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Final dissertation

Hyperthymesia:

the cognitive and cerebral processes of the people who never forget

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To all the psychological patients who helped the scientific community to advance in research.

Without you, we would not be able to help people nowadays and in the future.

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INDEX

CHAPTER 3: CRITICAL CONSIDERATIONS

ABSTRACT

In the present thesis, we explored hyperthymesia, a rare memory syndrome that makes people remembering very accurately their autobiographical experiences. We suggest that living with hyperthymesia is not a gift but rather a burden. Indeed, hyperthymesia does not help persons in their daily life. Moreover, hyperthymesia can even imply difficulties in cognitive functions, such as abstract and creative thinking. This statement has been supported by studies led among the years by authoritative scholars.

In Chapter 1, a general overview of the current memory taxonomy is presented. After a brief historical background, the Atkinson-Shiffrin's model is explained to describe sensory memory, short-term memory, and long-term memory, including all their subdivisions.

In Chapter 2, memory disorders, as pathologic memory loss, are briefly presented, for later introducing hyperthymesia. To this aim case studies of amnesic patients such as patient HM and C are mentioned. Hyperthymesia is then fully discussed. Case studies such as Jill Price, MM, BB, and HK are presented to explain the neural correlates, the mnestic functioning, and the concrete performance of the people affected by this syndrome. Moreover, distinctions with other forms of extraordinary memory are made, and the relation with obsessive compulsive disorder is considered. At the end of the chapter a consideration regarding the impairment that hyperthymesia causes and the patients' need of oblivion is presented.

Finally, in Chapter 3, we considered some critical points regarding hyperthymesia. First, we discuss some recent research about the topic, including possible treatments based on a phenomenological approach, some genetic studies, and the discovery of the severely deficient autobiographical memory syndrome. Thereafter, we analyzed how hyperthymesia can influence the scientific advances in discovering a cure for memory disorders, with special reference to Alzheimer's disease, thanks to the apolipoprotein E2 (APOE2).

Finally, hyperthymesia and the need of forgetting are discussed from a more anthropological perspective, presenting the cases of digital hyperthymesia and the ancient Greek myth of Lethe and Mnemosyne. As a last point, we agree that much more research is still needed for fully understanding hyperthymesia and for using it for getting closer to a cure for other memory disorders.

CHAPTER 1:
MEMORY AND ITS TAXONOMY

1.1 STAGES OF MEMORY

Klein (2015) argued that memory *“consists in an initial act of registration (learning) which, via the continuity assumed necessary and provided by the mechanism of storage, eventuates in an act of retrieval”* (p. 3). In fact, memory works through three stages, namely “encoding”, “storage”, and “retrieval”, and it is essential to consider them to start understanding how mnestic complex mechanisms work (Klein, 2015; Nolen-Hoeksema et al., 2014).

As Nolen-Hoeksema et al. (2014) explained, when a bit of information reaches us, our brain “encodes” it translating from the form that its source has in the world (e.g., a sound wave if the information was a spoken word) into a code that can enter memory. Then, in the “storage” stage, this information is stored for being, finally, accessed in the “retrieval” stage, when it is necessary to use that information another time. It is important to underline that memory is not infallible. Indeed, at any stage, information processing can be impaired resulting in a memory problem (Nolen-Hoeksema et al., 2014).

1.2 MEMORY TAXONOMY

1.2.1 HISTORICAL BACKGROUND

Since the beginning of the 19th century, scholars have struggled to understand and define memory. James (1890; as cited in Camina & Güell, 2017) was among the first ones who tried to classify memory, dividing it into “primary” and “secondary memory”; this old division will later correspond to our modern concepts of “short-term” and “long-term memory” (Camina & Güell, 2017). Later, Pavlov (1927; as cited in Camina & Güell, 2017), and Fitts and Posner (1967; as cited in Camina & Güell, 2017) contributed respectively to the study of associative and procedural memory (Camina & Güell, 2017). During the rest of the 20th century other noteworthy psychologists who advanced the knowledge that we had about memory were Milner (1962; as cited in Camina & Güell, 2017), who suggested that memory was not a unitary system, with HM experiments, and Atkinson and Shiffrin (1968; as cited in Camina & Güell, 2017), who proposed a modal model of memory (Camina & Güell, 2017).

1.2.2 THE ATKINSON-SHIFFRIN MODEL

As Camina and Güell (2017) reported, the current taxonomy of memory is based on the division among three modules: sensory memory, short-term memory (STM) and long-term memory (LTM). This classification has been proposed by Atkinson and Shiffrin (1968; as cited in Camina & Güell, 2017; Nolen-Hoeksema, 2014). For making this model, Atkinson and Shiffrin argued that each module of memory maintains information for a different time interval (Nolen-Hoeksema et al., 2014). In fact, information stored in sensory memory is transient and decay over a few milliseconds-seconds (Nolen-Hoeksema et al., 2014). Information stored in STM can be retained until 20-30 seconds (Nolen-Hoeksema et al., 2014). Finally, information stored in long-term memory can be stored for much longer periods of time (minutes to years; Nolen-Hoeksema et al., 2014).

The Atkinson and Shiffrin model (1968) is based on the information processing theory, according to which the brain processes bits of information to store them into memory, through different interconnected stages: encoding, storage, and retrieval (Freberg, 2019). Moreover, sensory memory, STM, and LTM are further divided into some sub-systems (Figure 1):

Figure 1. *Memory classification (Camina & Güell, 2017).*

It is noteworthy to mention that among all these sub-systems, the most relevant, for the purpose of the present dissertation about hyperthymesia, is declarative/explicit LTM. In fact, it stores the autobiographical memory of a person (Freberg, 2019).

1.2.2.1 SENSORY MEMORY

The information gathered by sensory memory is the one reached by the sensory organs (Nolen-Hoeksema et al., 2014). In fact, sensory data can be collected through touch (i.e., “haptic memory”), through hearing (i.e., “echoic memory”), or through sight (i.e., “iconic memory”; Camina & Güell, 2017).

Sensory memory has a very large capacity that can store a large amount of information at the same time (Nolen-Hoeksema et al., 2014). Nonetheless, sensory memory is transient because information can be stored only for a very brief amount of time (Nolen-Hoeksema, et al., 2014), precisely 1 second for iconic memory (Camina & Güell, 2017). These findings have been supported by the partial-report experiment by Sperling (1960; as cited in Camina & Güell, 2017; Nolen-Hoeksema et al., 2014) related to iconic memory; for further details about this study, please see Camina and Güell (2017) and Nolen-Hoeksema et al. (2014). Finally, the Di Lollo’s model (1980) has explained how iconic memory stores information by dividing its process into the components of persistence of vision and of information; for further details, please see Camina and Güell (2017) and Nolen-Hoeksema et al. (2014).

1.2.2.2 STM

The information, which the brain attends to, is moved from sensory to STM (Nolen-Hoeksema, 2014). This store has a limited capacity and the information collected can be used to produce new reasoning (Camina & Güell, 2017) and helping the person making decisions (Nolen-Hoeksema et al., 2014); in fact, it can be used to solve mathematical problems or to comprehend language tests (Nolen-Hoeksema et al., 2014).

The maximum time for the information to be stored in STM is about 20-30 seconds, and the only way for not being forgotten is repeating it through the “rehearsal” process (Nolen-Hoeksema et al., 2014). This process in divided in “maintenance rehearsal” (i.e., repetition of information for keeping it into STM), and “elaborative rehearsal” (i.e., repetition of information to pass it to LTM) (Nolen-Hoeksema et al., 2014). Furthermore, information in STM can be forgotten simply because new bits of information substitute the previous ones (Nolen-Hoeksema et al., 2014).

The retrieval of information is slower when more items are present in STM compared to when only a few items are present. Sternberg (1966, as cited in Nolen-Hoeksema et al., 2014) proved this experimentally, by showing that when people have to determine whether a digit is present or not in a list, their decision times proportionally rise according to the number of items currently present in STM.

1.2.2.2.1 WORKING MEMORY

STM has been recently interpreted as a space where the knowledge needed for a certain task is analyzed and processed for performing it immediately; according to this view, STM has a very important role in thinking processes and, therefore, it can be also called "working memory" (WM), to underline the active state that characterizes it (Nolen-Hoeksema et al., 2014). Because information encoded in STM can either have a phonological or a visual coding, the idea that WM operates through specialized buffers is popular among scholars (Nolen-Hoeksema et al., 2014). Baddeley (2000; as cited in Camina & Güell, 2017) proposed a multi-storehouse model supporting and explaining this argument.

1.2.2.2.1.1 BADDELEY'S MULTI-COMPONENTIAL MODEL

Four sub-systems have been identified within WM (Figure 2; Camina & Güell, 2017). First, the central executive is a sub-system that controls attention in its broader sense, including focusing and multi-tasking abilities; according to this view, the frontal lobes rule the executive control over the short-term stores (Camina & Güell, 2017). Second, the visuospatial sketchpad processes and stores a representation that combines both visual and spatial information (Camina & Güell, 2017). Indeed, thanks to studies done with brain-damaged patients, we know that the two types of information (visual vs. spatial) are stored separately in different brain areas (Camina & Güell, 2017). Third, auditory-verbal information is processed into the phonological buffer, found in the left hemisphere (Camina & Güell, 2017). The phonological loop has a limited capacity (span) of about 7 ± 2 items, (Nolen-Hoeksema et al., 2014).

