

Better memorization techniques: taking into account personality nuances**Técnicas para uma melhor memorização: levando em consideração as nuances da personalidade**

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ABSTRACT

A common complaint today is the lack of memory. Technology contributes to this difficulty in storage of information due the dysfunctions on our neurotransmitters, a result of the daily habits of the present times that affect one of the determining factors for the memorization that is the attention. On this article I detail the path to memory and techniques to obtain a better memorization. It is crucial to locate the source, root, and origin to understand the whole process as well as the ADHD and similarities that impair the capacity to obtain and maintain information. Research and experiments were necessary to prove these techniques, that can be used to avoid the need of using medicines.

Keywords: Memory, Neurotransmitters, Neurons, Neuroplasticity**RESUMO**

Uma queixa comum nos dias de hoje se prende com a falta de memória. A tecnologia contribui para esta dificuldade no armazenamento das informações devido às disfunções nos neurotransmissores, resultado dos hábitos cotidianos dos tempos atuais que afetam, inclusive, um dos fatores determinantes para a memorização que é a atenção. Neste artigo detalho o caminho para a memória e técnicas para obter uma melhor memorização. É determinante localizarmos a fonte, a raiz e a origem para compreender todo o processo assim como o transtorno TDAH e similaridades que prejudicam a capacidade de obter e manter a informação. Os experimentos e pesquisas foram necessários para comprovar essas técnicas a serem utilizadas evitando assim a necessidade do uso de medicamentos.

Palavras-chave: Memória, Neurotransmissores, Neurônios, Neuroplasticidade

1 INTRODUCTION

Memory can be worked since very early, a child used to read, in relation to one who has attention to another action, will have more possibilities to memorize contents since he has contact with the “new” and this factor can determine this “new” as learning and consequently, as we’ll see later, in memory. For being a more adapted brain.

Memory has three stages:

- Coding - contacts the information.
- Storage - where you save the information.
- Recovery - late recall of the information.

However, the prerogative of memory is attention. Without attention there will be no memorization. Usually, when there is difficulty in memorization, there is an attentional deficit.

In one of the attentions:

- Concentrated attention (usually)
- Divided attention
- Alternate attention

We are beings governed by the circadian cycle. We cannot neglect the importance of sleep for a “psychoprophylaxis” in addition to consolidating memory and maintaining homeostasis. Sleep is a very important activity for mental health and memory.

Another issue to be considered is the motivation “reason for an action (intrinsic)”, and the reward system. The human brain has a system dedicated exclusively to reward and motivation in the brain region, as well as brain processes that help us to achieve certain goals, and for that we need to be motivated.

And how to activate this motivation? What is the reason for an action? It is known that the prefrontal and orbitofrontal cortex are activated and the brain identifies opportunities for personal and professional growth. Brain circuits detect on the environment necessary conditions for the achievement of the objective.

The power of attentional focus on the action in progress and the goal to be achieved is the differential of those who reach their goal.

And two factors are essential in this action: physical activity and good nutrition. Physical activity helps to configure the brain motivation and make it fittest for logical and clear reasoning, and

healthy eating also contributes on making the brain faster, with speed in data processing and chain of logical ideas.

2 RESULTS AND DISCUSSIONS

2.1 WHERE IS MEMORY IN THE BRAIN

Our brain is a powerful and yet unknown machine. The advances in neuroscience in recent years lead us to new knowledge, but still far from understanding this complex system.

We do many things, because at a certain point in our lives, we learn these things. But why is much of what we see, hear, feel and learn are marked on our minds, and many others do not keep in our memory? Who determines what remains in our brain, which would be our hard disk (HD), if we were a computer?

There are several definitions of what memory would be. Tomaz (1993) says that:

Memory is the individual's ability to situate himself in the present taking into account the past and the future. Memory provides the basis for all of our knowledge, skills, dreams, plans and desires. Memory is therefore a determining factor in our behavior. Thus, knowledge about the nature and biological bases of memory are essential for the understanding of the human psyche. (TOMAZ, 1993, p. 02)

Tomaz (1993) also says that:

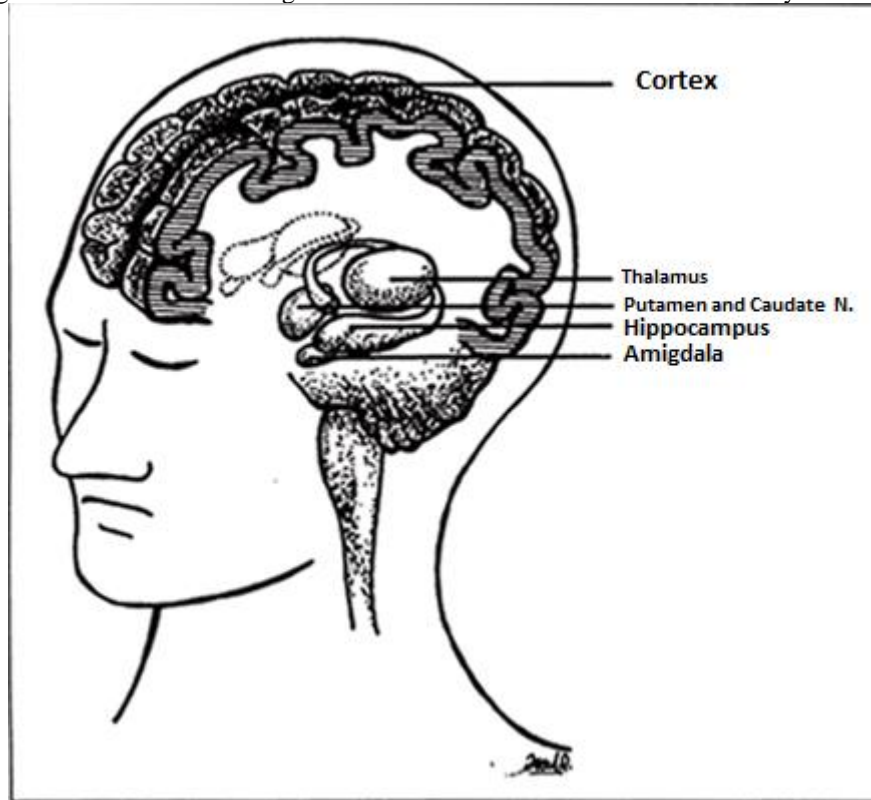
The basic research that investigates the psychobiology of memory is centered on two aspects. The first is the one which concerns the identification of brain areas involved on this phenomenon as well as the role of different brain systems in regulating the storage of memories and in the mediation of different types of memory. The second is related to the identification of cellular and biochemical changes that occur between neurons during the changes induced by the acquisition of information. (TOMAZ, 1993, p. 02)

And when it comes to memory, it is not an organ or two, one or another neurotransmitter that are involved. It is a complex system, as TOMAZ (1993) confirms:

Recent results of these researches indicate that memory can be influenced by changes in the functions of certain brain systems, as well as by changes between cellular interactions in specific brain areas. That is, different areas of the brain and different neurotransmitters are related to memory, and even to different types of memory. For example, injuries of the hippocampus, a brain structure located in the medial region of the human brain's temporal lobe, selectively prevent the memorization of new information without affecting perceptual learning and motor skills (SQUIRE, 1987). In laboratory animals, injuries of the hippocampus also block the retention of information related to the spatial environment, and changes in the amygdala's functioning (a structure located near the tip of the hippocampus), impair memory related to emotional experiences (LEDOUX, 1992 and PARENT; TOMAZ; MCGAUGH, 1992). (TOMAZ, 1993, p. 02)

Figure 01 below shows a schematic drawing of the main brain structures related to memory modulation.

Figure 01: Schematic drawing of the main brain structures related to memory modulation.



Lombroso (2004) on his study “*Aprendizado e memória*”, states that:

Two central concepts have emerged from recent researches in the area of learning and memory. The first belongs to the question discussed for many decades, if specific regions of the brain participate in specific forms of learning. An earlier view, which postulated that the nervous system would act as a block to achieve learning and memory, determined that cortical injuries would produce cognitive deficits that would increase in severity according to the size of the injury. However, nowadays it seems clear that specific types of tasks are learned within specific brain regions. This view emerged from the study of individuals with very limited brain injuries, accompanied by very characteristic memory deficits - work that has been confirmed in animal experiments. The first studies focused on the role of the hippocampus for learning and memory. Hippocampal injuries prevent the emergence of new memories of a specific type, the type of memory we use to learn new facts or events. Surprisingly, other types of memory remained intact. (LOMBROSO, 2004, p. 02)

According to neuroscience, there are two major forms of memory:

- Explicit (or declarative)
- Implicit (or non-declarative).

