Refl' Action

Neuronal plasticity, memory, and hormones: what happens inside us when we reflect

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Our body and reflection: analysis of the cognitive, emotional, and sensory level

In the first article of our research,[1] we mentioned the relationship between reflection and experience/thought and action. The binomial often read in the opposition between mind and body is, for us, on the contrary, an expression of the typical uniqueness of the human being. This uniqueness manifests itself in different terms and on different cognitive levels. Precisely about this binomial, here we will summarize some "biological-chemical[2]" aspects possibly related to our reflection.

In simpler words: what happens inside our body, on a biochemical level, when we reflect? During our research, it has emerged that reflection is considered an action involving the **human being's cognitive, emotional, and sensory activity**. In terms of the functioning of our body, these activities depend on several functions, systems, and organs of the human body, such as attention, memory, the parts of the amygdala and hypothalamus, the impact of hormones, and neural plasticity, the process of the nervous system, directly connected to the concept of experience of great interest for our research.

When we talk about cognitive activity, we refer to an information-processing process included in what we define as **attention**. Attention is the function that regulates the activity of mental processes by filtering and organizing information from the environment to issue an adequate response. It plays a fundamental role in many, if not all, human cognitive actions. But it is not limited to the field of cognition. It is an example of what defines the nervous system not as a machine but as a set of functions and processes from which the human being's learning, mnemonic and reasoning abilities come to life. These functions and procedures can be read here as the expression in scientific terms of the reflective process we discussed in previous articles. Our idea is to investigate the changes that experience has the power to create in us, in their relationship to the functions and biochemical processes of our body.

It must be emphasized that there are different theories related to brain functioning and its possible or impossible connections with the life of the human being. On the one hand, we find numerous scholars engaged in demonstrating the equivalence of the human brain; on the other, many scholars are fighting to draw attention to the impossibility of defining human individuality solely about its neuronal capacities. Both theories are considered here to be of equivalent value. Leibniz wrote in 1714[3] that

[1] All our articles can be downloaded here

[2] We want to underline that this article has no scientific value, as far as the concepts covered are concerned, a more in-depth study and a broader treatment of the same in the texts cited in the bibliography is recommended.

[3] " *I have found that most sects are right in much of what they propose, but not so much in what they deny."* Leibniz to Remond, 1714

scholars' errors are often not found in what they affirm but in what they deny. The idea of this article is that in neuroscientific studies on the functioning of the human body, it is possible to find exciting ideas and valuable data for humanistic research, just as in the humanistic field, it is possible to find tools helpful in reading and understanding the same data. The writer does not have the skills to affirm any truth; he wants to offer a prospectus that, as in the case of the previous article on meditative practices, can provide exciting ideas for the research on the concept of reflection carried out in our project.

Neural plasticity

The object of great interest for our research is what in modern neurobiology is defined as **neural plasticity**. It is a characteristic property of the cerebral cortex, which consists of the possibility of the connections of the nervous system being modified by experience. The phenomenon of neural plasticity concretely expresses what is affirmed by experiential learning: the continuous flow of environmental stimuli from the world concretely affects the human being's ability to perceive stimuli, think, remember, move, learn, and look fundamental to our research to develop behavioral strategies. Even though neural plasticity is recognized as a specific feature of the developing nervous system, and with the transition to adulthood, there is a substantial decrease in this phenomenon, some studies have shown that through adequate environmental stimulation, it is possible to induce phenomena of neural plasticity also in the adult brain.

In the context of our research, a fundamental question arises about the usefulness of education in reflective practices: is it possible to educate in reflection to the point of making subjects autonomous in developing a reflective personality?

According to modern neurobiology, the answer is yes. As in the case of experiential learning, neural plasticity is shown as a phenomenon that clarifies the expression "everything is possible through continuous exercise." In one of the previous articles, we have seen how habit[4] is one of the fundamental keys to developing a reflective personality. The same is valid here.

We can train our brains to think. Indeed, the very structure of our brain invites us to continuous training, cognitive, emotional, and sensory.