Baddeley (2000, as cited in Camina & Güell, 2017), has recently added the episodic buffer to identify the mechanism by which episodes are collected into memory and integrated with space and time. This buffer is essential to unify the knowledge that the visual sketchpad and the phonological buffer gather and to integrate it with information in LTM (Nolen-Hoeksema et al., 2014). The episodic buffer is probably the most noteworthy component regarding the topic of the present thesis (i.e., hyperthymesia), because it regards how people encode their life events and therefore start to construct their autobiographical memories).

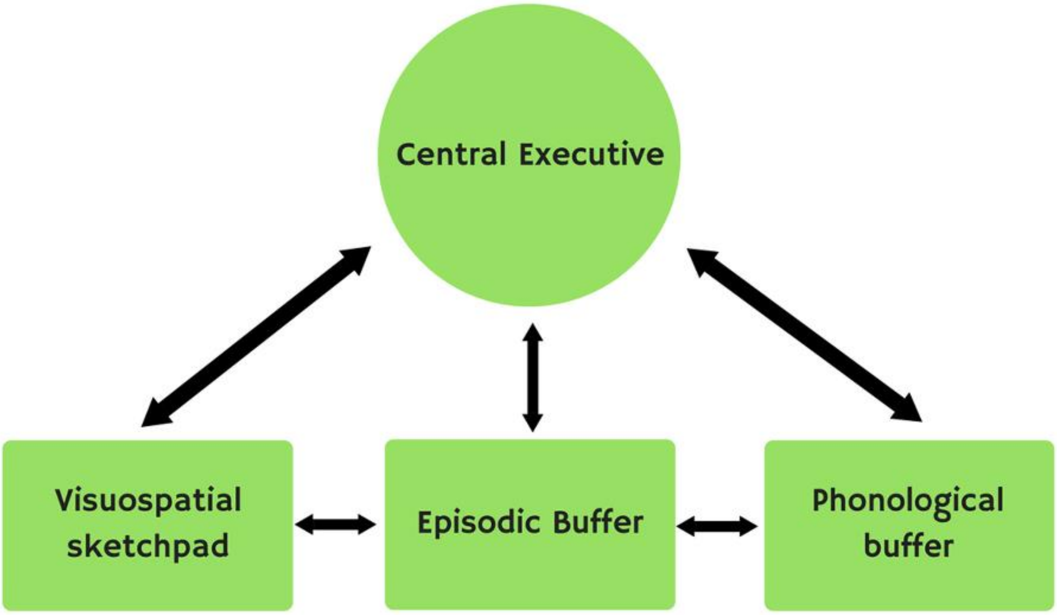

Figure 2. *Baddeley's model (Camina & Güell, 2017).*

1.2.2.3 LTM

LTM stores information that will be kept in the brain from a minute to a lifetime (Nolen-Hoeksema et al., 2014). LTM has an unlimited capacity, and it is filled through an elaborative process of information that comes from sensory memory and STM/WM (Nolen-Hoeksema et al., 2014). Information is exchanged another time, between STM/WM and LTM, through a process of retrieval, when some specific bits of information are needed to carry out a task (Nolen-Hoeksema et al., 2014).

LTM is divided into declarative/explicit and non-declarative/implicit memory (Camina & Güell, 2017). Declarative/explicit memory is further subdivided into episodic and semantic memory (Camina & Güell, 2017). Finally, non-declarative/implicit memory is further subdivided in procedural, associative, non-associative, and priming (Camina & Güell, 2017). Squire (1992, as cited in Sherman et al., 2023) pointed out that the division between explicit and implicit memory has been made relying upon the criteria of consciousness. In fact, Camina and Güell (2017) explained that the information contained into declarative/explicit memory was thought to be under conscious control, whereas the information contained into non-declarative/implicit memory was unconscious. Nevertheless, the findings of more recent studies argued that what establishes the difference is which brain structure underpins the two different processes, respectively the hippocampus (declarative/explicit) and the corpus striatum (non-declarative/implicit; Henke, 2010, as cited in Sherman et al., 2023).

This is the view proposed by the multiple memory sub-systems taxonomy, a traditional model that matches a brain region with a specific memory process (Sherman et al., 2023). According to this theory, the hippocampus involves episodic encoding and statistical learning, the corpus striatum guides goal-directed and habitual responses, and the amygdala rules the conditioned responses (Sherman et al., 2023). Nevertheless, Sherman et al. (2023) argued that these brain structures support multiple functions, pointing out that the same structure can host multiple functions (e.g., the hippocampus mainly controls episodic memory but also statistical learning). Nonetheless, at the same time, different brain regions host corresponding memory representations (i.e., both the hippocampus and the amygdala process episodic memory; Sherman et al., 2023).

1.2.2.3.1 DECLARATIVE/EXPLICIT MEMORY

Episodic memory regards the collection of information about personal events of one’s life, including theirs spatial and temporal components (Camina & Güell, 2017). The brain structures that govern this process are the hippocampus, the cortices closed to it (perirhinal, entorhinal, and para-hippocampal), and the circuits within the medial temporal lobe (Camina & Güell, 2017). Much of what is known about the neural correlates of episodic memory is due to the studies Milner (1966) conducted on patient HM, a patient who was affected by severe global amnesia after the bilateral removal of his hippocampus, his amygdala and of part of the association cortex of his temporal lobe (Freberg, 2019). By contrast, semantic memory stores information about facts, concepts, and encyclopedic knowledge, which are useful for answering general knowledge questions (Freberg, 2019). The brain regions that are activated are the inferior/anterior temporal lobes bilaterally (Visser et al., 2010).

The personal aspects in episodic and semantic memory together form the autobiographical memory (Freberg, 2019). At the neuroanatomical level, it has been found that the brain areas that are used for autobiographical memory include some of those that are part of the default mode network (DMN, i.e., a network of anatomically different brain areas that exhibit functional connectivity among each other; Bahk & Choi, 2017). In fact, some studies found that the DMN is activated not only during resting state but also for processing internal directed cognitive activities, such as recalling memories (Andreasen et al., 1995; Schacter et al., 2007; Spreng et al., 2009; as cited in Bahk & Choi, 2017).

1.2.2.3.2 NON-DECLARATIVE/IMPLICIT MEMORY

Non-declarative/implicit memory involves all those memories retained behind consciousness and that regard abilities or skills (Camina & Güell, 2017). Differently from the declarative/explicit memories, it is hard to describe these memories with words and they are straightforwardly understood only when shown or imitated (Freberg, 2019). Non-declarative/implicit memory is divided into four sub-systems, namely procedural, priming, associative, and non-associative (Camina & Güell, 2017).

First, procedural memory encompasses all those motor and executive skills that are automatically retrieved for performing a task such as riding a bicycle (Camina & Güell, 2017; Freberg, 2019). Second, priming consists in the response changing based on which stimulus the person has been previously exposed to (Camina & Güell, 2017; Freberg, 2019). Third, associative memory works through the processes of classical and operant conditioning, linking some data with other data to remember them more easily (Camina & Güell, 2017; Freberg, 2019). Finally, non-associative memory works through habituation (i.e., a stimulus is repeated determining a decrease in its response), and sensitization (i.e., a stimulus is repeated determining an increase in its response; Camina & Güell, 2017).

CHAPTER 2:
MEMORY DISORDERS AND HYPERTHYMESIA

2.1 MEMORY DISORDERS AS PATHOLOGIC MEMORY LOSS

As all cognitive functions, also memory can be damaged. Specifically, all the issues we might have with construing, maintaining, and evoking memory, resulting from an alteration in some brain structures, can be defined as memory disorders (Stanborough, 2023).

When individuals suffer from memory loss, they are affected by an amnesic syndrome (Allen, 2018). This condition can be:

1. Temporary (i.e., it does not last long, and it can be caused by a minor brain injury);
2. Permanent (i.e., it persists throughout a persons' life; strokes, traumatic head injuries, anoxia, viral infections can be responsible);
3. Progressive (i.e., continuous worsening of memory faculties as in the case of dementia in Alzheimer's disorder; Allen, 2018; Stanborough, 2023).

People suffering from amnesia might show different difficulties in remembering things. In fact, they can be affected by retrograde amnesia (i.e., struggling with recalling events happened anteriorly to the onset of the neurological disorder), anteretrograde amnesia (i.e., struggling with learning and recalling information collected after the onset of the neurological disorder), or dissociative amnesia (i.e., having troubles with remembering their own history and identity; Stanborough, 2023). Moreover, amnesia can be acquired during adulthood (i.e., at some point of their life, an individual can suffer from any kind of neurological disorder that led them to this condition) or developmental (i.e., the individual is affected by this condition since birth; Allen, 2018).

Since LTM is divided into episodic and semantic memory subsystems, patients had been described in whom either subsystem was selectively impaired (Wilson et al., 1995). Nonetheless, both episodic and semantic memory can be damaged if the causing lesions are extensive (as in the case of C, Wilson et al., 1995). Moreover, there might be cases of patients who have access to some components of semantic memory intact and some others spared, as it happens in associative visual agnosia (Farah, 1990, as cited in Wilson et al., 1995).