And Lombroso (2004) states that:

Explicit memories are those we can talk about, like last night's dinner or the date of a historic event. Such memories involve conscious thinking. We know that the hippocampus is necessary for the acquisition of these types of memories, because injuries in this region prevent individuals from establishing new explicit memories. It is possible, however, to recover older explicit memories, which were stored before the injury occurred. Implicit memories are usually procedural or associative memories in nature and are often acquired unconsciously. For example, learning to ride a bicycle or playing a musical instrument is procedural knowledge that depends on learning specific motor skills and usually requires multiple repetitions. However, there are also aspects of explicit memories embedded in these examples. We can remember the first bicycle we had or the hair color of the music teacher. These types of explicit memories are processed by the hippocampus. On the other hand, in order to learn the skill through which our fingers travel the piano keys, we need the activation of the basal ganglia and associated circuits. Thus, damage to these cores impairs the procedure learning. Individuals with early Parkinson's disease or Huntington's disease have specific deficits in their ability to learn procedural skills that are not explained by the loss of their motor coordination. (LOMBROSO, 2004, p. 03)

Lombroso (2004) says more:

Another form of implicit memory is particularly relevant for clinicians. If someone is walking in the forest and hears the sound of branches breaking, they can either stand still or take defensive measures against what is thought to be a snake. This type of learning is important for survival, as it involves the fight and flight response. This type of learning, which is sometimes called emotional or associative learning, requires an intact amygdala. Current theories surrounding the amygdala and learned fears suggest that this brain region is involved in several psychiatric disorders, including panic attacks, phobias, anxiety disorders and post-traumatic stress disorder. The amygdala is often mentioned in the context of learning to fear or other negative emotional responses, but it also participates in the processing of memories relating to positive emotions. For example, the amygdala is activated when children learn to respond to their mother's face and when learning social skills. Amygdala dysfunction and the consequences for this type of learning have recently been implicated in the development of autism and can help explain the serious social relationship incapacity observed in these children. (LOMBROSO, 2004, p. 03)

Lombroso (2004) reveals even more relationships between memory and learning:

The second central concept that emerged from the research on learning and memory is that the formation of long-term memories requires structural changes and other functional changes in neurons. A series of critical findings showed that learning requires morphological changes at specialized points of neuronal contacts, the synapses. These change with learning - new synapses are formed and old ones are strengthened. This phenomenon, called synaptic plasticity, is observed in all brain regions (LOMBROSO, 2004, p. 04)

In current studies that seek to determine how memory occurs, as learning begins, it relates brain movements of cognition to a "flood" of neurotransmitters and proteins into a new synapse. Lombroso (2004) highlights that:

A series of intracellular events is necessary for the structural modifications of the synapse required for learning to occur. An overview of what happens is useful before we turn to some details of the molecular events initiated by the activation signal. When the signals reach the

postsynaptic site, the release of the neurotransmitter - or sometimes the growth factor - activates the intracellular signaling pathways in the postsynaptic cell, which determines the production of new proteins used in synaptic modifications. An immense amount of researches had been dedicated on the understanding of this process in the past decade. Today, we know some of the critical proteins in this pathway from the surface of the postsynaptic neuron, by which the signal reaches the nucleus of the postsynaptic cell, where the genes are activated to produce the proteins necessary for synaptic modification. A key element on these events is a signal transduction pathway, known as the MAP protein kinase pathway.³⁻⁴ Mitogen-activated protein kinases (MAPK) are important signaling proteins activated by neurotransmitters and various growth factors. A member of this family is the regulated by extracellular signals kinase (ERK). The ERK cascade is used in all brain regions where synaptic plasticity occurs and its activation is required for the formation of new memories.⁵ If the activity of ERKs is blocked by injecting an inhibitor in a brain region such as the amygdala, the formation of all learning modes associated with this structure will be blocked. Similarly, if ERK activity is blocked in the hippocampus, the formation of hippocampal types of explicit memories is avoided. (LOMBROSO, 2004, p. 05)

Studies should really go deeper into the topic, as we do here in these lines that you read, memorize and learn. But know that there are many memories, and many paths taken in our brain, until a memory is stored. Izquierdo (1989) says that:

The variety of possible memories is so great that it is evident that the ability to acquire, store and evoke information is inherent in many brain areas or subsystems, and is not the exclusive function of any of them. (...) The notion that all memories are explainable by a single and determined molecular or biophysical process, nor by the constitution of new nerve pathways or new synapses or permanent changes in ionic conductance in this or any dendrite, does not seem credible. Each nerve pathway is different, from the point of view of the neurotransmitters involved, their biophysical consequences, etc.; and it is obvious that something learned using certain path (s) can be evoked using others. (IZQUIERDO, 1989. p. 04)

Izquierdo (1989) further says that:

Some memories consist of inhibiting natural or innate responses; others, an increase on these responses or the generation of new responses; others that do not involve any direct or apparent response. There are patients with global memory failures, and others with disorders limited to a single sensory modality, or for example, on the recognition of animals, but not objects (MARSHALL, 1988, p. 378). Certain people have an excellent memory for numbers and not for faces; or vice versa. All of this indicates that different memories use different pathways and processes for both their acquisition and evocation. However, there are certain structures and pathways (the hippocampus, the amygdala, and their connections to the hypothalamus and thalamus) that regulate the recording and evocation of all, of many, or at least most of the memories. This set of structures constitutes a modulating system that influences the decision, by the nervous system, before each experience, that it must be recorded and that it must or can be evoked. The hippocampus and the amygdala are interconnected and receive information from all sensory systems: partly from the cortex, and partly unspecified in terms of sensory modality, since from the mesencephalic reticular formation. The hippocampus and amygdala project to the hypothalamus, and through it to the thalamus, and finally to the cortex (GREEN, 1964, p. 561-608; GRAY, 1982). These structures and their connections are therefore strategically located to modulate the information processing based on experience. (IZQUIERDO, 1989. p. 04)

The formation or not of a memory after a certain event or experience, its resistance to extinction, interference and forgetfulness, depends on these four factors: selection, consolidation, more

information incorporation, formation of records or “files”. To understand the formation of memories based on experiences, it is necessary to consider four fundamental aspects, according to Izquierdo (1989, p. 06):

- We receive information constantly, through our senses; but we don't memorize them all. For example, after watching a movie, we remember some scenes; it may even be many; but not all. After listening to a class, we remember some concepts; perhaps whole sentences; but not all concepts or phrases. Therefore, there is a prior selection process to the formation of memories, that determines which information will be stored and which will not.
- Memories are not recorded in their definitive form, and are much more sensitive to facilitation or inhibition soon after acquisition than at any other later period. A recent memory is much more susceptible to the facilitating effect of certain drugs or to the amnesic effect of head trauma than an old memory (McGAUGH, 1988, p. 33-64). This indicates that there is a consolidation process after the acquisition (MÜLLER and PILZECKER, 1900, p. 1-288), whereby memories go from a labile state to a stable state.
- Memories are also much more sensitive to the incorporation of additional information in the first minutes or hours after acquisition. This information can be added, both by endogenous substances released by own experience □endorfine, adrenaline, etc. (IZQUIERDO, 1984, p. 65-77; IZQUIERDO, 1989), as well as for other experiences that leave memories (LOFTUS and YUILLE, 1984; CAHILL et al., 1986; IZQUIERDO et al., 1988a, b; IZQUIERDO, 1989).
- Memories do not consist on isolated items, but more or less complex records (“files”). We do not remember each letter of each word in isolation; if not whole sentences. We do not remember each color or each odor perceived yesterday as such, but as “files” details or more or less long records (the set of events at lunchtime; or in the afternoon; or in early evening).

These records are divided into:

- Selection
- Consolidation
- Additional Information Incorporation

As for the selection of memory “The mechanisms that select the information that will eventually be stored include the hippocampus and the amygdala” (IZQUIERDO, 1989, p. 07). Still according to Izquierdo (1989):

Bilateral damage to these two temporal lobe structures does not cause the loss of pre-existing memories (which, obviously, indicates that memories are not stored in them); but it prevents the acquisition of new memories (SCHÜTZ and IZQUIERDO, 1979, p. 97-105; MISHKIN et al., 1984, p. 65-77; MARKOWITSCH and PRITZEL, 1985, p. 189-287). (IZQUIERDO, 1989, p. 07)

And Izquierdo (1989) says more about the action of the hippocampus and the amygdala in our memory:

The hippocampus intervenes in the recognition of a certain stimulus, configuration of stimuli, environment or situation, if they are new or not, and therefore whether or not they deserve to be memorized (GRAY, 1982). It is evident that, for this, the hippocampus must be able to: a) distinguish stimuli, combinations of stimuli and environments; b) compare them with pre-existing memories, stored in the brain (not as we have seen in the hippocampus itself); c) send information regarding the novelty or not of the situation or the environment to other structures (their projection sites). In fact, we only recognize that we “learn something” when it comes to something new; not something we already knew. The amygdala participates in the selection processes as a consequence of its modulating function of consolidation (Mc-GAUGH, 1988, p. 33-64). (IZQUIERDO, 1989, p. 07)

