

A comprehensive study of the region of a human's brain called the hippocampus will be explored further in this essay. The purpose of this essay is to explore the function of the left hippocampus that has to do with the human's cognitive memory and learning theory. According to a study by (Jenneson & Squire, 2012), it said that the left hippocampus is more towards an individual's long-term memory (LTM). In order to have a deeper understanding of a human cognition, exploring its functioning clarifies the processes involved in the storage, retrieval of memories and the formation of memories. Engelhardt (2016) stated that the area of the hippocampus is widely recognised to be among the most extensively researched regions in the human brain. Bir et al. (2015) found out that in the year 1587, Arantius introduced the word "seahorse" or "hippocampus" that referred to the tiny organ situated inside the structure within the temporal horn of the lateral ventricle. Moreover, Arantius is recognised by many as the first person of the discovery and terminology of the hippocampus. Nevertheless, while Arantius received recognition for identifying the brain's hippocampus, he only used the verb "hippocampus" when referring to a particular section of the area.

Hippocampus is a complicated structure that is located deep within the temporal lobe of the brain, which is also located in the brain's cerebral cortex (Yassa, 2024). In addition, it is an organ in the central nervous system that is connected to the medial temporal lobe (also known as the MTL), known to be an area of the brain that takes responsibility for explicit memory as well as spatial cognition (Nadel & Hupbach, 2008). Baddeley (2001) stated in his study that declarative, also known as explicit memory is divided into two which are, episodic memory and declarative memory. It is also a structure that provides a very significant impact on oneself, especially if it is related to memorising, learning, emotional processing, and spatial navigation (Chauhan et al., 2021). There are many different stressors that might cause damage to this area because the structure is very sensitive and fragile (Anand & Dhikav, 2012).

According to the findings of many studies, it is also affected in a wide range of neurological and mental conditions (Rubin et al., 2014).

Spencer and Bland (2019), mentioned in their research study that the dentate gyrus and the hippocampus are two structures that are located beneath the cerebral cortex. The dentate gyrus and the hippocampus are both rectangular layers of the primitive brain cortex that are foldable in half along their longitudinal axis. Both of these structures are rather narrow and lengthy. One of the edges of the hippocampal was then folded and placed in between the two overlapping dentate gyrus. The other hippocampal edge was transformed into a distinct cortical region known as the subiculum. Moreover, the layer of tightly packed neurons can be identified as a curved structure that takes the shape of a S on the margin of the temporal lobe.

A study by Vargha-Khadem et al. (1997) monitored the development of a total of three people who suffered from amnesia in their medial temporal lobe. These individuals had bilateral injury to the medial temporal lobe at a very young age. Despite the fact that they experienced difficulty recalling many of the particular occurrences from their daily activities (episodic memory), they successfully had a normal life, for example, attending schools and developed a good level of language skills and factual understanding (semantic memory). Nevertheless, even if they achieved academic excellence, their episodic memory did not show any signs of improvement (as cited in Pinel & Barnes, 2018, p. 301). According to their study, identifying episodic memory impairments can be challenging, especially in cases when the impairments are severe. However, Gardiner et al. (2008) opposed that the significance of the hippocampus and its surrounding cortices is a subject of intense debate. Research has demonstrated that individuals with specific damage to the hippocampus, resulting in amnesia,

exhibit normal levels of identification based on familiarity, although experiencing significant difficulties in remembering (Brandt et al., 2009). However, there is also convincing proof indicating that people with this condition experience impairments in both semantic memory and recognition (Mans et al., 2003). As specified in (Clarks & Maguire, 2016) study, there are instances where it has been claimed that injuries that occur in individuals with bilateral hippocampal injury are not genuinely localised to the hippocampus which suggests that injury to other regions may have played a role in the impairment. Therefore, it would be impossible to draw conclusions that are specific to the hippocampus.

The concept of memory and its typical operation and abnormalities have been documented in written works since centuries ago. Amnesia, on the other hand, did not acquire its own standing as a clinical condition with pathological characteristics until the eighteenth century (Langer, 2021). Langer (2021) mentioned in her study that by using clinical information and few research findings, the temporal features of memory impairment were highlighted towards the end of the nineteenth century. Charcot discussed the characteristics of retrograde and anterograde amnesia, using a case of a violent traumatic event as an example in one of his studies. A study conducted by (White, 1997) confirmed that the challenge of identifying significant memories in relation to current sensory information is connected to the norepinephrine system and other neurohormones. It is possible that these systems are responsible for the hypermnesia and amnesia that are associated with post-traumatic stress disorder (PTSD).