A lengthy debate regarding the importance of genetics in brain development is linked to the concept of neural plasticity that we have introduced. Today it is widely believed that genes guide the early stages of brain development and the formation of neural connections. However, interactions with the environment are essential to complete the maturation of the circuits that control most of the individual's brain functions and the specific modality of each of us. In simpler terms, this means that what most characterizes us as unique individuals, different from each other, depends precisely on the contribution that different experiences bring to our growth. The processes of neural plasticity are, in fact, at the basis of the selection phenomenon, which involves the strengthening or elimination of some neural connections and leads to the definitive formation of the nervous system circuits. These changes occur during a time window

[4] Traveling the same river through different waters: reflections from the world of meditation

that is defined as a *critical period*. The maturation of different functions takes place in other moments, so the critical period should not be considered unique. Every human being goes through several critical periods during the development and degeneration of his brain system.

We have already seen how the phase in which most of these changes occur is that of development. Still, some exciting studies point out that some changes, therefore some critical periods, can also develop in the most adult phase of the individual. An example is the 2000[5] study of aspiring London taxi drivers, which revealed significant differences between those who succeeded and failed to pass the exam to obtain the qualification. Through several control MRI scans carried out over three years and by monitoring the subjects' mnemonic abilities, the research has identified a greater volume of gray matter present in the posterior portion of the hippocampus and the development of a more remarkable mnemonic ability of those who had managed to qualify. The concept of neural plasticity is still being studied, and many aspects still need to be explored and clarified. Still, the charm cannot be denied, especially the relationship to what is defined as experiential learning. The following paragraphs will discuss the general elements involved in processing emotional experiences. In memory functioning, we want to underline that neural plasticity also plays an essential role in these other sectors.

[5] Katherine Woollett, Eleanor A. Maguire. Acquiring "the Knowledge" of London's Layout Drives Structural Brain Changes. *Current Biology*, 2011; DOI: 10.1016/j.cub.2011.11.018

Emotions, hormones, and memory

In the introduction of this work, we have emphasized the activities included in the concept of reflection, such as cognitive, emotional, and sensory. The hormonal processes and functioning of the amygdala, hypothalamus, and hippocampus are of great interest in terms of emotion and sensoriality[6].

In an interesting article from 2016[7], Elena Di Donato offers a simple but complete overview of the chemical processes related to primary and secondary emotions and the components of the relationship between emotions and the organs of our body. In the article, the author defines primary and secondary emotions as the result of a chemical mechanism based on interaction with the outside world through the senses. **The origin of emotions** is identified here in the chemical reactions that take place within our body. These reactions, defined as neurovegetative, motor, and cognitive, correspond to what could be indicated as the physical manifestations of our emotions, such as, for example, the blushing of the cheeks, sweating, agitation, hyperactivity, etc., and the **endocrine system**. The brain, stimulated by external input, processes the data received by releasing the neurotransmitters; these, in turn, stimulate the endocrine system, which secretes certain hormones based on the context and therefore provides the most appropriate behavioral response of the individual about the survival of this.

Chemical mediators produced by the nervous system can have both inhibitory and excitatory functions. For example, dopamine is a neurotransmitter that, depending on the receptor involved in the process, can have both an excitatory and an inhibitory role. On the contrary, adrenaline is a typically exciting mediator and is fundamental in optimizing physical and cognitive performance about the individual's needs. In addition to chemical mediators, hormones released by the endocrine system, such as cortisol or oxytocin, are of fundamental importance. Several studies directly correlate these hormones to primary emotions. For example, the case of cortisol is associated with stress; it can trigger both alert and energy-saving reactions in the body.

Regarding our physical involvement in emotions, it is possible to identify a relationship between the organs involved in particular emotions. Taking the expression "I have butterflies in my stomach," there is a relationship between what we feel emotional and what happens to our body when we feel certain emotions. Let's think about fear; as a primary emotion, it can generate secondary emotions such as anxiety, stress, terror, etc.; when we are in a state of terror, it is not difficult to recognize within our body a reaction from our stomach, or a change in our breathing, or heart rate. Again, in the

[6] An insight into the brain components and their functions
[7] Full article here

case of joy, it is not difficult to recognize the involvement of our heart when the heartbeat suddenly increases in the face of a surprise.