According to neuroscientists like Mc Gaugh, Izquierdo, regarding the consolidation it is possible to perceive many stimuli at the same time, in different combinations; and we can even create several new memories simultaneously (Id. *ibid.*); some, however, will be better consolidated than others. (...) Izquierdo (1989) says that:

Consolidation is modular. Modulation processes are important because they are much better known than storage or evocation systems; and because, in fact, the only way available to affect memory quantitatively, or even qualitatively, is through variables that act on modulating systems. The only biological bases of memory that we know of are, in fact, the biological bases of modulation; and, although they do not serve us to understand how memories are stored, they serve us to treat them when they get reduced, as in example, on the different types of amnesia. Memories acquired in a state of alert and with a certain emotional or affective charge are better remembered than memories of unexpressive facts or acquired in drowsiness state. The affective and emotional alert states are accompanied by the release of peripheral hormones and central neurotransmitters. Several of these substances affect memory. Numerous experiments with drugs that release, mimic or block their action have demonstrated that they do not act during the acquisition, but in the immediately following period, affecting consolidation (McGAUGH, 1988; IZQUIERDO et al., 1988a; IZQUIERDO and PEREIRA, 1989; IZQUIERDO, 1989). Treatments are effective when applied after acquisition (in the period called post-training). (IZQUIERDO, 1989, p. 09)

At the central level, the main modulating systems are:

- Septo-hippocampal cholinergic system,
- Cholinergic system nucleus basalis-amygdala,

- Noradrenergic system locus ceruleus-amygdala.

And it is already known that while they are being consolidated, or even later, memories can incorporate additional information. Izquierdo (1989) says that:

One type of additional information comes from the action of β -endorphin, released by new experiences (IZQUIERDO, 1984; IZQUIERDO and NETTO, 1985a, b; IZQUIERDO et al., 1988a, b). This is incorporated into the memories as another stimulus: the intracerebral or systemic injection of β -endorphin, or a second cerebral release of it by another new experience, before evocation, has a facilitating effect, similar to that which would have the representation of any own stimulus (reminder effect) (IZQUIERDO and McGAUGH, 1985; IZQUIERDO and NETTO, 1985b). The administration of an excess of β -endorphin after acquisition requires the new administration of a larger amount of β -endorphin before evocation for this to be possible (IZQUIERDO and NETTO, 1985a). In the case where two memories are simultaneously processed or acquired, one being more novelty than the other, the β -endorphin, β -endorphin mimetics such as Leu-enkephalin, cerebral β -endorphin releasing agents such as electroshock, and β -endorphin antagonists such as naloxone, only affect the younger of the two (NETTO et al., 1986). (IZQUIERDO, 1989, p. 09-10)

2.2 MEMORY X ATTENTION

The attention aspect is a broad research where it requires a specific study to understand its process, we know that memorization has a direct connection with the synapses, where it enters the hippocampus, activating the memory through engrams found in all neural parts of the brain. Currently, the awakening of attention is researched in order to promote a deeper understanding of its origin and awakening a better memorization, according to Lúria (1981):

They differentiate the most elementary forms, present in the individual's first years of life, from the most elaborate socially constructed forms, calling the first involuntary attention and the second, voluntary. The involuntary is from biological origin, strongly attracted by external stimuli, while the voluntary is a social act developed by children in school age, requiring a certain degree of maturation of the nervous system and related to the ability to answer spoken instructions, even in front of distracting stimuli. (LÚRIA, 1981, s.p).

Today neuroanatomy studies in a deeper way the neural reactions that attract people's attention, studies using mental chronometry through electroencephalogram images, showed attention as an organic and functional system of the individual's own personality.

Lúria (1981) theorized about the biological bases of the attention mechanism, establishing that they were the reticular formation, the upper part of the brainstem, the limbic cortex and the frontal region.

Neuroscience has been advancing in research to answer the reason for the lack of attention, and according to the developed processes it was verified through electromagnetic images the existence of pathological processes in the frontal brain, according to the clinical studies of Lúria (1981), pointed out that the lack of attention comes from some brain regions that have suffered injuries, which are important for absorbing knowledge. According to a research, they

studied the neural basis of attention to action in an experiment carried out on 12 patients with Parkinson's disease and an equal number of healthy individuals. In this study, behavioral paradigms were used and the performance of individuals in attentional tasks was assessed using fMRI. There was an increase in activation of the prefrontal cortex, supplementary motor area, PCS and cerebellum in the control subjects, but not in the patients, indicating functional disconnection between the prefrontal, pre-motor cortex and supplementary motor area, specific to the Parkinson's disease context (ROWE et al. 2002, sp)

Studies carried out today confirm what Lúria (1981) says, that the attention comes from the formation of the brain stem, the frontal region and the limbic cortex. Researches have shown that the frontal cortex region is responsible for the action of emotion, where it arouses attention in itself, being the path to better memorization of the individual, sharing this information with the hippocampus, improving itself the ability to memorize.

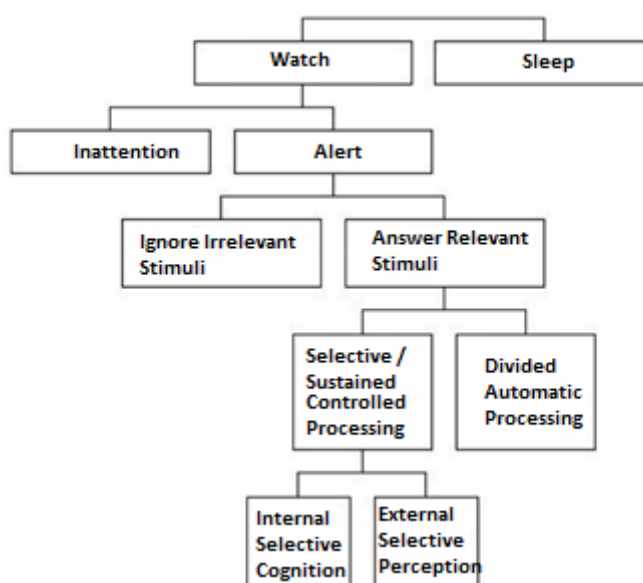
Another highlight is neuroimaging, which has had great results in studies of the composition of attention, obtaining together measures brought by neurobiology containing deeper studies for the formation and the appearance of brain construction, especially the origin of attention.

According to Kandel (1997):

Millions of items (...) are presented to my senses and never properly enter my consciousness. Why? Because they have no interest for me. My experience is what I agree to pay attention to (...). Everyone knows what attention is. It is the taking of possession by the mind, clearly and vivid, of one of what appears to be several possible simultaneous objects or line of thought. Focusing, concentration of consciousness is its essence. This implies abstaining from some things in order to deal effectively with others. (KANDEL, 1997, s.p.)

The Figure 02 below shows that attention is stimulated by different synaptic pathways.

Figure 02: various synaptic pathways that stimulate attention.



Source: Scielo

2.3 GENES: ORIGIN OF MEMORY, ATTENTION AND DISORDERS.

We know that the source of attention comes from a brain formation highlighted in the prefrontal cortex, we understand that its lack of training structure and construction can lead to attention deficit, such as ADHD (Attention Deficit Hyperactivity Disorder), and according to Mattos (2019) the study on the complex G x E relationship is called epigenetics.

Mattos (2019) states that:

The environment can modify the “behavior” of our DNA, our genetic code, “releasing” or “blocking” certain genes. Nowadays we know that many adverse events during childhood, such as abuse and neglect, for example, have a negative impact on the development of our brain; these effects are modulated, however, by our genetics (increasing or decreasing the chances of this happening).

Still Mattos (2019) says that:

In the case of ADHD, there is not a single gene, as in some diseases (for example, in Huntington, a neurological disease, there is a specific gene that individuals without the disease do not have in their DNA). In studies of psychiatric disorders, such as ADHD, we usually do not speak of “gene” in the traditional sense, but of “variants” of genes that we all have (common genetic variants). To put it better: individuals in the population have a “gene A” with the following composition “X-Y-Z-2”, for example. A few individuals have the composition “X-Y-W-2” of the same “gene A” (with W in place of Z), that is, there is a variation or variant of that gene, but they all have the same “gene A”. Only very rarely are there specific genes (and not variants) that are associated with sporadic cases of ADHD. As in other mammals, our genes are always located at the same locations in our DNA and each gene, in turn, has several different locations within it. Geneticists now have a “map” of these locations. We know that there are places specifically related to the gastrointestinal system, the nervous system, the kidneys, etc. (MATTOS, 2019, s.p.)

