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The brain involved in Design

O cérebro envolvido no Design

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ABSTRACT
Neuroscience helps us to understand one of the most relevant aspects: the understanding of the role played by the brain in our biographical history and how the human being confronts the dilemma of existence, therefore, it supports us to understand the role of designers as professionals of intentional visualization and how to face the paradoxes that come into play in design processes. A little more than two decades ago, not so much information was known about the brain due to the lack of resources to study and research it. Medicine, like any other science, is based on observation. Once the person died, they looked at what happened to that brain and drew conclusions. In many cases, neuroscience accepted the lesions found and subsequently observed, but not in all cases. The brain keeps a map of the evolution of species, which is nothing more than the result of a journey of millions of years from the condition of the tiniest cell; It's a primitive, primal story that houses our Homo *sapiens* brain. The term neuroscience is relatively recent. Its current use corresponds to the need to integrate the contributions of the various areas of scientific research and clinical sciences for the understanding of the functioning of the nervous system. Today's brain scholars know that in order to understand it, it is necessary to break down the barriers of traditional disciplines to mention just a few of the areas that have been created, largely to characterize the methods of study. This tendency is very evident in recent scientific works which deal with the most complex functions of this organ, such as emotions and consciousness, based on the main concepts from the various disciplines (Gross, Rocha-Miranda & Bender, 2001, p. 96). As an object of constant study, our brain approaches an epistemological condition of robust and full neuroplastic complexity, since it resides: memory, effects, perceptions, feelings, intelligences and consciousness. Everything we pay attention to and that emerges strongly in our field of learning is what we understand based on our cognitive processes, and we are capable of questioning what happens in the brain and, when we do, we also modify it.

Keywords: Design, Brain, Neuroscience, Cognition, Neurodesign.

1 INTRODUCTION

What differentiates us from other species (at least that's what we know so far) is neither how nor where we are, nor whether we walk straight, nor the intensity of our feelings. The most

relevant thing is how we use our intelligence in relation to consciousness and how many neural networks code, flow and link together to create fields.

Human beings have a great capacity for consciousness, perhaps the greatest in the entire animal kingdom. This fact has made us different, stand out, develop cultural and technological products, but we also keep within ourselves from the most primitive areas. This primitive, social and neurobiological memory allows us to access a great deal of intergenerational and interspecies knowledge.

Recognising the neuroscientific concept of *learning* brings us closer to the keys that neuroscience can offer to the field of design education. It is important to underline the fact that this immersion is based on neurodiversity**,** attending to unavoidable thematic axes and without forgetting that this is based on the management of uncertainty and permanent becoming.

Neuroscience in design, or neurodesign, is an interdisciplinary discipline that asks us to give it the attention it deserves. It seems to follow from current neuroscience that the emotional brain is responsible for all creative activity, for motivating action and driving it (Ledoux, 1999).

Never as much has been known about the brain as has been researched in the last twenty years, and there is no telling where it will take us in the coming decades. This is a great paradox, and managing it is not easy. For design, it is significant to obtain essential keys to know the various capacities and increase them for the benefit of personal and professional development, given that, in the brain, there are answers that make us know what we have been and what we will be in the coming years.

A fundamental thematic axis is the relationship between technology and design, something that is mutating and shaping the new disciplinary paths based on the evolution of digital resources that are worked as metaphors for brain processes. Another foundation is the viable relationship between neuroscience and design, an essential terrain when we want to fully address the competencies and keys to how we learn to design.

A transcendent issue is located in the basic mechanism known as synaptic plasticity. The value we place on synaptic connections depends on how neurons associate, destroy, or link based on the value we place on design development. Neurodesign will thus be the transdiscipline that applies neuroscience and psychology to all design processes.

To address brain neuroplasticity, Hebb's Theory is considered here , which talks about how neurons connect to form their cellular assemblies, an important theory to understand how we learn and how we apply it in all praxis. Hence the neuroscientific idea that *learning to design does take up space*.

Whether the brain learns no matter what, the quality depends on the stimuli and challenges it faces. The designer's first challenge is to create a resonant environment so that he himself is able to resonate with it. This refers to the concept of the father of positive psychology, Martin Seligman (2007) about the three capacities: *connecting, relating and* developing.

Paraphrasing Alexander Luria (1984), one of the founders of cognitive neuroscience, from his heuristic thinking, it is described as the branch of science that studies the neurological bases of cognitive and creative abilities giving rise to neurodesign. Its purpose is to provide a source of potential development in cognitive, emotional, imaginative and inventive areas by studying and structuring where design skills are produced, developed and enhanced.