According to Allen (2018), memory loss is due to damage in different brain areas, but usually the regions affected the most are the hippocampus and the medial temporal lobes

(MTL). In fact, it has been found that the circuitry of MTL, including the hippocampus, along with cortical and subcortical structures, controls our episodic memory (Dickerson & Eichenbaum, 2009). Many studies led to this conclusion and the case of patient HM supports it (Allen, 2018).

2.1.1 PATIENT HM

In 1953, a young man (HM) who suffered from epilepsy got removed bilaterally his hippocampus, amygdala, and part of the association cortex of the temporal lobe through a surgery that was supposed to improve some seizures he had (Freberg, 2019; Figure 3). Unfortunately, after this operation, he started to suffer from global amnesia, because of the presence of both anteretrograde and retrograde amnesia. Nonetheless, the brain damage affected only his declarative memories, while the non-declarative ones were spared (Freberg, 2019). In fact, the studies carried out on HM definitely proved that the temporal lobes play a role in declarative memories, but not in the non-declarative ones (Freberg, 2019). Further studies proved that other cerebral areas govern non-declarative memories. For example, procedural learning is controlled by cortico-striatal systems, and, therefore, it can be compromised because of Parkinson’s and Huntington’s diseases (Dickerson & Eichenbaum, 2009).

According to Dickerson and Eichenbaum (2009), HM was a particular interesting case because he was suffering from a severe memory deficit with both anteretrograde and retrograde symptoms, while maintaining intact his very old memories and the other intellectual and personality characteristics. Moreover, it does not seem that his semantic memory was affected (Wilson et al., 1995).

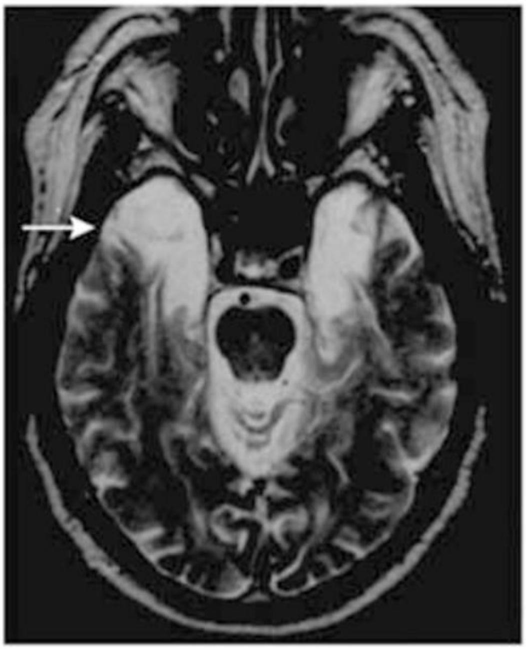

Figure 3. *Horizontal section, from a transverse MRI (Magnetic Resonance Imaging) of HM's brain, showing the surgical lesion (Dickerson & Eichenbaum, 2009).*

2.1.2 *PATIENT* C

The clinical case of patient C helped scholars understanding the association between brain structures and memory. C was a professional musician who suffered from severe global amnesia, following a herpes simplex encephalitis, in 1985 (Wilson et al., 1995). He had issues with both semantic and episodic memories, and he constantly believed that he had just woken up, whereas HM was aware that other days came before (Wilson et al., 1995). Moreover, C was showing confabulation, which was not the case with HM (Wilson et al., 1995).

The differences between the two patients (HM vs. C) can be explained through the anatomical analyses of their damaged brain areas: HM got removed only the mesial section of his temporal lobes, whereas the entire C's left temporal lobe and a part of the right temporal lobe were injured (Wilson et al., 1995). C preserved his non-declarative memory as HM did (i.e., C was still able to play music; Wilson et al., 1995). This result suggests that declarative and non-declarative memories are supported by different brain areas.

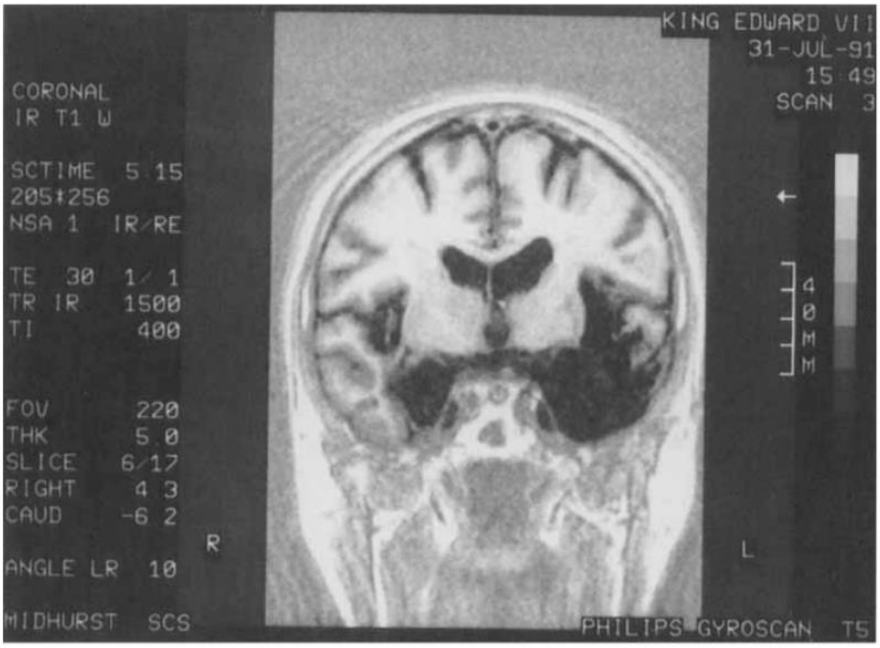

Figure 4. *Coronal view of MRI scan of C's brain, showing the lesions (Wilson et al., 1995).*

2.2 MEMORY DISORDERS AS PATHOLOGIC MEMORY PRESENCE

Usually, we associate the idea of having a memory disorder exclusively with amnesia and forgetting things, whereas we believe that remembering everything could be a sort of superpower. Nevertheless, psychologist William James stated that *"if we could recall everything, we would be as incapacitated as if we could not recall at all; a condition to remember is that we must forget"* (James, 1890, as cited in Fornazzari et al., 2018). According to this famous sentence, the scientific literature reports cases of people with amazing memory who were struggling as well as amnesic people do.

2.2.1 THE CASE OF SOLOMON SHERESHEVSKY

Luria (1967) reported the case of Solomon (Borri & Galfano, 2023; Fornazzari et al., 2018), a person who showed outstanding memory capacities (e.g., he was able to recall a list of words he had learnt 12 and 16 years before). Nevertheless, at the same time, Shereshevsky was suffering some executive deficits (Fornazzari et al., 2018). For instance, he was struggling to understand things that he could not see and that were not very concrete (Fornazzari et al., 2018). Moreover, he had troubles with comprehending poetry and metaphors, and he was struggling to understand abstractions (Fornazzari et al., 2018). According to Borri & Galfano (2023), his extraordinary memory was based on synesthesia (i.e., the ability that permits us to associate concepts through different sensory modalities).

Finally, Shereshevsky was not showing a remarkable ability for recalling autobiographical memories (Borri & Galfano, 2023).

Fornazzari et al. (2018) investigated the hypothesis that Shereshevsky was an undiagnosed case of autism spectrum disorder (ASD) - savant syndrome; in fact, he was showing ASD symptoms. For instance, Shereshevsky struggled with face recognition, and this might be a signal of the impairment in social interaction caused by ASD (Fornazzari et al., 2018). Indeed, sometimes, ASD people have different memory capacities compared to neurotypicals (Fornazzari et al, 2018). Fornazzari et al. (2018) argued that individuals with ASD might have MTL dysfunctions and this would provoke struggles with categorizing, abstracting concepts, and neurotypical memory; these were the same characteristics as those showed by Shereshevsky. Therefore, more research is needed to investigate the correlation between MTL, ASD, and hyper-memory in Shereshevsky (Fornazzari et al, 2018).

2.2.2 RECALLING AUTOBIOGRAPHICAL MEMORIES

Despite the efforts described for giving an explanation to Shereshevsky’s abilities, his skills have not been recognized as an independent syndrome. Brandt & Bakker (2018) defined him a “mnemonist” because of his amazing capacity of memorizing new information. Nonetheless, more recently, some scholars were able to prove that there is indeed a syndrome that does not involve forgetfulness; this syndrome is called hyperthymesia (Borri & Galfano, 2023). Differently from Shereshevsky, individuals with this syndrome can recall very accurately, exclusively, their life events, without using any mnemonic techniques or experiencing synesthesia (Borri & Galfano, 2023).

2.3 HYPERTHYMESIA

Hyperthymesia characterizes persons who show a Highly Superior Autobiographical Memory (HSAM, Parker et al., 2006). These individuals remember every detail of their personal experiences, even the more irrelevant and ordinary ones, without using mnemonics (Abiuso, 2023; Borri & Galfano, 2023; Brandt & Bakker, 2018). The term hyperthymesia has been coined by Parker et al. (2006), after having tested AJ (pseudonym of Jill Price), a middle-aged woman who had an astonishing ability for recalling her own past. The name comes from the Greek words “hyper”, meaning “more than normal”, and “thymesis”, meaning “remembering” (Parker et al., 2006). According to the definition of Parker et al. (2006), for being diagnosed with hyperthymesia, individuals must constantly ruminate their own memories and they must be able to recall very precisely events occurred to them.