We understand that the lack of attention or the disease that affects this lack is not just a malformation, but something genetic, so there is bipolar disorder, the autism for example, where mechanisms are created to disperse attention for protection greater than that which affects something more serious in human beings. Mattos (2019) states that:

We found that there are several variants associated with the disorder, there is no “single” variant; the same occurs with other disorders with a strong genetic influence, such as Autism, Schizophrenia and Bipolar Mood Disorder. Therefore, in genetics studies we use the term called “polygenic score”, this score refers to the variants that the individual has, the greater these variants are in our DNA, the greater the probability of the child being born with ADHD, these variants can be identified in different places between genes. (MATTOS, 2019, s.p.)

But Roman et al (2002):

Another gene in the dopaminergic system intensively investigated in this disorder is the dopamine D4 receptor (DRD4) gene. The great interest in this gene arose from the observation of its association, with the personality dimension the search for novelty, probably related to ADHD. In addition, the product of this gene is concentrated in areas of the brain whose

functions are implicated in disease symptoms.^{35,36} The main polymorphism investigated in the DRD4 gene is a 48bp VNTR, located in exon 3, a region that supposedly encodes an important functional domain of the protein. (ROMAN et al, 2002, p. 02)

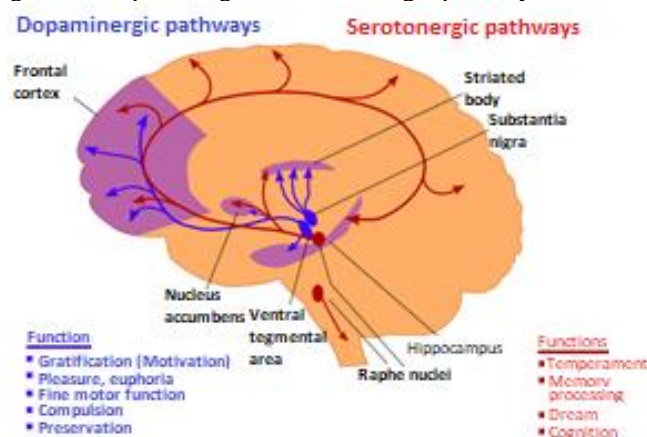
This observation points out that studies on the dopaminergic system have an impacting influence on disorders and lack of attention that affects the subject in his personality formation, it is located in the frontal brain, a region regulated by dopamine, these neurons that effectively participate in communication with other neurons bringing about triggering a wide variety of information in the biological system, some of them are:

- Motivation
- Movement
- Intellectuality

However, cells that are born or are damaged over time, lead the subject to adhere to disorders or diseases such as Parkinson's, significantly reaching the person's attention, within this deformation, schizophrenia is included.

Figure 03 shows where dopaminergic and serotonergic pathways run.

Figure 03: dopaminergic and serotonergic pathways in the brain



Source: maestrovirtuale

On this subject, Schwartzman (2008) says that:

In the history of the evolution of species, the increasing complexity of individuals made central control necessary, a structure responsible for controlling the joint work of the other systems. Thus, arose the need of a nervous system that could receive information from other systems and the outside environment and use that information to maintain survival, reproduction, feeding, excretion and all other functions necessary to keep the individual alive and in good operating conditions. The cells that specialize to perform the required tasks are neurons, which alongside the glial cells, are fundamental elements in the nervous system. (SCHWARTZMAN, 2008, s.p)

And Schwartzman (2008) also states that:

Neurons communicate with each other through a structure: the synapse. The typical neuron consists of a cell body, several extensions that bring stimuli from outside the cell to the cell body, called dendrites, and a prolongation that takes stimuli from the cell body outward, called axon. Most neurons have a fatty sheath that surrounds the axon. This sheath consists of myelin, which is produced in the Schwann cell. Myelin curls around the axon in several concentric layers. Myelinated axons have a speed of conduction of the stimulus much higher than that which we can observe in non-myelinated axons. (SCHWARTZMAN, 2008, s.p)

The lack of dopamine in the brain can unleash problems in attention or even ADHD, this deficiency can be analyzed through twins who came from the same egg.

Goldstein & Goldstein (1994) states that:

There is a relationship between ADHD and heredity. A child with ADHD characteristics is four times more likely to have other family members with the same problem. To demonstrate that the highest incidence of ADHD within the family was related to heredity, it was necessary to study situations in which the child was raised far from the biological family, as in the case of 14 adoptions. Another way to study the effect of heredity is by comparing twins. Identical twins, resulting from the division of the same egg, are more likely to exhibit similar behaviors than twins resulting from the fertilization of two eggs. (GOLDSTEIN; GOLDSTEIN, 1994, s.p)

For Schwartzman (2008, s.p.): “in the reticular formation we find systems that act through different neurotransmitters: noradrenaline, serotonin, dopamine and acetylcholine. Attention disorders involve dopaminergic and noradrenergic pathways”.

2.4 FROM LACK TO COMPENSATION THROUGH THE NEUROFEEDBACK (NF)

ADHD is a disorder caused by malformation of the frontal cortex, disorders caused by dysfunctionalities of dopaminergics linked to the dopamine neurotransmitter, although there is an influence with other neurotransmitters such as serotonin, noradrenaline as already mentioned in this article.

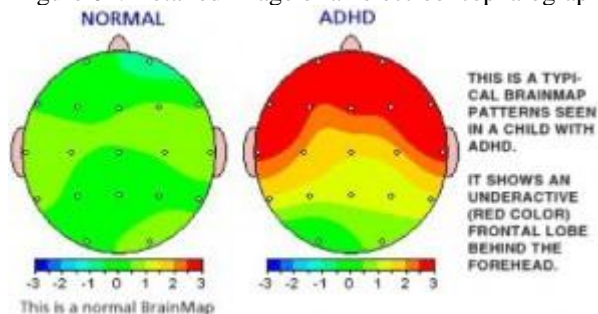
According to the website neurosciences in debate (2015) points to studies carried out with children with ADHD, where they were the targets of research being tested with the treatment of neurofeedback, within the analysis were evaluated:

- Learning regulation;
- Stimulation through synapses;

The records were analyzed by the electroencephalographic, where electrodes are placed in specific regions of the patients' brain and these individuals are stimulated by audiovisual contact, and on this test several brain frequency bands are analyzed where the electrodes are installed.

During the analysis the reactions on attention are quantified and, finally, monitored for a detailed analysis, according to Figure 04 below.

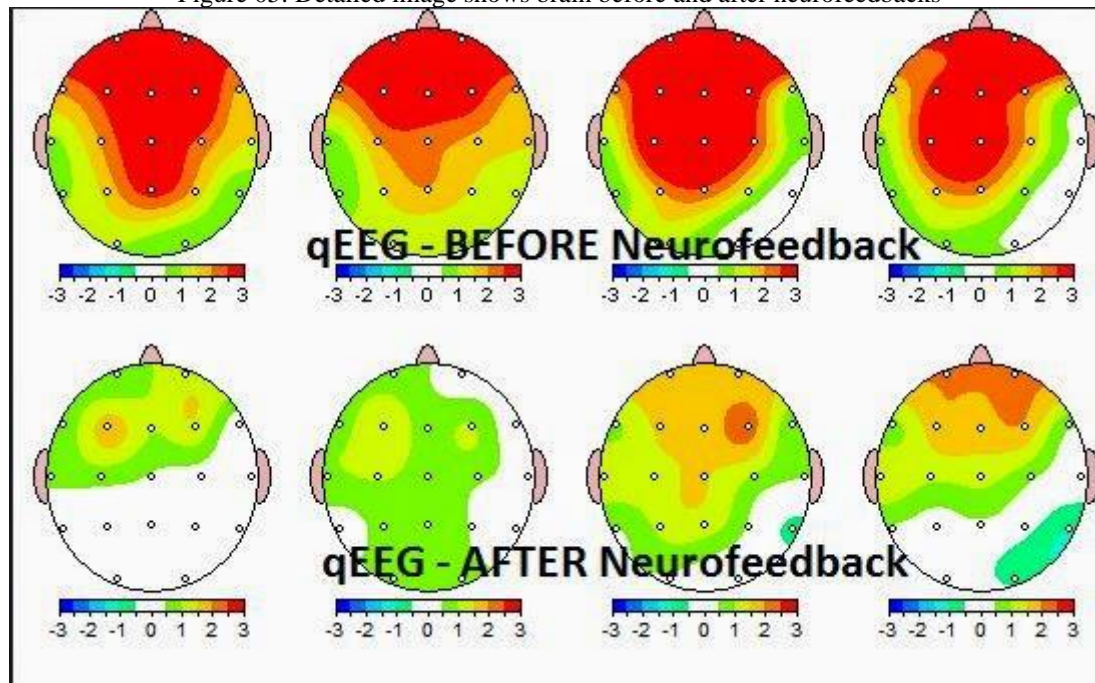
Figure 04: Detailed image of an electroencephalograph



Source: Science and cognition

Figure 05 below shows the brain mapping related to neurofeedback.