Henry Moliason, also known as patient H.M., suffered from epileptic seizures that could possibly pose a threat to daily life (Mackay, 2023). A procedure that is called bilateral

medial temporal lobectomy was conducted on H.M. in order to remove both sides of his temporal lobes which includes the amygdala, majority or two thirds of the hippocampus and nearby the cortex area (Pinel & Barnes, 2018, p. 297). Procedure was done to H.M.'s to make sure that his epileptic seizures were under control. As per stated in (Mackay, 2023) study, following his post-surgical procedure, H.M. experienced a reduction in seizures, nevertheless, he has lost the ability to create new memories and had trouble remembering the events of the previous eleven years of his lifetime.

Anterograde memory deficiencies indicate the incapacity to create new memories, whereas retrograde amnesia pertains to the loss of previously acquired knowledge. These types of memory impairment offer understanding into the mechanisms of memory creation, consolidation, and retrieval of information (Rastogi et al., 2022). Approximately half of individuals with epilepsy experience both anterograde and retrograde memory deficits, which are usually triggered by a combination of factors including frequent seizures, lengthy duration of the condition, underlying hippocampal dysfunction, and early onset of epilepsy (Rastogi et al., 2022). When a patient is diagnosed with a condition known as anterograde amnesia, the next move of action commonly involves determining whether the impairment in forming new memories affects short-term memory, long-term memory or both (Pinel & Barnes, 2018, p 298-299). To assess H.M.'s anterograde memory impairments, researchers initially evaluated the way he performed on objective assessments that measured several types of memory. There are four different types of tests that were run by H.M. to measure his performance, such as the digit span test, block-tapping memory-span test, mirror-drawing test, and lastly, the incomplete picture test (Pinel & Barnes, 2018, p. 298).

Medial temporal lobe amnesia has demonstrated that H.M.'s have difficulty to create explicit LTM, yet still being able to develop implicit LTM of the same situations, is not exclusive to him. This condition has been identified as an indication of medial temporal lobe amnesia, together with various other types of amnesic illnesses. Consequently, assessing the validity of implicit LTM has become a significant factor in the examination of human memory (Pinel & Barnes, 2018, p. 300). Reber (2013) stated that there has been extensive research on human's cognitive neuroscience that is related to the functioning of the medial temporal lobe memory system, which was impaired due to the surgery performed to reduce H.M.'s seizures. After much investigation, it has been found out that the areas of the adjacent cortical areas such as, parahippocampal cortex, entorhinal and perirhinal as well as hippocampus were related to the medial temporal lobe memory system (Reber, 2013).

In this study, there is a type of theory that is called Standard consolidation theory or referred to as dual-trace theory. In the case of H.M., there was evidence that showed consolidation of memory, and it suggested that his hippocampus contributed to a specific part in the process. According to Scoville and Milner (1957), memories are temporarily captured in the hippocampus until they can be transferred to a more permanent cortical memory system. This explanation helps to explain why the bilateral medial temporal lobectomy disrupted only those retrograde memories acquired in the few years prior to H.M.'s surgery. (as cited in Pinel & Barnes, p. 305-306). According to the results of the remaining tests that were conducted on H.M., which included the incomplete picture, mirror drawing, Pavlovian conditioning, and mirror drawing, it was discovered that he was not aware of its memory, although his brain was capable of holding on to LTM.

Multiple trace theory (MTT) provided a more precise differentiation between the semantic memories and episodic memories in the context of a consolidation system (Sutherland et al., 2019). Roesler et al. (2021) stated that the early study conducted by Brenda Milner, specifically with patients like H.M. has provided substantial proof indicating that the hippocampus and related components in the medial temporal lobe, such as the parahippocampal and rhinal cortices, possess a crucial role within the creation and consolidation of declarative memories. However, (Nadel et al., 2000) did a comparison to the consolidation theory, which claims that the hippocampus complex is consistently linked to both the retention and retrieval of LTM, regardless of their age. They believed that the interactions between neocortex and the hippocampus complex may impact the consolidation of the semantic memory in the neocortex.