> With Luria's proposal, the localization of brain functions is overcome and progress is made towards an understanding of brain functioning as a product of the interaction of various functional units, which allow human beings to carry out mental and behavioral activity. From this author's perspective, the brain is configured into three functional units, where the first is responsible for regulating cortical tone and wakefulness; the second is to receive, process and store the information; and the third functional unit, which is responsible for the planning, execution and verification of cognitive and behavioural activity (Ramos-Galarza et al., 2017, p. 55).

These design capacities, also called creative-cognitive, add both the intellectual ones: attention, perception or memory, to the so-called primitive functions, which are more associated with metacognition: planning, projecting, structuring, making decisions and monitoring behavior to modify it and bring it to the intricate world of praxis. These cognitive abilities are based in the most frontal part of our brain known as the neocortex.

Daniel Goleman (2018) states that emotional intelligence is the most important of all intelligences (a position not exempt from criticism), although emotions play a very important part in the brain. All our capacities are neutral, amoral. Our intelligence depends on emotions and the ability to think about any action in the long term. It is critical to raise designers' emotional quotient and their understanding of neuroscience in order for them to understand this. Based on cognitive neuroscience, neurodesign takes this to benefit the design process, thus developing its full potential. Neurolearning studies the entire brain as a system of systems in which cognitive, creative, and metacognitive faculties operate.

> Neurolearning is an essential tool for the trainer of these times who knows that the only sure way to achieve a promising future is to contribute to the formation of beings capable of self-management and self-improvement [...] teachers interested in the construction of knowledge are needed [to] achieve the meaning and understanding of the contents [...] (Pherez, Vargas & Jerez, 2016, p. 150)

Until a little less than two decades ago, designers did what they could with the resources provided by some areas of knowledge and we did not have information about the brain and its links to our discipline. By observation, when a new theory appeared, we merged and applied it eclectically. Now, with the contributions of neuropsychology, we have a lot to study and learn. We know that it is an open discipline that is constantly changing and that it is a great conceptual paradigm.

> In the last decade of the last century we have begun to understand that brain and mind are the same, that is, that all mental processes are due to brain activity and that all brain activity produces mental processes. [...] This is the main concept that underlies the heyday that neuropsychology is experiencing today. [...] Neuropsychology proposes a model and a level of analysis that allows it to be placed between the most mentalistic and the most neurobiological models, with which it unites mind and brain. (Tirapu, 2011, p. 12)

On many occasions, the work of scientists has been compared to that of visual artists, since both take a raw material and mold it. A scientist or a designer has an obligation to know what raw materials they are working with. This is knowing the brain, knowing that each designer has a unique brain, with unique styles of learning and application, of practice and materialization. This is one of the great challenges we have to face. Knowing this, let's capture a seed that can actually grow and develop. To design is to stimulate key points of the brain, to open possibilities, to generate resources, to gather material supports and to raise challenges so that the designer's mentality is motivated and initiates the dialectical process of opening, conceptualizing and materializing ideas.

Socrates sums up this stimulus in one sentence: I can't teach you anything, I can only teach you how to think. In Zen, the most valid thing is not the answer, but the one who knows how to ask the right questions. That question, that encouragement is important.

You have to know your brain to know what seed to plant in design. The brain is the organ of design because it has neuroplasticity, which allows it to reorganize and adapt throughout life. That's why mobility and innovation in design is possible.

We know that the basic unit of the nervous system and learning is the neuron, and that the neuron, in turn, forms a network. A group of neurons communicates by forming synaptic processes through chemicals that weave networks. Every learning in design is a synaptic network, and we know that, in order for this large neurological learning network to consolidate into what is designed, it needs to make use of long-term memory through great emotional impact or repetition with novelty.

> The process of synapses or interneuronal communication and the way in which these cells form networks that transmit the impulses that stimulate the brain and promote its action as a central processor, are of relevance for the achievement of learning. Through this process, neuronal plasticity can also be observed, which is the ability of the nervous system to promote neuronal contacts, and synaptic efficiency, in response to internal and external stimuli received by the brain. (Velázquez, Remolina & Calle, 2009, p, 331)

If I always repeat the same way, the brain does not use more neural circuits, since it always makes the same itineraries, which is why the whole theory of multiple intelligences is so important, according to which we are all capable of learning from different paths of intelligence.

The key is creative repetition so that you can access information from different sides and reach long-term memory in a variety of ways. The functions of the brain and the possibilities of learning are some of the foundations for understanding the mechanisms of design in the mind.