Figure 05: Detailed image shows brain before and after neurofeedbacks



Source: Science and cognition

It is possible to see inside this mapping at the top of Figure 05 showing a normal brain, where the region responsible for the attention turns green, without any type of problem or disorder. At the bottom of Figure 05, we see the phases of a brain before and after the neurofeedback treatment, we observe the regions of the prefrontal cortex with significant improvements after treatment, within a scale ranging from 3 to -3, which shows us that the lack of dopamine and the neural dysfunction through dopaminergic can cause ADHD and when the brain has excess of this neurotransmitter, it can trigger schizophrenia disease.

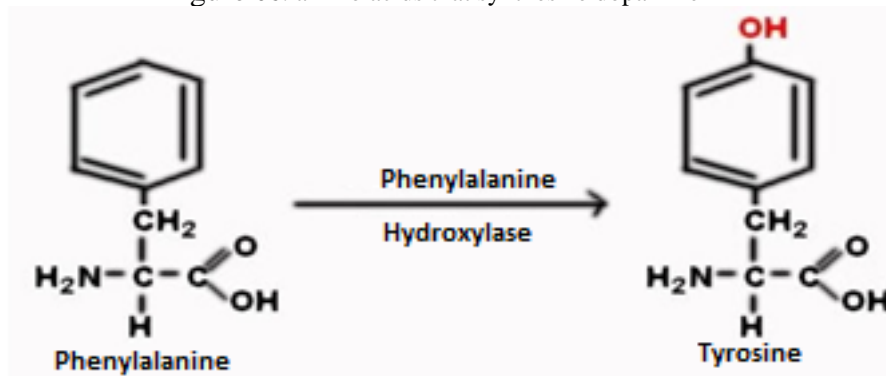
This assessment demonstrates that synapses should be stimulating sources for patients, where it has already been found that people who suffer from this disorder are not stimulated with the same signs as people that have brain normality. In short, it is necessary to stimulate the prefrontal cortex according to the degree of ADHD.

2.5 PROTEINS FOR BETTER MEMORIZATION.

Dopamine is made from tyrosine amino acid that comes from phenylalanine. Eating a tyrosine rich diet will ensure that you have the basic building blocks necessary for dopamine production, when this neurotransmitter is stimulated, it causes the synapses to become stronger causing the concentration to be automatically activated for a better memorization.

Figure 06 represents the amino acids that synthesize dopamine in our body.

Figure 06: amino acids that synthesize dopamine



Source: (robertofrancodoamaral)

According to Nora D. Volkow (2009), dopamine researcher and director of the National Institute on Drug Abuse, points out that people talk about receiving their “dopamine rush” of chocolate, music, the stock market, the blackberry buzz in the thigh anything that gives a small and pleasant emotion. Familiar addiction agents like cocaine, meth, alcohol and nicotine are known to stimulate the brain’s dopamine circuits, as well as increasingly popular stimulants like Adderall and Ritalin.

In addition, our dopamine-ledge detector will focus on familiar objects that we imbue with high value, both positive and negative: objects we want and objects we fear. If we love chocolate, our dopamine neurons are likely to start firing when they see a small chocolate bean lying on the counter. But if we fear cockroaches, those same neurons can fire even more when we notice that the “bean” has six legs. The pleasurable taste of chocolate itself, however, or the anxiety of cockroach phobia, may very well be the handwork of other signaling molecules, such as opiates or stress hormones. Dopamine simply makes a relevant object almost impossible to ignore. (VOLKOW, 2009, s.p.)

Dopamine is composed of 22 atoms, being made up of compact molecules, some proteins derived from cocaine for example, leaves dopamine stagnant as reflected by the researcher, recreational

drugs like cocaine tend to block this transporter, allowing dopamine to remain in the neuronal vestibule and keep punching your signal together.

People differ from each other in each conjuncture of the dopamine matrix, in the tonal background rhythm in which their dopamine neurons fire rhythmically, the avidity with which the cells increase in response to the need or the news, and the ease which the hyperstimulated cells revert to the baseline. (VOLKOW, 2009, s.p).

The lack of protein from tyrosine causes dopamine stimuli to be low, creating dysfunction of neurotransmitters and the lack of attention and motivation, as we said tyrosine is the carrier of the proteins we eat, whether in food, drinks, smoke, among others.

For the researcher, Dan T. A. Eisenberg from Northwestern University (2009), scientists have detected a modest connection between a relatively elongated version of dopamine receptor # 4 and a tendency to impulsivity and risky behavior, particularly financial risk taking.

Proteins are important in human genetics, and may be responsible for stagnating or releasing more neurotransmitters of pleasure, foods that can enrich our best memorization through proteins taken to tyrosine by the phenylalanine amino acid.

Phenylalanine is an amino acid composition of foods that are transformed into proteins, going to tyrosine where it absorbs this information in which dopamine obtains this information, being important for its neuronal stimuli.

Proteins in addition to tyrosine, phenylalanine and hydroxyls, obtained from these foods, are essential for the entire process.

It is known that foods rich in tyrosine: almonds, apples, avocado, bananas, beets, cocoa, coffee and fava are important, because the digestion of these foods make proteins taken from tyrosine become stimulants, to reinforce the memorization located in main neurotransmitters that are responsible for attention, concentration and consequently the memories installed in memory.

2.6 TECHNIQUES AND SOLUTIONS FOR A BETTER MEMORIZATION

Emotion is important to make the focus of attention and memorization more effective, for example, situations that are exciting and interesting end up becoming more accessible for memorization than moments that arouse no interest in people.

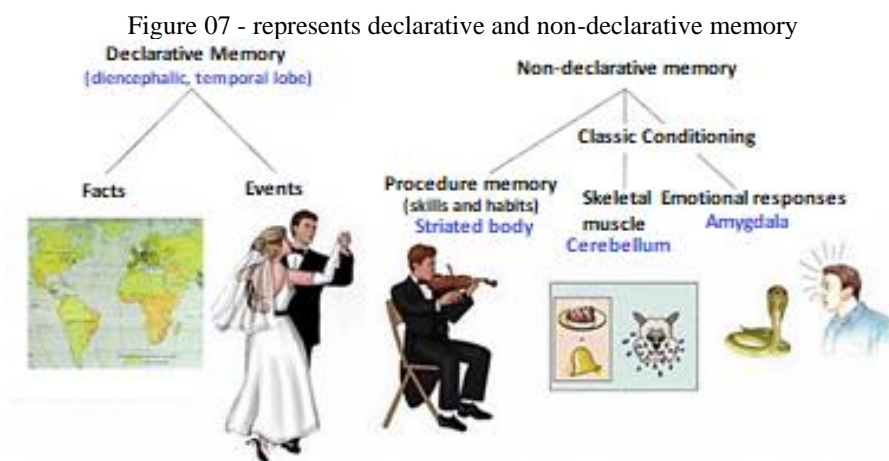
That's because the experienced situations and the introduced synapses cause the pleasure neurotransmitters to release their substances of greater or lesser quantity, and this also has a direct connection with the proteins we consume, as already mentioned on this article, the dopamine neurotransmitter will seek for tyrosine and phenylalanine amino acids, among children, playful games

cause them to release more proteins 'cause of the emotion of the game, making memorization to be better exercised.

According to Cardoso (2000):

Memory is an extremely important cognitive faculty because it forms the basis for learning. If there were no way of mentally storing representations of the past, we would not have a solution to take advantage of the experience. Thus, memory involves a complex mechanism that encompasses the archiving and retrieval of experiences, therefore, it is closely associated with learning, which is the ability to change our behavior through the experiences that have been stored in memory; in other words, learning is the acquisition of new knowledge and memory is the retention of that learned knowledge (CARDOSO, 2000, s.p)

For children to have consistent and sufficient proteins to release this emotion and then explain a better memorization in their cognition, it is necessary to have a good diet that contains vitamin B12, proteins that are transformed into amino acids that stimulate the pleasure neurotransmitters, causing the cognitive region is able to function at its best memorization capacity.



Source: Cérebro & Mente

When the respective proteins work in the activation of neurotransmitters, they make the attention bigger, creating a better memorization and the easiness of learning, called Synaptic Plasticity, synapses can significantly alter CNS impulses. Proteins as transformed into amino acids are important for synapses to help in the development of memory from the cognitive field and increasing plasticity.

