various demands made on it, including the encoding, consolidation, storage and retrieval of memories.

The connections between neurons are not static, though, they change over time. In addition to neurons, the brain contains about an equal mass of glial cells, The glial cells are smaller than neurons. It used to be thought that the role of glial cells was limited to the physical support, nutrition and repair of the neurons of the central nervous system.

Memory are stored in the Brain – How?

In general, the brain does not store new memories directly. Memory is a decentralized, distributed process in the brain. All parts of the brain are adapting to new information all the time. The main criteria the neural circuits use to decide when to alter themselves to accommodate new information is repetition. The more frequently two or more unusual pieces of information co-occur, the more the brain decides they must be important and prioritize them for associative retention by altering neural circuits. The brain does not really store "information" but rather adapts to statistical relationships among signals.

Another criteria by which the brain selects memory for storage is perceived value. If something unexpected happens, the brain records everything that led up to it. This process is mediated by the neurotransmitter dopamine.

Most recall occurs by association. An event or situation that is somehow similar to a memory from the past, or a piece of knowledge, causes that memory or knowledge to spontaneously consciousness. The spontaneous retrieval of memory by association is closer to a process of "reconstruction" than "retrieval". Clues about a past mental state are activated until something coherent emerges. That coherent "recreated" brain state may or may not be an accurate reproduction of the past, as the high error rate of eye-witness testimonys.

The Spectrum

Memory divided into two kinds such as habit memory and image or true memory (Chaube, 2003).

Habit memory

This memory is related to cramming. Habit memory is related to laws of mathematics, tables, poems etc. In habit memory a person does not understand the principles involved. So they are unable to use these principles when an occasion demands.

True or image memory

When the image of a thing remembered settles down properly in the mind then the person also understands fully the principles involved in the same. This is the stage when the person gets true or image memory relating to things. By the repeated use of image memory an individual gets so much habituated that image memory may appear like the habit memory.

Based on the duration of memory retention

The popular image of memory is as a kind of tiny filing cabinet full of individual memory folders in which information is stored away, or perhaps as a neural super-computer of huge capacity and speed.

Three distinct types of memory: sensory memory, short-term memory, and long-term memory (Fernald & Fernald, 2007).

Sensory memory

The sensory memory corresponds approximately to the initial moment that an item is perceived. Some of this information in the sensory area proceeds to the sensory store, which is referred to as short-term memory. Sensory memory is characterized by the duration of memory retention from milliseconds to seconds and short-term memory from seconds to minutes (Davis & Houghton, 1995).

Long-term memory

The third stage of memory is long term memory (LTM), the system into which all the information is placed to be kept more (or) less permanently. In terms of a capacity, LTM is unlimited (Barnyard & Gayson, 1996). This storage are generally characterised as of strictly limited capacity and duration, whereas in general stored information can be retrieved in a period of time which ranges from days to years; this type of memory is called long-term memory. In long-term memories are maintained by more stable and permanent changes in neural structure that are dependent on protein synthesis.

Declarative memory

Declarative memory requires conscious recall, in that some conscious process must call back the information. It is sometimes called explicit memory, since it consists of information that is explicitly stored and retrieved. Declarative memory can be further sub-divided into **s**emantic memory, which concerns facts taken independent of context; and episodic memory.

Semantic memory

Semantic memory which concerns facts taken independent of context, Semantic memory allows the encoding of abstract knowledge about the world, such as "Paris is the capital of France"(Davis & Houghton, 1995). Hierarchical network theory dates from the late 1960s when Collins and Quillian (1969) proposed that knowledge is stored in a network that contains nodal points.

Episodic memory

Episodic memory, which concerns information specific to a particular context, such as a time and place. Episodic memory, on the other hand, is used for more personal memories, such as the sensations, emotions, and personal associations of a particular place or time.