Hyperthymesia is very rare and, thus, only 50 patients have been reported worldwide (Santangelo et al., 2021, as cited in Borri & Galfano, 2023). Unfortunately, a single specific test accepted by the whole scientific community for diagnosing this syndrome does not exist yet (Olivine, 2024). Nevertheless, specialists (i.e., either a neurologist or a psychologist) can use memory and cognitive tests combined with brain imaging tools and interviewing for understanding if an individual shows hyperthymesia (Olivine, 2024). For example, individuals can be tested using the Autobiographical Memory Test (Williams & Broadbent, 1986). In this test, participants must recall an autobiographical memory after having received a word with an emotional value as cue (Williams & Broadbent, 1986). Overall, there are 10 words and participants have a limit of 60 s to answer to each cue; the time taken by the participant to give answers is recorded (Williams & Broadbent, 1986). Furthermore, people can be tested by means of the Autobiographical Memory Interview (AMI; Kopelman et al., 1989), a tool that tests how well individuals remember their own lives; it comprises both general facts about a person's life and specific episodes (Brandt & Bakker, 2018; Kopelman et al., 1989). Moreover, scholars can use the Survey of Autobiographical Memory (SAM; Palombo et al., 2013; Sheldon et al., 2016); it has 26 items, and it is aimed to measure how well someone dwell with episodic, semantic, spatial, and imaginative future regarding autobiographical memory (Brandt & Bakker, 2018).

Another tool is the Public Events Quiz (Noone et al., 2014). This is a questionnaire of 30 items, where people are required to name dates of public events, likely known by the person, who is asked to specify in which day of the week those events occurred (Borri & Galfano, 2023). Regarding the neuropsychological tests, Parker et al. (2006) established that if Jill Price scored + 1.5 *SD* compared to controls, her performance was to be considered above average or perfect; thus, they considered the skills that scored + 1.5 *SD* as significant for diagnosing Price with hyperthymesia. Therefore, we could assume that this is the level people should reach for being diagnosed with hyperthymesia. Nevertheless, this has not been formally declared yet in the literature.

Moreover, neuroimaging tools, such as magnetic resonance imaging (MRI) can be used (Olivine, 2024); in fact, scholars that investigated hyperthymesia, such as Ally et al. (2013) and Brandt & Bakker (2018), used this technique to test whether individuals with presumed HSAM showed differences in brain areas. The main characteristics of hyperthymesia will be explained through two case studies, Jill Price (Parker et al, 2006) and MM (Brandt & Bakker, 2018).

2.3.1 JILL PRICE

The case of Jill Price was the first one to be documented (Parker et al, 2006). She sought professional help because she was experiencing the recollection of memories as intrusive thoughts, and these were bothering her emotionally (Borri & Galfano, 2023). During a conversation with Parker et al., she reported that the flow of her memories was perceived *“like a running movie that never stops”* (Parker et al., 2006), underlining its uncontrollability. According to Parker et al. (2006), it seems as if she had always the episodic retrieval mode active (i.e., when focusing on the past, one memory is interpreted as a cue to retrieve another memory).

The remembrances that Price was experiencing were defined by herself not as simple recollections, but as vivid memories she got aware of when she was 12, describing accurately the day when the memory occurred, the event and if something important happened (Parker et al., 2006). Moreover, her memory ability did not concern learning information such as series of numbers and she was not extremely talented for studying (Borri & Galfano, 2023; Parker et al, 2006). She used to keep a diary in which she was reporting all the events that happened in her life (Parker et al., 2006). Price declared that she felt the urge to write everything down, because otherwise her thoughts would have been stuck in her mind (Parker et al, 2006).

When Price contacted Dr. McGaugh, she was 34 years old (Parker et al., 2006). She reported that her first memory was from when she was only a toddler; she stated that she remembered her uncle’s dog awakening her in the cradle before age 2, and his brother’s birthday at age 3 (Parker et al., 2006). She added that after her family moved, when she was 8, her memories “changed” somehow; indeed, from that moment on, she started to relive her experiences and categorizing her memories (Parker et al., 2006). Between ages 8 and 13, she could not recall perfectly all the events, but she stated that after age 14 her memory became automatic (Ally et al., 2013; Parker et al., 2006). It is interesting noticing that a very similar timeline of developing hyperthymesia occurred also for HK, another HSAM patient studied by Ally et al. (2013). According to Bauer et al. (2007; as cited in Ally et al., 2013), these changes in the memories of Price and HK can be explained by the development of brain structures and neural connectivity.

Regarding her medical history, Price has complained migraines since her very early age (Parker et al., 2006). She also reported having suffered anxiety and even took medication for it and she reported having many phobias (e.g., doctors, birds, stage frights; Parker et al., 2006). Interestingly, she was able to recall when and what her phobias started to be such (Parker et al., 2006). Nevertheless, she claimed that these fears were not correlated with her memory issue, thus not being part of the cause of her syndrome (Parker et al, 2006). Moreover, she showed obsessive-compulsive features (e.g., since she was a child, she was feeling a sense of discomfort when her external environment was not in order; Parker et al., 2006).

For testing Price's autobiographical memory abilities, Parker et al. (2006) asked her many different dates expecting a recollection of what she did on that specific day. When this test was administered, Price never knew the dates beforehand and researchers had the opportunity to check the correctness of her answers with a diary she kept throughout her life (Parker et al., 2006). Price's performance turned out to be highly accurate (Parker et al., 2006). For example, when asked what she did on July 1, 1986, she was able to tell that it was a Tuesday and that she went to a restaurant with a friend (Parker et al., 2006). Again, she precisely said that October 3, 1987, was a Saturday and on that day, she hurt her elbow with a sling (Parker et al., 2006).

When Price was tested with neuropsychological tests, she showed some areas of strengths; her performance was defined as HSAM when her score was > 1.5 *SD* above average or perfect (Parker et al., 2006). For example, her performance was astonishing in the Autobiographical Memory Test (ATM; Parker et al., 2006; Williams & Broadbent, 1986); in fact, her raw score was 27/27 (Parker et al., 2006). Also, on the Wechsler Memory Scale-Revised (WMS-R; Weschler, 1987) she showed an extraordinary Visual Memory Index, reaching a raw score of 128 and a Z-score of 1.9 (Parker et al., 2006). Nevertheless, when her verbal memory was measured with the WMS-R it scored Z = 0.93, thus being within the normal range of 1.5 *SD* (Parker et al., 2006).

Despite she had some extraordinary abilities, it was interesting to notice that Price showed important deficits, as well (Z score > 1.5 above/below average; Parker et al., 2006). For example, she was impaired on the task of word-list recall of the California Verbal Learning Test (CVLT; Delis et al., 1987), which requires a lot of organization from the examinee to perform it correctly (Parker et al., 2006). She scored >-2.0, leading to label her performance as "impaired" (Parker et al., 2006). Moreover, Price struggled with creating concepts abstractly, as showed by the low Z-score of -2.3 of the Halstead Category Test

(Broshek & Barth, 2000), and with analogical reasoning, as showed by means of the Similarities subtest of the Wechsler Adult Intelligence Scale-R (WAIS-R; Parker et al., 2006; Weschler, 1981) for which she scored Z = -1.6 (Parker et al., 2006).

These findings proved that her skills were highly selective, and that her extraordinary memory ability was restricted only to her autobiography (Parker et al., 2006). According to Parker et al. (2006), the results of the neuropsychological tests suggested that poor executive functions in abstraction, reflection, and inhibition might be correlated, and be the cause of her hyperthymesia. In fact, Parker et al. (2006) proposed the hypothesis that Price suffered a kind of disinhibition that was preventing her to *"switch off"* her own memories.

Parker et al. (2006) observed that when they asked Price about recalling her own memories (e.g., talking about one of her schoolteachers) she was clearly happy and talked in a very involved and touching way. By contrast, Price was upset when she could not correctly complete a task (e.g., she did not enjoy the Halstead Category Test; Parker et al., 2006). Moreover, she never showed signs of lying, because when she was not able to answer a question, she simply admitted it (Parker et al., 2006). As an explanation for these memory blanks, Price stated that she did not remember things that she was not interested in (Parker et al., 2006). Finally, she never showed confabulations (Parker et al., 2006).

Based on Price's performance on the neuropsychological tests and on the available scientific literature, Parker et al. (2006) advanced the hypothesis that the cause of hyperthymesia was to be found in a sub-type of neurodevelopmental, fronto-striatal disorder that Price might have had. Parker et al. (2006) argued that this syndrome includes obsessive-compulsive disorder (OCD) and ASD. Even though Price did not meet the criteria for these diagnoses, she showed some similarities (Parker et al., 2006). Nevertheless, Parker et al. (2006) claimed that it was also possible that the relation between Price's memory and her neuropsychological deficits was only correlative, and that more research on HSAM individuals was needed to confirm it.