In scientific laboratories it was also possible to demonstrate that mice have a much larger number of brain cells interconnected with each other when they live together in a cage full of toys such as wheels, balls, etc., than mice that live in a cage alone and with nothing to do or learn. Some of the greatest scholars of the phenomenon of learning and memory in the 1940s, Donald Hebb from Montreal, and Jerzy Konorski from Poland, were the first to believe that memory should involve changes or increases on nervous circuits. (CARDOSO, 2000, s.p)

And Cardoso (2000) also says that:

Research found that “exercised” neurons have a greater number of branches (dendrites) communicating with dendrites from other neurons. So, for memories to be created, nerve cells need to form new interconnections and new protein molecules. Memory loss can be associated with certain neurological diseases, psychological disorders, metabolic problems and also certain intoxications. The most frequent form of memory loss is popularly known as “sclerosis” or dementia. The most common dementia is Alzheimer’s disease, which is characterized by severe memory loss accompanied by serious psychological manifestations such as alienation. Altered psychological states like stress, anxiety and depression can also alter memory. Lack of vitamin B1 (thiamine) and alcoholism lead to memory loss for recent events and are often associated with problems with walking and mental confusion. Thyroid diseases, such as hypothyroidism, are accompanied by impaired memory. The use of tranquilizer medication (“tranquilizers”) for a long time causes a decrease in memory and also favors depression, which leads to a situation that can be confused with dementia. Sedentary life with excessive worries and dissatisfactions, as well as a poor diet, favors memory loss. Contrary to the common forgetfulness that normally occurs on our daily lives, there are some diseases and injuries in the brain that cause serious memory loss and also interfere with the ability to learn. This inability is called amnesia. (CARDOSO, 2000, s.p)

It is understood that many factors related to dependence and lack of proteins can lead to a considerable loss of memory together with its plasticity.

How to stimulate memory? To reduce the attention deficit, it is necessary to have a good diet with the proteins mentioned in this article, it is necessary to use the maximum mental capacity, but not try to memorize and record everything, because there is a mental strain causing important proteins to be consumed leading to mental tiredness and not focusing properly on a certain situation.

Another important aspect is not leaving the mind overloaded with multitasking, as mentioned above, the wear and tear of proteins, makes the neurons responsible for memorization also fail to respond in the best quality, leading to the lack of interest and difficulty in memorization.

Stimulating organs that are responsible for stimulating synapses such as ears, smells and vision, as they are important channels for beneficial mental development, because all the signals that activate the nervous system, make it work correctly in the production of new neurons, because it is from this neuronal interconnection that new memories arise.

2.7 METHODS

- Listening to classical music, without too much mixing of instruments, music that does not take the focus off, but can divide the attention smoothly in a way that increases the focus on learning.
- Sleep at night, not at dawn, eight hours a day, avoid lights in front of your eyes before going to sleep.
- Define a study place, comfortable, but repeated, so that no object in the environment takes the attentional focus away.

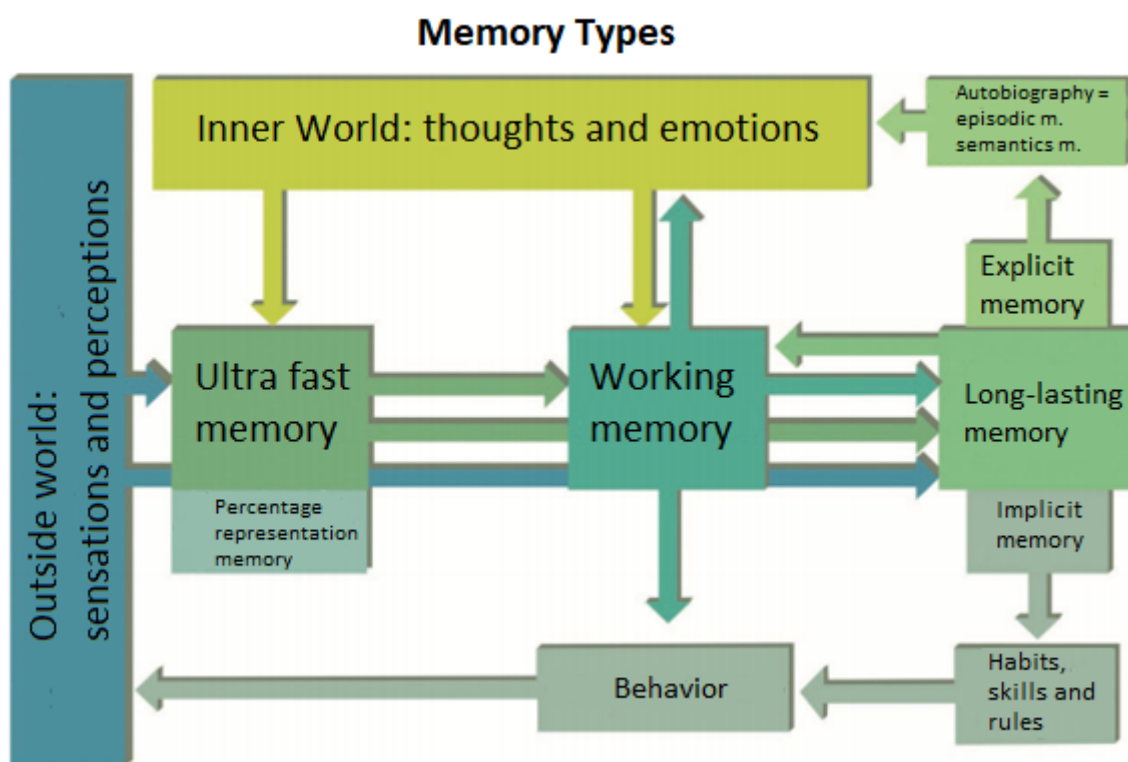
- Watch videos for better learning in the middle of physical exercise, taking advantage of the production of various neurotransmitters derived from physical exercise.
- Summarize your reading, it reinforces what you have learned to rewrite.
- Read in fractional form, for short periods of time, but often. Synapses grow at night, while sleeping, so it is better to, for example, study gradually every day.
- Avoid distractions, that is, turn off everything around you, put your phone in airplane mode and withdraw to increase concentration.
- Reading 20 minutes before bed can facilitate memory consolidation.
- Read aloud, reading forces you to memorize what you read so you can talk about what you read.
- Study for 20 to 30 minutes. Stop, rest for 5 minutes, then go back to studying, do it during the study cycle. Use an alarm clock to let you know when you have to take a break so you don't worry about the moment losing focus.
- Reading is not a punishment, but an absorption of knowledge that will bring a better life. Read without forced intentions.
- Read in the morning, starting with the most difficult. When it comes to the easiest, the wear and tear on the brain will not affect it as much as it has passed the most difficult stage.
- Having a good diet, sleeping, exercises, meditation and nature.
- Look for different but comfortable environments to study. An environment that does not make you lose focus.
- Associate what you want to memorize with furniture or objects of your home's environment, which you already know.
- Review the reading, we store it in the repetition reinforcing the engram on our neuron bone.
- In a lecture, study less and rehearse more. In the rehearsal you can better reinforce the memorization.
- Create on your imagination stories of what you want to memorize.
- Use your imagination in reading, according to events that encourage emotion for better memorization.
- Use emotional intelligence to release emotion in the middle of reading, facilitating memorization.
- Make a mental map, graphically, on paper, mapping important points and correlating. Working with graphics.
- Associate what you want to memorize with something you already know.

- Reflect on what you are trying to memorize.
- Turn content into music.

2.8 IMPACTS OF THE ENGRAMS ON MEMORIZATION.

Memory is stored according to each biophysics and or biochemistry of the individual that acts on the brain, always activating engrams, composed of a protein complex, a group of two or more associated polypeptide chains.

The engrams are activated with the various synapses that arise from the outside to the inside, causing the activation of memories and with the emergence of new synapses a new type of memorization is created, changing the behavior of the passerby.



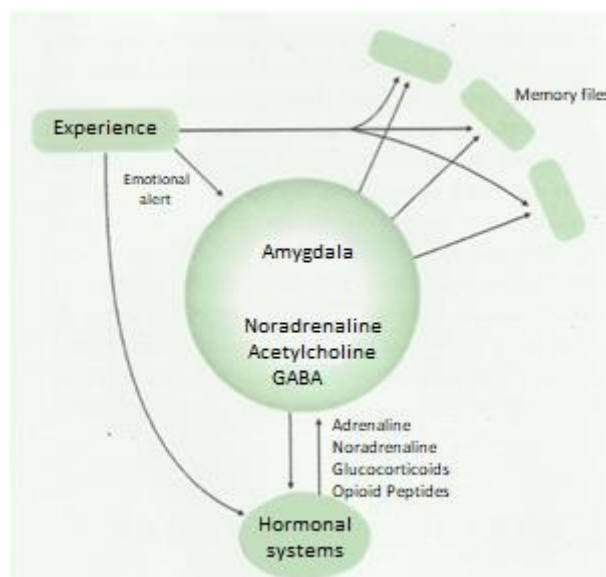
Source: http://www.avm.edu.br/docpdf/monografias_publicadas/c205287.pdf

The hippocampus and the surrounding cortex of the temporal lobe as the region in charge of processing both short and long lasting memories and their evocation (Izquierdo, 2007).

When dealing with the hippocampus being the important part for the new connections within the formation of memory, biochemical agents participate in the formation of protein synthesis, creating cellular bonds with engrams.