Malmberg et al. (2019) proposed that Atkinson and Shiffrin (A & S) laid the groundwork for the essential principles that emerged in the early days of psychology. They created several ideas that are now regarded as fundamental to the modal model, notably the distinction between long-term and short-term memory. According to A & S, there are three main parts to the structure: a sensory store, a short-term store (STS), and a long-term store (LTS). It is also known as the Multi-Store Model. They justify this position by using previous study results, particularly information obtained from neuropsychological single case studies (Baddeley et al., 2018). Finotelli and Eustache (2023) stated that episodic memory is a component of LTM, which refers to the ability to recall and remember one's personal experiences in a specific chronological order and in a structural way. The primary attribute of conscious memory is the ability to recall a past experience, including the time, the location, and the event itself. When a memory is retrieved in episodic memory, it creates the sensation

of experiencing the event again through a "mental journey in time" of one's own past, accompanied with self-consciousness.

Baddeley and Hitch (1974) established a working memory model that transformed the standard and simplistic belief that memory was either short-term or long-term (as cited in Chai et al., 2018). The memory system known as working memory is the one that is accountable for temporarily storing and manipulating information that is required to carry out activities as varied as comprehending, learning, and thinking. The structure of the system comprises two storage systems, namely the visuo-spatial sketchpad and phonological loop, overseen by a cognitive component called the central administrator. (Finotelli & Eustache, 2023). The visuospatial sketchpad is a cognitive system that is specifically designed for storing and manipulating data which can be expressed through spatial and visual terms. Visuospatial short-term memory is linked to heightened neural activity in particular sections of the right hemisphere, including the inferior prefrontal cortex, anterior occipital cortex, and posterior parietal cortex. If these areas of the brain are damaged, individuals may experience difficulties in recalling visuospatial information (Gathercole, 2008). On the other hand, as cited in (Swanson & Stomel, 2012) according to the Baddeley and Logie's concept (1999), the phonological loop's structure is specifically designed to store language-related data for short durations. The structure of the system consists of a phonological store, that retains information in phonological form, and a rehearsal process, which helps to keep the visualisations in the phonological store intact. The capability to store and retrieve phonological representations is believed to be linked to linguistic short-term memory, particularly through the use of the phonological loop. Finotelli and Eustache (2023) mentioned in their research that a central administrator is responsible for managing the process of information being transferred to LTM.

In the 1940s, cognitive map theory was first established by Edward. C Tolman. He concluded that all living things have mental maps. These maps allow individuals to use mental visualisation in order to get around and grasp within the environment they are in, regardless of whether they are present or not. According to Epstein et al., (2017), through fMRI (functional magnetic resonance imaging), it showed the hippocampus reacted when people use cognitive maps as virtual navigation. Usage of response-based approach, on the other hand, used certain visual stimuli that linked to a series of actions that took place near the basal ganglia. Study by Ekstrom and Ranganath (2017) showed how hippocampus have excessive influence in spatial tasks that can lead to control of the functions of medial temporal lobes. In addition, several new hypotheses on the function of hippocampus indicated that the task of hippocampus is not only to generate and keep cognitive maps. One perspective of the main role of the hippocampus was to link past information and now to ensure better behaviours in time to come. Innovative application spatial tasks within the hippocampus were activated because these activities commonly depend on formally acquired knowledge (Ekstrom & Ranganath, 2013).

In conclusion, in every human being, the hippocampus plays an important part in our every life, cognitive thinking, as well as learning ability. Poor spatial ability, Alzheimer disease, amnesia could happen to individuals if there is an injury in the hippocampus area. However, to lessen symptoms, these people are suggested to go through therapies and intervention programmes. When once experienced injury to the hippocampus, it cannot be taken lightly. This is because with right approaches and proper assistance with one's daily activities, one can have almost a normal live that may improve one's overall wellbeing There is still an ongoing research on how to improve a person's life who is going through

hippocampus impairments, where this will allow them to get through their life although they have this kind of disability. Further research on methods and treatments for illness connected to the hippocampus are still ongoing since greater understanding on this matter is crucial. This is to ensure that those with these disorders have greater emotional welfare and pliability.

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