2.3.2 MM

MM was called the "Amazing Memory Man" for his striking memory capacities (Brandt & Bakker, 2018). For this reason, he was diagnosed with HSAM (Brandt & Bakker, 2018). At the time of his evaluation, MM was 63 years old, and he was unmarried (Brandt & Bakker, 2018). He was particularly interested in the Olympics Games, especially athletics, and history; he was able to recall with high accuracy facts and dates regarding these topics (Brandt & Bakker, 2018), showing how persons with HSAM easily recall facts that have a personal relevance to them (Borri & Galfano, 2023). For example, when MM was asked what happened on May 18, he correctly reported that Pope John Paul II and Brooks Robinson were born in that day, in 1920 e 1937 respectively (Brandt & Bakker, 2018). Furthermore, regarding events linked to his personal life, he was able to recall all the 15 addresses of the houses he lived in for at least 6 months (Brandt & Bakker, 2018). MM reported to not experiencing eidetic imagery, not having calendrical skills, as people with ASD-savant syndrome might have, and not studying to learn the information he remembered (Brandt & Bakker, 2018).

MM did not report having parents with extraordinary memory abilities (Brandt & Bakker, 2018). Brandt and Bakker (2018) commented that he suffered from major depressive disorder (MDD), and he also experienced anxiety. Nevertheless, at the time of the evaluation, he was being treated (Brandt & Bakker, 2018). Furthermore, MM showed some obsessional features, such as overthinking about historical and sports facts (Brandt & Bakker, 2018). Nevertheless, he did not present proper OCD clinical characteristics (Brandt & Bakker, 2018). According to his Personality Assessment Inventory (PAI; Morey L. C., 2007) profile, he did not show any psychiatric disorder (Brandt & Bakker, 2018). Brandt and Bakker (2018) claimed that there was no sure correlation between MM's psychiatric condition and his exceptional memory.

For testing his autobiographical memory, MM was tested with the AMI (Brandt & Bakker, 2018; Kopelman et al., 1989); he reached excellent results, ranging from 90.5% to 100% of accuracy (Brandt & Bakker, 2018). Moreover, he was tested with the SAM (Palombo et al., 2013; Sheldon et al., 2016), and while the means were 100, he scored 123 in the episodic and semantic sections, 112 in the spatial area, and only 91 in future remembering (Brandt & Bakker, 2018). The results on this test proved that MM was amazing in recollecting personal and general life events, whereas he was not exceptional in future thinking (Brandt & Bakker, 2018).

MM was tested also for generic memory abilities (Brandt & Bakker, 2018). For example, he was tested with the Presidents Test (Hasmher & Roberts, 1985), in which participants are required to recall all the names of the United States of America's Presidents (Hasmher & Roberts, 1985). MM correctly reported all the names required in reverse order, while, on average, people reported only the first 3 or 4 Presidents and the last 7 or 8 (Brandt & Bakker, 2018). Furthermore, MM was asked to match a random date to a historical fact that he remembered happening on that specific day (Brandt & Bakker, 2018). He replied correctly 27/30 of times, usually matching more than only one historical fact for each date, and sometimes he even added a personal episode (Brandt & Bakker, 2018). For example, he correctly stated that, on July 21, the Battle of Bull Run happened in 1861 (Brandt & Bakker, 2018). He also added that, on the same day in 1987, his mother passed away and that the singer who wrote his favorite song was born on the same day in 1948 (Brandt & Bakker, 2018).

Differently from Price, MM was able to recall events that happened long before his birth that were not directly connected to him (Brandt & Bakker, 2018). By contrast, he was not always capable to remember vividly details of his adulthood (Brandt & Bakker, 2018). For example, he was struggling to precisely recall the weather or what he had eaten on a specific day (Borri & Galfano, 2023). Nevertheless, he could still be diagnosed with HSAM; Borri & Galfano (2023) argued that MM might have been oriented more on dates, than on details, because of his anxiety and OCD characteristics, that are usually showed in HSAM individuals. These old events might have played a relevant role in his personal life and, therefore, they might having been easily remembered (Borri & Galfano, 2023). Furthermore, according to the tests administered by Brandt and Bakker (2018), MM showed similar results to those of Price (e.g., average intelligence, high percentage of correct answers in memory tests). Moreover, Brandt & Bakker (2018) argued that according to the theory proposed by Conway and Pleydell-Pearce (2000, as cited in Brandt & Bakker, 2018), our autobiographical memory is organized in levels (i.e., personally relevant times, general life events, specific episodes). Accordingly, MM's mind seems to join very easily personal facts with historical events, moving from one level to another without difficulties; this should explain MM's extraordinary recalling (Brandt & Bakker, 2018).

2.3.3 NEURAL CORRELATES

2.3.3.1 MORPHOLOGICAL PECULIARITIES

Scholars have investigated whether the brain structures underpinning HSAM individuals differ from that of controls, through techniques of structural neuroimaging (Borri & Galfano, 2023). First, it is important to underline that striking neuroanatomical differences have not been found yet (Brandt & Bakker, 2018; Borri & Galfano, 2023). Nevertheless, some areas known for playing a role in memory circuits have been noted to look unusual. For example, LePort et al. (2012, as cited in Borri & Galfano, 2023) found that some areas, such as the temporal gyri, the insular cortex, and the para-hippocampal gyri, have different shapes and dimensions in HSAM individuals compared to controls.

Ally et al. (2013) reported a case study (HK) whose amygdala -especially the right one- was hypertrophic: its volume was found to be fractionally larger (18 +/- 6%) compared to controls (Figure 3). Amygdala is recognized as the brain area that encodes autobiographical memories (Greenberg et al., 2005; Spreng & Mar, 2010; as cited in Ally et. al, 2013) and it adds biological and social meanings to our memories (Markowitsch & Staniloiu, 2011; as cited in Ally et al., 2013). According to Neufang et al. (2009, as cited in Ally et al., 2013), an individual's amygdala increases its volume from 11 to 13 years of age; interestingly, during this time frame HK showed an enhanced accuracy in the recalling of his autobiographical memory (Ally et al., 2013). Moreover, Muscatell et al. (2010, as cited in Ally et al., 2013), declared that the right amygdala-hippocampus connectivity (showed as high by HK; Ally et al., 2013) to medial prefrontal regions play an important role for encoding self-relevant memories.

This high amygdala-hippocampus connectivity probably led HK to process information in a more self-relevant way, compared to controls (Ally et al., 2013). Moreover, the larger amygdala's size led HK to process the 90% of his own memories from a first-person viewpoint (Ally et al., 2013), whereas controls experience only the 66% of memories in the first person (Sutin and Robinson, 2008, as cited in Ally et al., 2013). Therefore, it is highly probable that amygdala plays an important role in the enhanced recalling of autobiographical memory, that is typical of hyperthymesia, but more studies are needed to confirm even more this hypothesis (Ally et al., 2013). In fact, HK presented blindness, and it is important to assure that his particular condition did not influence the findings (Ally et al., 2013). Thus, future studies should compare neuroanatomical and functional connectivity differences between HK and born blind people with standard autobiographical memories (Ally et al., 2013).

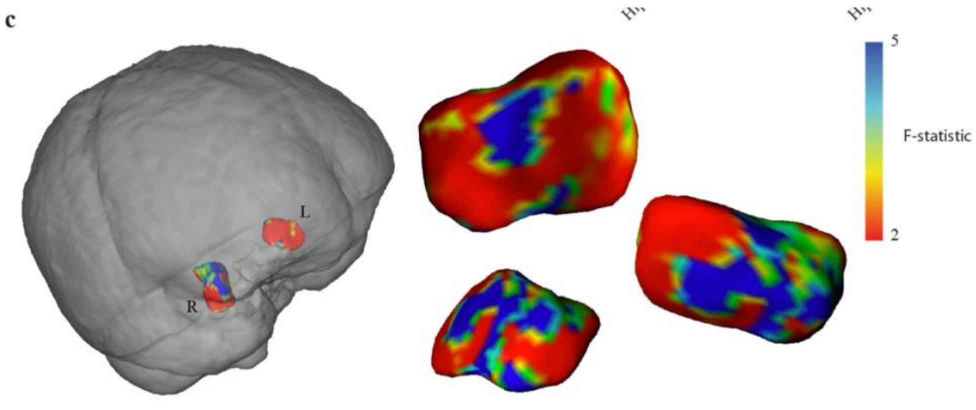

***Figure 3.** On the left, HK's amygdala volume seen on standard space brain atlas. In the center, the HK's right amygdala is shown from three different perspectives; the hypertrophic areas are those depicted in blue and green. On the left, the F-statistics shows how HK's amygdala has a larger volume compared to controls (Ally et al., 2013).*

Brandt and Bakker (2018) reported that MM showed a larger right temporal pole, a smaller right perirhinal cortex, a smaller left entorhinal cortex, and a deeper and wider collateral sulcus (Figure 5A), along with the left perirhinal and entorhinal cortices with a circular section of gray matter surrounded by some white matter (Figure 5B).