Short memory does not activate gene memory or protein synthesis, but uses several different metabolisms in the formation of long-term memory and also occurs in the hippocampus and entorhinal cortex, with little participation from other brain areas. (Izquierdo, 2007).

When there is neither gene nor protein participation, it means that there is a wear and tear of important proteins within this process for better memorization influencing neuronal cells. According to McGAUGH, 1988; IZQUIERDO et al., 1988a; IZQUIERDO and PEREIRA, 1989; IZQUIERDO, 1989, memories acquired in a state of alert and with a certain emotional or affective charge are better remembered than memories of unexpressive facts or acquired in a state of drowsiness. The alert, affective and emotional states are accompanied by the release of peripheral hormones and central neurotransmitters. Several of these substances affect memory. Numerous experiments with drugs that release, mimic or block their action have shown that they do not act during acquisition, but in the immediately following period, affecting the consolidation.



<https://www.neurometria.com.br>

When we use proteins in conjunction with our emotions, we awaken a greater focus on us, creating greater attention and consequently better memorization, since we know that synapses are factors that decisively interfere on our behavior and consequently neurotransmitters use proteins to manage a better memorization because our emotion will be in high, differently when our emotion is low, not giving any sense for a better memorization and also making sure that our proteins are not spent as it should.

It is important to emphasize that there are proteins that stimulate our emotions, when there is a lack of these nutrients, it consequently weakens the engrams and consequently the neurotransmitters, mainly serotonin.

Serotonin produces a feeling of optimism, relaxation and feelings in general, the feeling of well-being is directly linked to the availability of this substance, so much that people in depression usually have a low amount of it. But this spice of happiness also regulates several other functions, such as sleep, level of motor activity, learning capacity and much more. Food is the raw material for the manufacture of serotonin. (Almeida, Sandra Regina de, Soncin, Dayane, Lopes, Luciana, Bria, Mainardes, Sandra, Cristina, Catelan, 2008, p.3).

With the absence of serotonin, the person's mood also changes, including lack of emotion. Within this context, the cortisol hormone is activated to supply the lack of serotonin, creating an immune system causing fatigue in the subject, preventing other diseases such as depression, anxiety reaches its highest level, therefore, the physiological impact occurs on the individual, bringing the lack of interest, feeling of tiredness and the weakening of engrams, making it difficult to pay attention and memorize something.

Food's function is to provide a variety of nutrients. Food has an impact on feelings and emotions. Poor nutrition can cause changes on brain functioning, modern society has considerably increased the intake of foods, especially vitamins and minerals. And these, in turn, have primary functions in all body systems, including the central nervous system. (Almeida, Sandra Regina de Soncin, Dayane, Lopes, Luciana, Bria, Mainardes, Sandra, Cristina, Catelan, 2008, p.3).

Still

it is possible to establish a direct relationship that the lack of nutrients causes problems in brain performance, the lack of important nutrients in food can decrease brain performance, cognitive aspects and quality of sleep. (Almeida, Sandra Regina de, Soncin, Dayane, Lopes, Luciana, Bria, Mainardes, Sandra, Cristina, Catelan, 2008, p.3).

The lack of vitamin B and B12 for example directly impacts emotion and memorization, we find these vitamins on avocados, cabbage, spinach, beer yeasts, among others. The ingestion of these vitamins makes neurotransmitters work correctly, boosting an emotion for what we are doing, with greater attention, maximizing brain power with a greater capacity for memorization, because the engrams are motivated by the new synapses created by frontal lobe.

When eating a food, the nutrients contained in it act in the formation and release of neurotransmitters, which are sent to the Central Nervous System. (Almeida, Sandra Regina de Soncin, Dayane, Lopes, Luciana, Bria, Mainardes, Sandra, Cristina, Catelan, 2008, p.3).

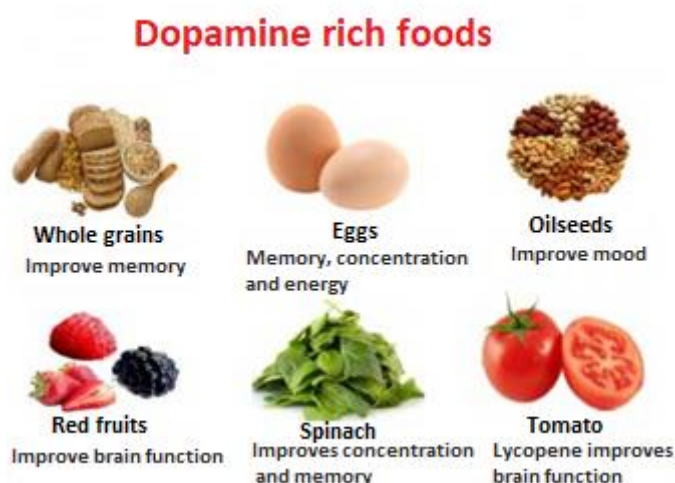
With each emotion placed in a focus, the greater the interest, the better the memorization and we obtain new learning through lived experiences. There is no memory without learning, nor is there learning without experiences. Aristotle said, 2,000 years ago: "There is nothing in the intellect that has not been in the senses before" (MARSHALL, 1988, p. 378).

Learning and memory are basic properties of the nervous system; there is no nervous activity that does not include or is not affected at any way by learning and memory. We learn to walk, think, love, imagine, create, make simple and complex motor-acts or ideas, etc .; and our lives depend on us to remember all of that. (Izquierdo, 1989, s.p).

Food has an impact on feelings and emotions. Poor nutrition can cause changes in brain functioning, modern society has considerably increased the intake of foods low in nutrients, especially vitamins and minerals. Almeida, Sandra Regina de, Soncin, Dayane, Lopes, Luciana, Bria, Mainardes, Sandra, Cristina, Catelan, 2008, p.3).

The lack of memory, the attention deficit, the lack of interest is related to the bad habits we are causing in our daily lives and interfering with the digestion of food.

According to the BS Care website (2013) Scientists observed that animals that had a diet high in sugars and fats had an inflammation in the hippocampus region, the part of the brain related to the formation and storage of memory and one of the first regions affected by Alzheimer's disease, the animals were not obese after six days, but the changes in knowledge, the loss of memory occurred before any variation in weight.



Source: <https://verdesnaturais.com/12/dopamina-como-ativar-naturalmente/>

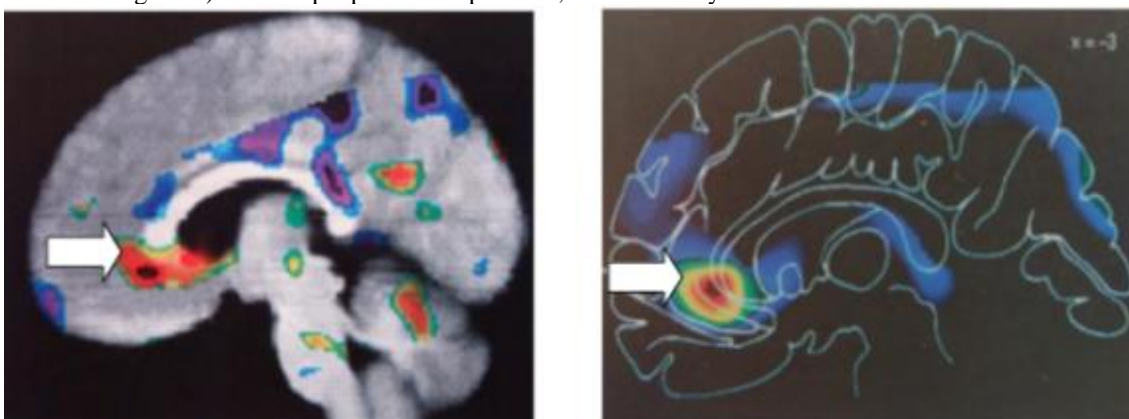
The hypothalamus is largely responsible for the control of homeostasis in the internal environment, in addition to participating in the orientation of behaviors, often loaded with emotional content, whose main purpose is success in trying to survive (DALGLEISH, 2004).

According to Fellous (1999) together with the thyroid, the pituitary, the parathyroid, the pancreas and the cortex of the anatomical regions related to adrenal emotions, they have been associated with a wide variety of mental disorders, many of which are associated with emotional symptoms, as is the case of depression. Several studies have pointed out the hypothalamic-pituitary-

adrenal axis in the involvement of depression, mainly due to the cortisol secretion stimulated by the corticotrophin hypersecretion (ACTH).

Emotions are mediated by the ANS, also known as the visceral or neurovegetative motor system. This system consists of autonomous control centers, which are located in the limbic system and the brain stem, and also by the projections of neurons originating in these centers and destined for the smooth muscle of the organism's viscera, the myocardium, the exocrine / endocrine glands and the blood vessels (DAMÁSIO, 1996; CRITCHLEY; ECCLES; GARFINKEL, 2013).

Figure A) brain of normal people with tendency of a better memorization.
Figure B) brain of people with depression, with tendency to decline the memorization.