It is possible to carry out numerous activities but apply them from the same intelligence, from the same modality, from the same conception of the design process, however, this is not how project trajectories work. It is based on the principle that teachers with visual training will tend to give visual priority in their didactic structure without confronting other learning trajectories. A design content can be worked on in different ways during different stages of learning, but it should be noted that using different activities does not mean that different forms of learning are appealed to from the point of view of neuroscience.

2 DESIGN AND NEUROPLASTICITY

Neuroplasticity is a relatively new concept, it refers to the ability of the brain to change itself because it is a plastic organ because it renews itself or rewires its circuits.

> Neuronal plasticity is the ability of the central nervous system to adapt [...] or to adjust to new environmental requirements, i.e., to learn. This means that our brain is constantly changing and if these mechanisms could be better understood, strategies would be implemented to modify it for a specific purpose [...] these changes in neurons would produce, according to some theories, new neural networks (new synapses), replacing the neural networks that existed [...] neuronal plasticity can be modulated with different cognitive strategies [among which are] cognitive [because] it is learned and recovered faster when There is a significant degree of attention [...] (Frausto, 2011, p. 38)

As Kleim and Jones (2008) put it, "neural plasticity is the mechanism by which the brain encodes experience and learns new behaviors [...] whereby the damaged brain learns the behavior lost in response to rehabilitation." Neuroplasticity is a process, in which the brain forms new neurons and establishes alternative connections, new synapses, in response to learning, configuring alternative pathways to replicate learned behaviors.

It is necessary to clarify that neuronal plasticity does not occur in a vacuum, it will depend on experience, and some experiences will make a greater difference than others. There are some important principles for facilitating the neuroplasticity of designers, which are described below.

First, designers, like any other professional, need to be aware that a lack of management of brain functions can lead to the loss of skills. This is evident with people subjected to long immobility treatments, when they are asked to walk again or to demonstrate some of their skills, they are unable to do so. Training routines are required to recover in your memory certain brain functions that are usually as elementary as walking or eating.

By consistently practicing a skill, it will be significantly improved. Therefore, when children or young people dedicate themselves to training some skill with games such as the Rubik's Cube, they establish the fundamental parameters and later move on to other challenges such as improving times.

The nature of the training experience or mental exercise will always dictate the nature of the possible brain changes. Plasticity is linked to the flexibility to accept any alteration in predetermined routines and for this it is important both the magnitude and the insistent reproduction of the learned parameters and, therefore, the time dedicated, since the brain can respond in different periods and permute learning at any time, it is not possible to predict it.

Prominence matters, i.e., the training experience must be meaningful to the person in order to bring about the change that neuroplasticity implies, and while it is true that this happens more easily in young brains, it is also true that the age of the brain does not depend on biological age.

> Neuroscientists have established very well that the brain has a very powerful and well-developed capacity to change in response to the demands of the environment: a process called plasticity. This involves the creation and strengthening of some neural connections and the weakening or elimination of others. The degree of modification depends on the type of learning that occurs: long-term learning involves more profound modification. It also depends on the learning period: young children experience extraordinary growth of new synapses. However, a profound message is that plasticity is a central feature of the brain throughout life. (OECD, 2009, p. 20)

When changes occur in brain processes, it is possible for transfers to occur leading synapses towards the learning of other skills similar to the one that was sought to be developed. It is the opposite of the interference process by which a bad habit obstructs the learning of a good habit.

It should not be overlooked that design learning is in a constant exchange of sensitive periods since it permanently faces the challenge of solving problems of a creative nature, these are, in short, loopholes for learning. The point is that, in all tasks driven by creativity, there are

critical lapses, it is the blank canvas, they are moments in which answers to communication needs are not found and the first images remain insistently repeating work schemes.

All creative thinking works dialectically with critical thinking, an idea will correspond to a concept and its consequent materialization or, as Csikszentmihalyi (1988) states, these nodes can be translated as talent, field and field that affect in correspondence with the individual, discipline and creative judgment.

The practice of design is understood as a systemic act of a professional nature under the methodological framework for the construction of a project that is not developed in the field of intuition. The objects designed and their reason for existence have their foundation in praxis. In this regard, Bruno Munari (2016) points out the convenience of establishing the distinction between the professional designer who uses a project method and the improvised one who leaves the emergence of a 'brilliant' idea to chance.