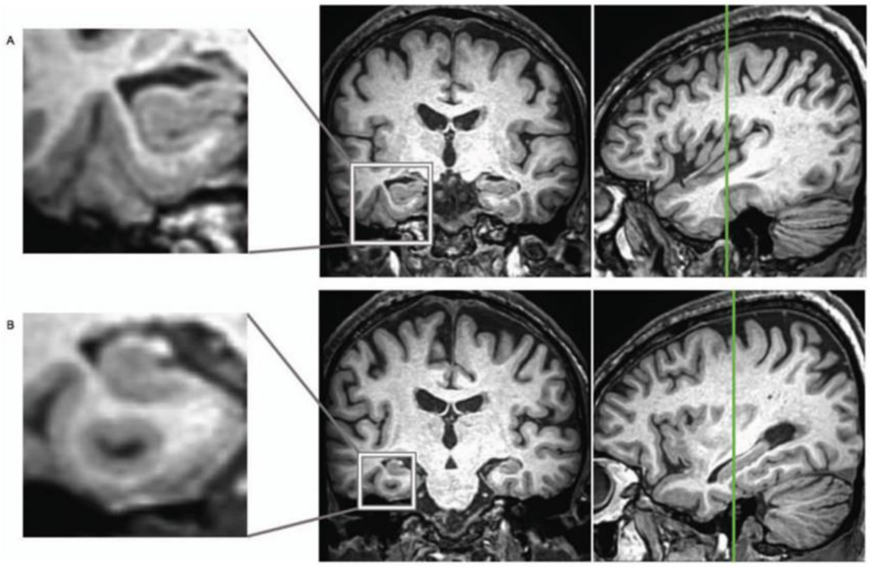

Figure 5. *This section of MM's left medial temporal lobe shows a wider collateral sulcus (Figure 5A) and a round of grey matter encircled in a band of white matter (Figure 5B). The images more on the left show a zoomed version of the interested regions. The central images present a coronal view of the left medial temporal lobe. Finally, the images on the right side have a green line that highlight, respectively, the location of the collateral sulcus (Figure 5A) and the circle of grey matter (Figure 5B), from a sagittal perspective (Brandt & Bakker, 2018).*

In conclusion, even though some brain abnormalities have been, indeed, found in the brain of HSAM individuals, one cannot sustain that they play a significant role for explaining the cause of hyperthymesia (Borri & Galfano, 2023). Nevertheless, the presence of the abovementioned abnormalities can open the path for further studies to investigate better the phenomena underlying hyperthymesia, and to see if they can provide a satisfactory clarification (Brand & Bakker, 2018). Furthermore, conducting more research on the structural brain differences of HSAM individuals might help us finding new therapeutic approaches for memory disorders (Ally et al., 2013).

2.3.3.2 NEURAL CONNECTIVITY

Scholars have investigated the presence of biomarkers across memory networks with techniques of functional neuroimaging. These findings are considered now as more informative than those obtained with structural neuroimaging, because they show those brain areas that are more activated during memory retrieval (Borri & Galfano, 2023).

Santangelo et al. (2018, 2020, 2021; as cited in Borri & Galfano, 2023) reported that HSAM individuals showed an enhanced activity compared to controls in the temporo-parieto-frontal cortex (including prefrontal ventromedial and dorsolateral cortexes, hippocampal region, insular cortex, angular gyri, and temporo-parietal junction), which controls the stage of memory access. This might be evidence that the brain of HSAM individuals is highly active during this stage, along with the fact that the angular gyri (which are usually active when we re-experience a memory) might be activated spontaneously, at the same time, when the HSAM individuals access their memory (Borri & Galfano, 2023).

The hippocampus has been highly studied because of its known relevance in the memory circuitry. First, through functional MRI scans, Brandt and Bakker (2018) discovered that patient MM showed high connectivity between the left hippocampus seed and the frontal cortex (Figure 6). Brandt and Bakker (2018) argued that this finding could explain why MM used to make links between personal and public facts, when there was not apparent connection between them. Second, investigating the hippocampus through functional neuroimaging helped understanding also why HSAM individuals struggle with identifying contextual-relevant information leading them to print everything indistinctly in their memory (Borri & Galfano, 2023). In fact, as reported by Daviddi et al. (2022; as cited in Borri & Galfano, 2023), the way in which the hippocampus of HSAM individuals establishes functional connectivity with other brain areas can be crucial. For example, their hippocampi show a low connectivity with the cingulate cortex, the temporo-parietal junction, and the inferior temporal gyri, that are all structures implied in elaborating relevant characteristics for the task (Borri & Galfano, 2023). Furthermore, the hippocampus of HSAM individuals show a high connectivity with the fusiform and the inferior temporal gyrus, that are responsible for the high level of sensory elaboration (Borri & Galfano, 2023).

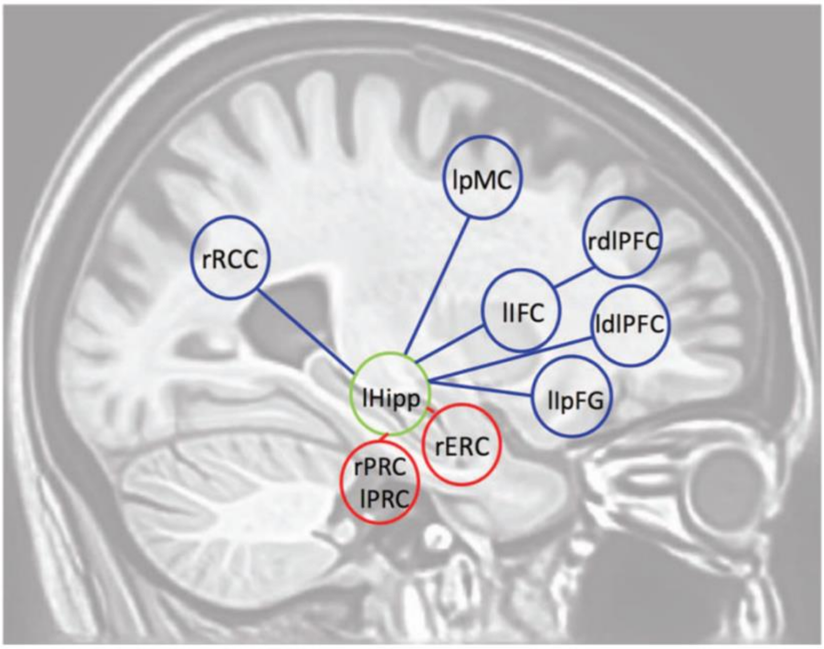

Figure 6. *Here it is shown how the left hippocampus of MM had an enhanced connectivity with the prefrontal cortex. In fact, all the areas linked with blue lines show higher connectivity, whereas those linked with red lines depict a decreased functional connectivity (Brandt & Bakker, 2018).*

Mazzoni et al. (2019) carried out a study on BB, showing a high activation of the precuneus (Figure 7) during the phases of access and elaboration of memory. This finding is interesting linked to the fact that BB was describing his memory as having a significant visual component and as being highly self-relevant (Mazzoni et al., 2019). Indeed, the precuneus is considered as an area involved both in visual memory and in specific retrieval of personal information (Addis, Moscovitch et al., 2004a; Addis, McIntosh, Moscovitch et al. 2004b; Fletcher et al., 1996; Gardini et al., 2005; Gardini et al., 2006; Rugg, 1995. All as cited in Mazzoni et al., 2019).

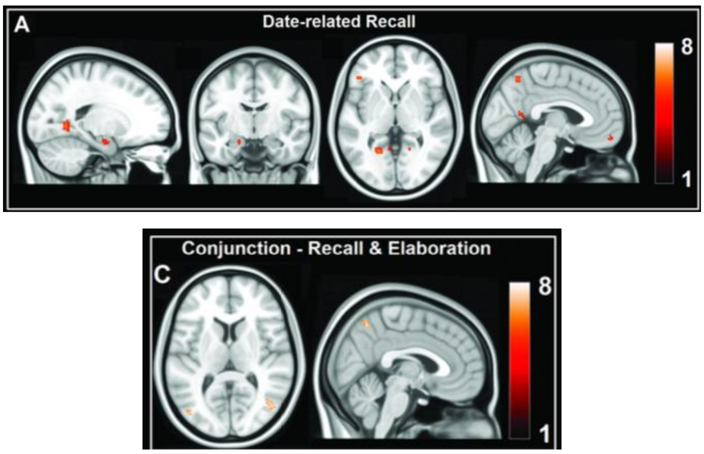

Figure 7. *Pattern of activation regarding different memory processes where the precuneus look highly activated. The results are in z scores and the color bar explains the color coding (Mazzoni et al., 2019).*

Ally et al. (2013) argued about the easiness with which information is processed as self-relevant, by stating that it is probably due to the right amygdala-hippocampus high connectivity showed by HK mentioned above (Figure 8). Nonetheless, Mazzoni et al. (2019) argued that the blindness, by which HK was suffering since his birth, might have changed some brain structures and the process of encoding memory, making it difficult to discern what is due to HSAM and what to blindness. Therefore, according to Mazzoni et al. (2019), the findings of Ally et al. (2013) are not exhaustive for explaining hyperthymesia. Thus, further studies are needed to support the results.