Procedural memory (or implicit memory)

This is not based on the conscious recall of information, but on implicit learning. Procedural memory is primarily employed in learning motor skills and should be considered a subset of implicit memory. It is revealed when we do better in a given task due only to repetition - no new explicit memories have been formed, but we are unconsciously accessing aspects of those previous experiences. Procedural memory involved in motor learning depends on the cerebellum and basal ganglia.

Short-term memory and working memory

Information moves from sensory memory to the next stage of memory, called short-term memory (STM) through the process of selective attention or the ability to focus on only one stimulus from among all sensory input (Broadbent,1958). The term working memory is used to refer the short-term storage needed for certain mental tasks .It is not a synonym for short-term memory, since it is defined not in terms of duration, but rather in terms of purpose. Some theories consider working memory to be the combination of short-term memory and some selective attentional control. Selective attention is responsible for the “cocktail party effect” that has been long established in studies of perception and attention (Handel, 1989). If we’ve ever been at a party where there’s a lot of noise and conversations going on in the background but we are able to notice when someone says our name, we have experienced this effect. The areas of the brain that are involved in selective attention were working even though you were not consciously aware of it, and when that important bit of information (your name) appeared, those areas brought the information to your conscious awareness (Stuss *et al*., 2002). The only time this attention filter is not working its peak is during deep stage four sleep, and it is still functioning even then (LaBerge, 1980).

Short-term memory tends to be encoded in auditory (sound) from. That simply means that people tends to “talk” inside their own heads. Although some images are certainly stored in STM in a kind of “visual sketchpad” (Baddeley, 1986), auditory storage accounts for much of short-term encoding. An artist planning a painting certainly has visual information in STM but may also keep up an internal dialogue that is primarily auditory. Research in which participants were asked to recall numbers and letters showed that errors were nearly always made with numbers or letters that sounded like the target but not with those that looked like the target word or number (Conrad & Hull, 1964).

Another way to think about short-term memory is a working memory. This term emphasizes the fact that short-term memory is not merely a “box” into which information is placed but is a working, active system that processs the information it contains at any given moment (Engle & Kane, 2004). For instance, when we are asked to mentally multiply 45 by 4, we have to perform a series of simple calculations (additions and multiplications) to arrive the final answer. The ability to store the information regarding the instructions and intermediate results is what is referred to as working memory.

When Memory Fails

There are forms of severe loss of memory disorders caused by problems in the functioning of the memory areas of the brain.

The damage of particular brain structure is the basis of amnesia (Hirst, 1983).

Retrograde Amnesia: People who are in accidents in which they received a head injury often are unable to recall the accident itself. Sometimes they cannot remember the last several hours or even days before the accident. This type of amnesia is called retrograde amnesia, which is loss of memory from the point of injury backwards (Hodges, 1994). What apparently happens in this kind of memory loss is that the consolidation process, which was busy making the physical changes to allow new memories to be stored, gets disrupted and loses everything that was not already nearly "finished".

***Anterograde Amnesia*:** The loss of memories from the point of injury or illness forward is called Anterograde amnesia (Squire & Slater, 1978). This is also the kind of amnesia most often seen in people with senile dementia, a mental disorder in which severe forgetfulness, mental confusion, and mood swings are the primary symptoms. (dementia patients also may suffer from retrograde amnesia in addition to anterograde amnesia). This is the reason that elderly people with a dementia such as alzheimer's will sometimes take several doses of medicine because they cannot remember having already taken a dose. It also makes for some very repetitive conversations, such as being told the same story or asked the same question numerous times in the space of a 20-minute conversation.

CONCLUSION

The knowledge about brain and memory directly impacts an individual's performance on cognitive tasks of students at the individual level, to the need for an understanding of the social, cultural, political and economic implications of any knowledge or skill in its context. Through such a concept of education, an individual can learn knowledge, specific skills expected, and the capacity to take initiatives, whatever their specific occupation or position, through individual performance, persons experience increases. These experiences are converted to in memory and stored at various parts of brain.

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