The design method consists of a series of indispensable operations arranged in a logical order dictated by experience. It will always be necessary to take into account the social reality and the values involved in the meaning of signs. "All the products of design practice can be studied from various angles: technical, aesthetic, etc., but mainly from three fundamental areas: form, function and significance." (González, 2007, p. 20)

Every designer, like any other creative professional, requires a constant change of manners or mental patterns, they can work all their lives under the same paradigm, however, within that territory they break the schemes again and again, that is why when we see certain works of art or design we recognize the author, however, We recognize that it is not repeated, that in some way it reinvents itself and this happens because it is capable of carrying out new neuronal connections with great plasticity, either reinforcing the original learning or implying new paths.

> From a neurobiological approach, vision has a broad brain representation with high levels of functional specialization that clearly reveal a multifunctional character in human activity. We find highly specialized implications that allow a specific response for the identification of light, color, shape, movement, etc. [...] we also find higher levels of complexity from the interaction with other sensory feedback systems that modulate, regulate and orient each other [...] From a cognitive approach, vision can be considered as a process of mental representation that can be analyzed in a structural and functional character. (Chávez, 2012, p. 102)

Vision is a phenomenon of active reception, which becomes evident when analyzing the vast representation it has in various regions of the brain, which is why creative fields are referred to as those in which the ability to create cortical maps is more developed. Even so, there are internal and external factors, dependent and non-dependent variables that generate states of alertness or

stress and impede neural processes. It should not be forgotten that there are chemical processes involved in neuroplasticity sequences and that some elements could hinder neurogenesis in a designer or an artist.

> Information is stored in the brain in the form of connection intensities between neurons. These connection intensities allow the brain to produce a certain output in response to a specific input [...] the neuronal processing of information takes place through the transmission of activations in a very high number of synapses, involving a very high number of neurons [...] the nerve impulse is electrical, but the transmission from one neuron to another is not electrical, but chemistry. The "intersynaptic space" is dominated by "neurotransmitters," chemicals that transmit, block, and modulate nerve signals. Our behaviour is therefore influenced by chemical components (serotonin, dopamine...), which has led some authors to say that we actually have a "chemical brain" [...] (Bernal, 2011, p. 20)

Designers are always in a constant search for solutions that refer to creativity in response to the demands of form, function and meaning. It will be necessary to understand the scope of the strategic systems proposed by neuropsychology within the framework of visual language.

The form expresses itself in an infinite universe of creative possibilities, delving into imagination and metaphorical interpretation. The implications lie in the sensitivity of expression, in the openness to the various forms of thought, in the understanding of the seemingly incomprehensible.

Visual language is ubiquitous par excellence, present in the communication of human beings. Creative representation away from traditional rigid doctrine translates into joy of experience

> [...] the creative individual is a person who regularly solves problems, develops products, or solves new issues in a field in a way that is at first considered new, but is eventually accepted in a particular cultural setting [...] a person must be creative in a field [exhibit] his or her creativity on a regular basis and [be culturally accepted] (Gardner, 1999). 2011, p. 63)

The experiences of alternative thinking is the liberating stage of the spirit where ideas are materialized through design and visual configuration. The grammar of design shows the formal side of the signifier that at the same time is presented under the metalanguage of visual expression where reality can be seen through the optics of metaphor, a subjective thought that teaches a kinder vision of the world by unfolding the essence of the creative being.

3 CONCLUSIONS

Design is a complex of actions aimed at solving a problem and satisfying a need, in this profession we work with three main aspects: messages, objects and spaces with which it constantly carries out multisensory interventions in perceivers, receivers or users.

The point is that, if we only work on the training of designers who are experts in matters related to form, we lose a transcendent element, which is the work with the substance, the content, the meaning and with it the meaning of what is designed.

This is also learned through the mastery of those actions that will provide a response to the intentionality of the act of designing, this supposes the involvement of the brain in all design processes with the consequent understanding that only plasticity, understood as the flow of ideas and the deepening of their materialization, will be a fundamental resource to professionalize design in another way. The guide would no longer be the dictates of marketing, the guidelines would be from the same background as the design.

For this reason, a pedagogical intervention is proposed here in the educational proposal of the Faculty of Arts and Design of the UNAM to transform the context, achieving another performance on the part of the students. The idea is, based on the implementation of a didactic unit, to interpose gradual modifications in the curriculum of the bachelor's degree in visual communication design by identifying ways in which a student can approach meaningful experiences. (Gardner, 2001).

If a design student manages to understand the remarkable possibilities of elaborating visual proposals based on substantive elements such as context, semantic memory and mirror neurons, he will achieve the involvement of his brain in design decisions and thus establish new paradigms of design that would thus be based on thinking design and feeling design.

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