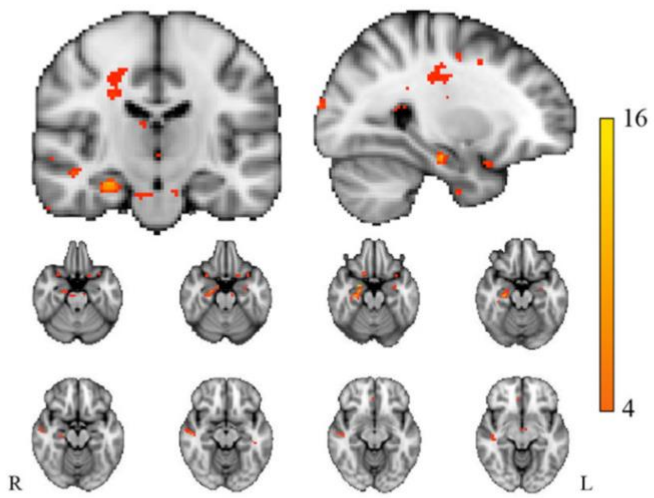

Figure 8. *Increased functional connectivity between the right amygdala and the right hippocampus of HK from coronal, sagittal and axial perspectives. (Ally et al., 2013).*

Overall, it is important to remember that the studies by Ally et al. (2013), Brandt and Bakker (2018), Daviddi et al. (2022; as cited in Borri & Galfano, 2023), and Santangelo et al. (2018, 2020, 2021, as cited in Borri & Galfano, 2023) have been conducted with a small sample of HSAM individuals. Therefore, one should be cautious in generalizing, and, thus, further studies should be carried out. Moreover, as Mazzoni et al. (2019) warned, during autobiographical memory retrieval the brain regions that are activated can vary among persons with no exceptional memory, leading us to consider these results carefully. Nevertheless, it is probable that changes in functional connectivity can play a role in hyperthymesia (Brandt & Bakker, 2018). For example, it is unlikely that such a marked difference about neural connectivity between MM and controls is due to chance, because if this was the case the distribution of brain areas would have been less specific (Brandt & Bakker, 2018). Furthermore, the brain areas that have been listed for having a different kind of connectivity with the left hippocampus compared to controls (i.e., cingulate, perirhinal and entorhinal cortices) have been already proved to be involved in memory processes (Brandt & Bakker, 2018).

2.3.4 MNESTIC FUNCTIONING

Importantly, people with HSAM show a high selectivity regarding their ability because the capacity to remember information strictly concerns only their autobiographical experiences (Borri & Galfano, 2023). For investigating the mnestic mechanisms leading HSAM individuals showing their astonishing mnestic ability, Patihis (2016; as cited in Borri & Galfano, 2023) conducted a study proving that the difference among HSAM individuals and controls, regarding their imaginative absorption (i.e., tendency of being highly interested in unreal scenarios), was significant in the difference they have regarding memory abilities.

From the case study of Jill Price, we know that the memory of HSAM individuals works in an associative way (i.e., all the recollections that they make are connected to one another leading to an automatic retrieval of high amounts of information; Parker et al., 2006). This has been further proven in a study by Patihis et al. (2013) regarding the development of false memories in HSAM individuals. If they were presented with target words that were semantically linked, in a couple of minutes, people with HSAM would automatically associate another semantically connected word that was not actually presented to them (Patihis et al., 2013, as cited in Borri & Galfano, 2023). The results of this study confirmed the associative mechanism noticed by Parker et al. (2006) and they also suggest that HSAM individuals are not immune from false memories (Borri & Galfano, 2023; Patihis et al, 2013).

2.3.5 THE RELATION BETWEEN HSAM AND OCD

Marcus (2009) argued that the exceptional memory of Jill Price was due to her unvoluntary obsession of rehearsing her autobiographical memories, implying that she would show more a type of OCD for her own memory rather than a memory syndrome. Saying this, Marcus (2009) did not discuss Price’s memory ability but debated its cause. Moreover, obsessional features have been also found in other HSAM individuals, as MM (see Brandt & Bakker, 2018).

These last considerations might suggest that OCD is a necessary trait for having hyperthymesia. Nevertheless, Mazzoni et al. (2019) reported the case of BB, a 20-year-old, male student who was showing HSAM without any OCD characteristics. The findings of Mazzoni et al. (2019) support the idea of this thesis, according to which hyperthymesia may be enhanced by obsessions and rehearsal of autobiographical memory, but it is not based on them. Moreover, Mazzoni et al. (2019) stated that BB's performance on executive tasks was brilliant, rejecting the hypothesis that a neurodevelopmental disorder linked to the dysexecutive syndrome, showed by Price (Parker et al., 2006), is a prerogative of hyperthymesia.

3.6 NEVER FORGETTING IS A BURDEN, NOT A GIFT

According to the findings listed above, it is clear that hyperthymesia does not make life easier. In fact, it does not help people to better memorize concepts at school and, paradoxically, it might lead individuals to lose time because they are constantly worried by thinking on their past (Parker et al, 2006). As Parker et al. reported (2006), Jill Price had a controversial relation with her condition. In fact, she believed that her unstoppable thinking had both a *"soothing"* and a *"burdensome"* spirit (Parker et al., 2006). Nevertheless, the times when she complained about her peculiar capacity far exceeded the times when she stated to enjoy it (Parker et al, 2006). For supporting the thesis that having this condition is a weight for the people who are affected by it, we report some Price's sentences (Parker et al. 2006):

"My memory has ruled my life"

"I run my entire life through my head every day and it drives me crazy!!!"

Clearly, these phrases state the discomfort Price was experiencing for living with her syndrome.

Price is not the only case who reported unpleasant feelings towards her HSAM. Indeed, also MM stated that the horrible things that happened in his life are constantly stuck in his head (e.g., the death of his mother), and that this makes him feel the syndrome as a handicap (Brandt & Bakker, 2018). Nevertheless, in general, MM had a better view than Price, because he believed that, on balance, his memory was a gift (Brandt & Bakker, 2018).

Even when a superior memory ability is not exclusively concerned about remembering autobiographical information, it does not seem helpful in daily life. In fact, taking the example of the mnemonist Shereshevsky, he experienced executive functions deficits (Fornazzari et al., 2018) that were creating him troubles in understanding metaphors and what he was reading (Fornazzari et al., 2018; Parker et al., 2006). As a probable consequence, Shereshevsky changed jobs repeatedly (Parker et al., 2006).

Many studies have supported the need of oblivion and the positive implications that it can have on individuals. Abiuso (2023) argued that if people can oversee the emotional impact of their memories, they can regulate better their own feelings and reduce the negative ones. Based on this viewpoint, it can be argued that MM was not able to regulate his emotions, regarding his mother's death, and that if he could lower the emotional charge of this event and, somehow remembered it less, he would have lived happier.

Again, with forgetting old memories, the mind would be clearer, and people could enhance their abstract and creative thinking (Abiuso, 2023), an area that is sometimes lacking in HSAM individuals. Finally, Abiuso (2023) reported some oblivion mechanisms that can be useful in managing the recollection of memories through a selective process. Nørby (2015, as cited in Abiuso, 2023) proposed a technique of active oblivion, named suppression-induced forgetting (SIF): by stimulating mechanisms of inhibitory control, individuals can suppress the memory that the environmental stimuli usually elicit spontaneously (Abiuso, 2023).

Overall, hyperthymesia makes the lives of the individuals who suffered from it more difficult, and it should be seen as a disorder and not as a super-power. As humans, forgetting is necessary to clean our minds and make our cognitive functions work better.

CHAPTER 3:

CRITICAL CONSIDERATIONS

3.1 RECENT RESEARCH ON HYPERTHYMESIA

3.1.1 A PHENOMENOLOGICAL PERSPECTIVE FOR ACHIEVING A THERAPY FOR HYPERTHYMESIA

Baglieri (2020) stated that oblivion is therapeutically necessary to remember our own memories without being their prisoners. According to Baglieri (2020), experiencing the finitude of life is essential for avoiding the struggles with living in the present and projecting towards the future that HSAM individuals usually experience. In fact, as humans we experience the world in a temporal way (Baglieri, 2020). This way of thinking shapes our living body and language (Baglieri, 2020). Through oblivion, that is memory's natural limit, and through the selection of relevant memories, people can control better their lives (Baglieri, 2020). According to the existential analysis (*Daseinanalyse*), time is not measured with a clock, but rather through how we live our experiences and memories (Baglieri, 2020). In this framework, HSAM individuals seem to not accept temporality and not leaving apart unnecessary memories (Baglieri, 2020).

By considering this phenomenological perspective, it is interesting to remember that Jill Price herself kept a diary with all her memories (Baglieri, 2020). In this way, on one hand, memories become immortal, somehow escaping the necessary flowing of Time (Baglieri, 2020). On the other hand, while she was narrating, she had the possibility to select her own memories, deciding which one keeping for the purposes of the narration and which ones leaving apart (Baglieri, 2020). Nevertheless, Price did not find her writing as therapeutically and she kept struggling with her inability of selecting her own memories until she verbalized her memory issues in psychotherapy (Baglieri, 2020). In fact, according to this perspective, psychotherapy and existential analysis can be valid therapeutic approaches because they helped Jill Price herself to let time flow and live her own temporality (Baglieri, 2020). By narrating to someone else (i.e., a psychotherapist) her own history, Price felt relieved because she left herself to "*dive into her own temporality*" (Baglieri, 2020). Because Price has been helped by this approach, psychoanalysis and existential analysis can be seen as valid therapies for HSAM individuals (Baglieri, 2020).

3.1.2 GENETIC STUDIES

Some scholars have argued that hyperthymesia might have a genetic component. For example, it has been discovered that HSAM individuals show the apolipoprotein E2 (APOE2), an allele of the gene APOE, that is involved in the enhancement of working memory and might be involved in the development of the syndrome (Chia & Shu, 2018). Moreover, it has been found that children can also show this syndrome; the Center for the Neurobiology of Learning and Memory at the University of California, Irvine (UCI), with a research group of Harvard University have, therefore, started to carry on some genetic studies in twins (Center for the Neurobiology of Learning and Memory, 2017). For trying to involve as many participants as possible in the study, on the website of the Center for the Neurobiology of Learning and Memory of UCI, parents whose children seem to show HSAM characteristics can fill a form to contribute to the investigation of hyperthymesia (Center for the Neurobiology of Learning and Memory, 2017).