From the point of view of the nervous system, there are mainly two areas particularly affected by these phenomena: the amygdala and the hippocampus. We have seen how the first play a fundamental role in the relationship with the emotional and the management of the endocrine system. On the other hand, the hippocampus interests us mainly for memory functioning—the central concept regarding reflection. When we understand reflection as a process based on collected data, we imply that this is developed thanks to many of the chemical-functional components we have mentioned. From this point of view, the **mnemonic process** plays a significant role. It is precisely thanks to our ability to remember to keep sensory, cognitive, and emotional data that we can reflect. But how is this data stored?

First, it should be emphasized that memories are not single data stored within our brains. On the contrary, it is the union of more information deriving from our senses and filtered by perception. In the complex mnemonic process, several parts of our brain are involved, some active in the recording function, others concentrated on data maintenance: the **hippocampus**, the **amygdala**, the **cerebral cortex,** and the **frontal lobes**.

The **hippocampus** is primarily involved in acquiring and consolidating memories. All the information that in the future will constitute the memory first passes through the hippocampus and the areas that surround it and subsequently reach the other brain structures involved. The **amygdala**, located near the hippocampus, reacts, as we have seen in the previous paragraph, to emotional experiences and "classifies" them according to their importance. Once the amygdala has classified the memory, it is distributed in different areas of the **cerebral cortex**. The role of the frontal lobes is related to the attention we mentioned in the introduction. Indeed, thanks to the frontal lobes, we can focus and maintain attention on what we consider essential.

A machine that doesn't work without magic

In his exciting work, *Out of Our Heads: Why You Are Not Your Brain, and Other Lessons from the Biology of Consciousness*[8], the philosopher of science Alva Noë argues a critical theoretical position regarding the brain/identity relationship. The author wants to underline the importance of aspects related to the functions performed by the nervous system and deny the affirmation that the individual is defined by his brain action[9]. Taking a cue from the concept of consciousness, Noë underlines how this cannot be traced back solely to the human brain because the neuroscientific explanation, from his point of view, does not conclude the questions that the history of thought asks about what consciousness is.

Without going into the specific merit of the debate between the philosopher and neuroscientists, Noah's opposition to theories that see the brain as the key to understanding the human being underlines an essential aspect of our thinking and reflection. That of the sphere of interaction with the outside world. The philosopher does not deny that the nervous system plays an essential role in our existence, but he wants to understand that this is not enough to define us. The primary element that, from his point of view, is not considered by explanations of this type is that of interaction with the world. In this work, we have highlighted not so much the points of disagreement as what could be called a strong communication bridge between the two theoretical worlds.

Neural plasticity, the functioning of the endocrine system, the correlation between emotions, their physical manifestations, and the biochemical processes that underlie them: are all human functioning. These elements do not take humans away from their experience of interaction with the world. On the contrary, they are part of it. It is not stated here either that man is his brain or that he is not. Taking up Kolb's experiential cycle, we believe that humans develop and learn thanks to their experiences and the spontaneous work of reflection that acts on them. This work is influenced as much by the cerebral reality of every human being as by the interactions it has with the environment. From this point of view, neural plasticity is not the only explanation of a phenomenon; it is the functional and scientific part of a complex process that does not end either in the scientific field or outside it. Meditative practice experts invite you to control your breathing. Neuroscientists tell us that breath influences our emotions (therefore, our well-being). Philosophers tell us that a breath has not one but millions of meanings.

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[8] Alva Noë, *Out of Our Heads: Why You Are Not Your Brain, and Other Lessons from the Biology of Consciousness*, Hill and Wang, 2009 New York

[9] In contrast to the theories promoted by Francis Harry Compton Crick, neuroscientist and biochemist, Nobel Prize for medicine in 1962

Whatever name we want to give to reflection, whether we understand it as the result of biochemical processes that take place inside our body or as the result of a historical, conceptual evolution lasting centuries, the fact remains that, even if we change the theoretical framework of reference, it is confirmed as the primary tool of human evolution and learning.

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