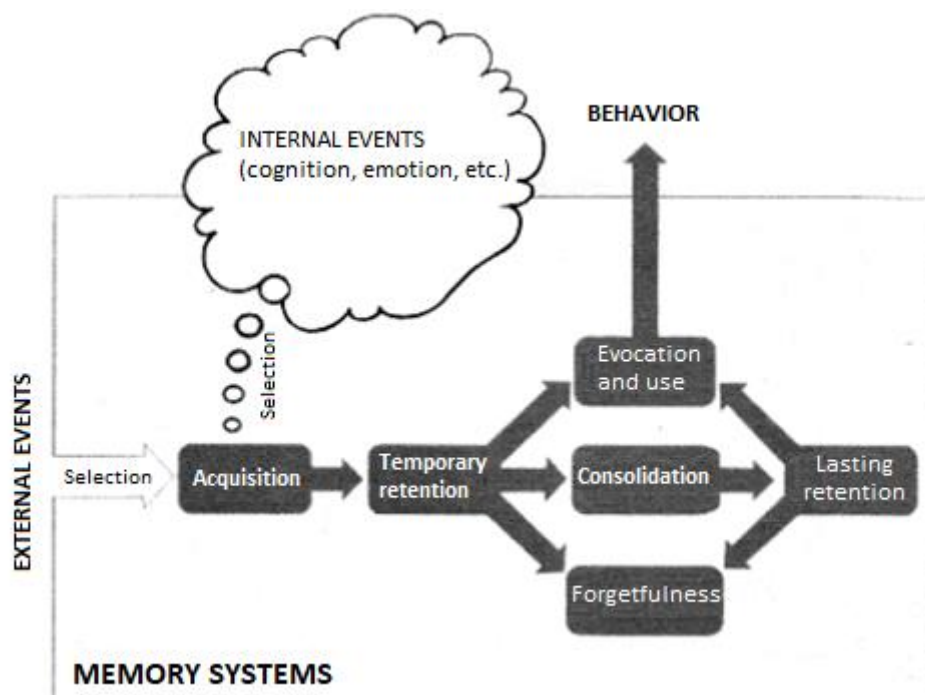
Source: https://repositorio.ufmg.br/bitstream/1843/ICBB-BD4UPT/1/monografia_sarahdavid_final.pdf

An important role of the prefrontal cortex in human behavior occurs in decision making. This region is also activated when the individual performs a task through a reward or punishment. This indicates that the emotional meaning of the reward or punishment is necessary for decision making. During an emotional response, ventromedial and orbitofrontal areas coordinate attention directed to certain stimuli, in addition to influencing the evoked content of memory and assist in the elaboration of mental plans designed in response to a trigger stimulus. For this to occur, it is necessary to work in parallel between the amygdala and the prefrontal cortex (KOENIGS et al., 2007; ROLLS, 2000).

LASTLY

Learning is anchored in various cognitive skills and events, such as perception, attention, motivation and interest. However, one of the mental functions that most favor learning is memory, which is also closely related to emotions. Memory is the process by which knowledge about the learned world is encoded, stored and later evoked. Rotta, Ohlweiler and Riesgo (2015).

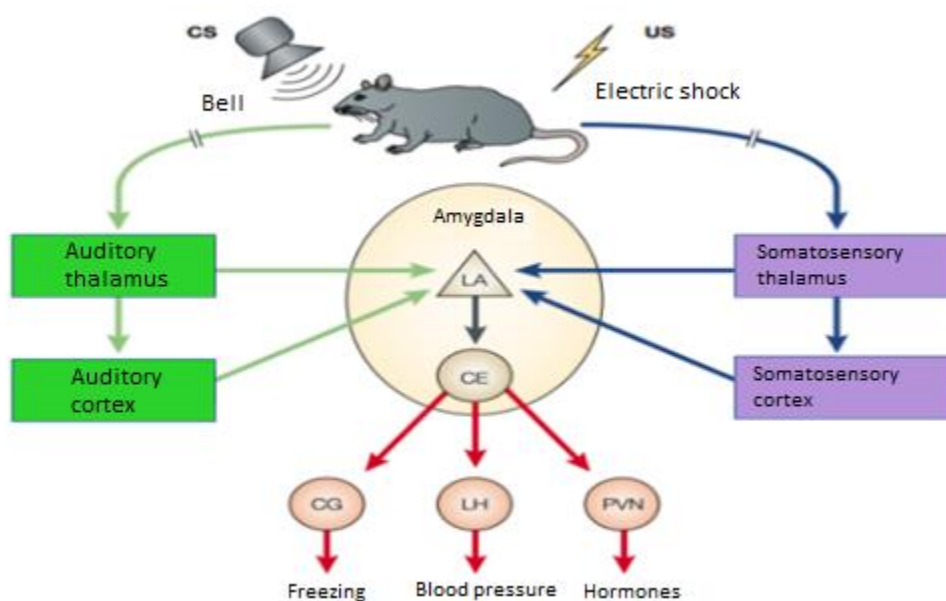
Willingham (2009), memory is a product about what one thinks, and those events involved with a relevant emotional charge will be remembered more easily than those devoid of emotions. It is prudent to emphasize that emotions are not a mandatory prerequisite for forming long-term memories.



https://repositorio.ufmg.br/bitstream/1843/ICBB-BD4UPT/1/monografia_sarahdavid_final.pdf

Through experimental studies, it was proven that the amygdala receives information that has some emotional association and connects it with mnemonic information in the process of consolidation, strengthening or depleting information retention. (David, Sarah 2018)

Engrams are formed by means of synapses, where they may or may not form a memory of the situation experienced at that moment, being up to the emotion to correspond the signs.



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After the conditioned and unconditioned stimuli are paired, the cellular response to the conditioned stimulus is even greater, as more action potentials are triggered. Initially, cells in the upper part of the dorsal lateral amygdala undergo synaptic plasticity. After several experiences, they back to answer to the stimuli as they initially did. However, lower cells of the dorsal lateral nucleus present these changes more slowly and maintain this plasticity for a longer time. Thus, it is suggested that the higher neurons appear to start learning when conditioned and unconditioned stimuli are paired, while lower neural cells mediate the long-term memory of the association of these stimuli (LEDOUX; DAMASIO, 2014, p. 938). Therefore, it is up to the amygdala to assess the emotional charge of a stimulus in order to determine whether there is an imminent danger. If any danger is detected, behavioral and physiological responses are triggered through connections with the hypothalamus and the brainstem (PHELPS; LEDOUX, 2005).

3 FINAL CONSIDERATIONS

It is understood that memory is formed long before the brain structure be built and constituted by neurons, the information comes directly from the father's genetics where his information is transmitted through the sperm and his stimuli will occur in a more compact and concise way in the proteins sent by the mother, being the child able or not to memorize and interest more closely or being born with attention deficit hyperactivity disorder (ADHD)

A child born with a low dose of dopamine is more likely to develop ADHD, whereas people who are born with excess dopamine end up developing Alzheimer's disease.

Dopamine is fed by the amino acid extracted from tyrosine, phenylalanine, where they transform proteins into an energy source by stimulating dopamine through dopaminergic, while in the mother's belly, neurotransmitters can be regulated through the amount of proteins and amino acids by the baby ingested.

Nowadays, images recorded by neurofeedback (NF) have been of great advancement in search of a solution for the attention disorder. Through the evaluation it is possible to demonstrate that synapses should be stimulating sources for patients, where it has already been confirmed that people who suffer from this disorder are not stimulated with the same signs as people that have a normal brain. In short, it is necessary to stimulate the prefrontal cortex according to the degree of ADHD.

The compensation for the lack of neurotransmitter stimulating proteins may vary from case to case as we have seen in this article, to help in the process of memorization through synapses it is important that the proteins, amino acids formed by tyrosine, phenylalanine be part of this process to increase concentration and people's attention, properly and correctly stimulating the release of dopamine, dopaminergic, serotonin, melanin, regulating neurotransmitters to work on a regular basis.

In addition, emotion is driven by proteins which are important for neurotransmitters regulation and consequently, memorization, important foods for the elevation of emotion, as well as fruits including avocado, vegetables such as cabbage, broccoli, among others.

When proteins are part of the emotion development, serotonin is released in an appropriate manner, causing good mood to modify the subject's physiological system and consequently strengthen the engram, which will improve brain maximization and our memorization with greater focus and attention on what we do at the present time.

With the lack of proteins, transformed into amino acids by tyrosine to stimulate emotion, dopamine will need to spend its insufficient accumulated amino acids and the hormone cortisol will take action to supply the lack of serotonin, where it will lead the individual to fatigue, stress and anxiety, and consequently there will be no focus and attention for memorizing the moment lived, as memorization only occurs in a connection between the amygdala and the frontal cortex, where emotion is used to connect the new engrams emerged from the frontal lobe.

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