3.1.3 SEVERELY DEFICIENT AUTOBIOGRAPHICAL MEMORY (SDAM)

Palombo et al. (2015) discovered that, while people who suffer from hyperthymesia present an enhanced recalling of personal memories, there are also persons who show the opposite pattern. In fact, Palombo et al. (2015) studied three individuals who presented impairment in recollecting personal events from their own viewpoint in absence of any neurological disease. After a detailed investigation, Palombo et al. (2015) stated that these persons were affected by a syndrome termed “severely deficient autobiographical memory” (SDAM).

SDAM can be linked to HSAM because these two syndromes represent the two extremes of episodic memory (Palombo et al., 2015). Moreover, both conditions are strictly selective for the domain of autobiographical memory, and apparently, they develop without neurological damages (Palombo et al., 2015). Despite the deficit of recollecting personal events, people affected by SDAM do not show major shortfalls regarding other cognitive abilities (Palombo et al., 2015). The only impaired faculty reported was visual memory (Palombo et al., 2015), that is, interestingly, one of the areas of strengths of HSAM individuals (Parker et al., 2006).

3.2 UNDERSTANDING HYPERTHYMESIA TO TREAT MEMORY DISORDERS

Santangelo et al. (2022, as cited in Borri & Galfano, 2023) argued that studying HSAM might give insights for finding new therapeutic approaches for treating other memory disorders that have forgetfulness as their major symptom. Santangelo et al. (2021, as cited in Borri & Galfano, 2023), investigated whether HSAM people can suffer from cognitive deterioration. Findings showed that aging does not affect their memory abilities (Santangelo et al., 2021, as cited in Borri & Galfano, 2023). Therefore, future research should be aimed to analyze how mnestic deterioration takes place in normal individuals, for discovering compensating mechanisms that can help to avoid mnestic deterioration (Santangelo et al., 2022, as cited in Borri & Galfano, 2023).

3.2.1 LOOKING FOR THE CURE FOR ALZHEIMER'S

Price herself, while talking with Dr. McGaugh, expressed her wish that studying her syndrome could lead scholars, one day, to discover the cure for Alzheimer's disease (Rodriguez McRobbie, 2017). People suffering from Alzheimer's disease struggle with remembering and have deficits especially with episodic memory (Freberg, 2019). Eventually, they end up developing dementia (Freberg, 2019). The cerebral cortex of Alzheimer's patients show atrophy because of neuronal degeneration (Freberg, 2019). This is due to neurofibrillary tangles made up by detached tau molecules, that endanger microtubules' structure making the neuron to breakdown (Freberg, 2019). Moreover, in Alzheimer's patients, cholinesterase is overly produced making the tau proteins to tangle and the beta amyloid to form blockages causing the neuron's death (Chia & Shu, 2018). Furthermore, the formation of protein blockages is promoted by the apolipoprotein E4 (APOE4), a gene's allele that controls neural pruning and maintenance (Lindsey et al., 2017, as cited in Chia & Shu, 2018).

Scholars discovered that the above-mentioned apolipoprotein E2 (APOE2), present in HSAM individuals, fight neurons pruning and can counterbalance APOE4's effects (Sinclair et al, 2015, as cited in Chia & Shu, 2018), therefore, helping people with Alzheimer's (Chia & Shu, 2018). In fact, from this finding, scholars started to hypothesize that studying hyperthymesia could be essential for understanding how to use E2 (APOE2) to treat Alzheimer's through a genetic based therapy (Chia & Shu, 2018). Much research is still needed to understand how this allele could contribute to fight Alzheimer, but the premises are promising (Chia & Shu, 2018).

3.3 DIGITAL HYPERTHYMESIA

With the aim of supporting the thesis that forgetting is a healthy cognitive process and that remembering everything has not a positive connotation, we briefly present the case of digital hyperthymesia (i.e., the digital recording of all our memories, Van Bree, 2016). Interestingly, the concept is not strictly related to psychology, and it is presented here with the purpose of highlighting how much hyperthymesia can have an impact in many different fields and the necessity of forgetting has become a cultural issue.

Van Bree (2016), a digital designer, created the term “digital hyperthymesia” inspired by the story of Jill Price. Because of the known struggles which Price had for dealing with her exaggerated memory, Van Bree (2016) wondered if our society would have suffered similar consequences for not being able to forget because of a perfect digital recording of our lives.

All our memories could be stored in a technological device that we can access all the time (hard disks, pen drives, cloud stores, etc.; Van Bree, 2016). Therefore, we do not need to put effort in remembering facts, because we simply need to look for them in external storage devices to easily find them (Van Bree, 2016). According to Van Bree (2016), in this way, we use a passive method of remembrance, because we do not “own” anymore our memories, but we simply get to know where to find them in an external device.

To go back to an active way of remembering things, Van Bree (2016) designed “digital forgetting”. With this aim, she proposed “Artificial Ignorance”, an application that only gives “memory cues” about what the person asks to the device, without showing immediately the original data the person was looking for (Van Bree, 2016). For instance, if the person wants to see a digital photo, the application will simply show pictures that are similar to the photo requested, for stimulating the person’s mind to find by itself the memory about the original photo (Van Bree, 2016). The aim of Van Bree (2016) was multiple. First, she wanted to raise awareness about the issue of digital hyperthymesia. Second, she wanted to encourage people to strive to continue practicing the art of memory. Finally, she wanted to decrease the amount of digital data that daily overwhelms information designers (Van Bree, 2016).

According to this view, our concept of memory is devalued if we do not trust anymore our own memory and we put all our information in an external machine that will work for us (Van Bree, 2016). Moreover, if we undervalue that much our own memory, we go against our own ancestors’ cultural milestones. For instance, the Ancient Greeks believed that memory was extremely important, because it was believed to be the “art of thinking” (Van Bree, 2016).

3.4 HYPERTHYMESIA AND THE RIVER LETHE

As we argued several times, throughout this thesis, forgetting is necessary for living. The ancient Greek myth of Lethe and Mnemosyne, as it is narrated in the *Repubblica* by Platon (as cited in Sabater, 2023), helps explaining this point. According to the myth, in the Afterlife, there were two rivers, one named Lethe that made people forgetting things, and the other one named Mnemosyne that helped people remembering (Sabater, 2023). It was believed that the dead souls used to drink Lethe’s water to forget their own lives and to be able to reincarnate and live again (Sabater, 2023). Moreover, Ancient Greeks believed that the Lethe’s effect lasted until the first years of life of an individual. In this way, Ancient Greeks were explaining our inability to recollect our very first memories (Sabater, 2023).

This ancient belief has been explained by science, with the neural pruning that occurs as a natural and necessary process in newborns’ brains for assuring a correct development (Sabater, 2023). In fact, through this act of modeling the brain has more cognitive strength, even though the price is losing some memories (Sabater, 2023). Deleting information is in fact essential for functionally adapt to an environment (Sabater, 2023). From this example, it is clear how the act of forgetting is structurally inherent in our own culture, with a positive value, and that it has been proved as healthy by the current science.

Keeping the metaphor of the two rivers, Sabater (2023) stated that Mnemosyne’s water was drunk by individuals with HSAM, making them remember every single detail of their life. Nonetheless, this does not help them, but on the contrary the constant rehearsal of their memories provokes, in them, mental exhaustion (Sabater, 2023). As Sabater (2023) argued, drinking the water from Mnemosyne’s river is important for learning, but only by drinking from Lethe’s, our brain can be modeled functionally and can lead us to advance as a species.

3.5 CONCLUSIONS

We argue that living with hyperthymesia is not a gift, but rather is a burden that prevents the individuals to develop themselves and live fully their own lives. From the struggles experienced by Jill Price and the other HSAM individuals, through the need of oblivion, and the proof of forgetting as a natural part of neural pruning, we believe to prove that forgetting is essential for living. Ideally, everyone should be able to experience the right balance between the rivers of Mnemosyne and Lethe.

Considering what has been analyzed in this thesis, it is clear that much research is still needed to fully understand hyperthymesia. The small sample of HSAM individuals is certainly a limitation, while studying this syndrome. We suggest that the scientific community educates more the general population about hyperthymesia for making them aware and go to get tested. In fact, if more HSAM cases will be found, it will be easier generalizing the findings and improving diagnostic criteria, outcomes, and therapeutic approaches for hyperthymesia. Only in this way it can be established without doubts which are the causing factors of the syndrome and diagnose it accurately.

In addition to compare the results among case studies, it would be crucial applying the same methods and tests to all of them. Only in this case it would be possible to state for sure which are the correct diagnostic tools. In fact, we noticed that Ally et al. (2013), Brandt & Bakker (2018), Mazzoni et al. (2019), and Parker et al. (2006) did not always use the same tests to test the superior memory abilities of their participants. For example, the SAM (Palombo et al., 2013; Sheldon et al., 2016) was administered to MM, but not to Jill Price.

By keeping investigating, promising results might be achieved with more neuroanatomical and neural functional analysis as those mentioned in Chapter 2. Finally, genetic studies on HSAM individuals, could help us to find treatments for memory disorders.

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