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BEHAVIOURAL HUMANOMICS IN ANTHROPOID BRAIN

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ABSTRACT

New brain imaging technologies have motivated neuro - managerial science studies of the internal order of the mind and its links with the continuum of managerial (humanoid) judgements from judgement making among fixed gambles to judgement making mediated by market and other institutional rules. We are only at the beginning of the enterprise, but its promise suggests a fundamental change in how we think, observe and model judgement in all its contexts. Vernon Smith Currently, the continuous advances in Neuroscience allow us to know which brain centers are activated during most of the episodes of our daily life. The different brain structures that we anthropoids have allow us to accept or reject the different alternative courses of action that are presented to us at each moment, analyzing their convenience or not, but in a broad sense (permanent interaction between the deliberative system and intuitive system), and not under the simple hyper-rational cost-benefit calculation of the Neoclassical Anthropoidomics, which considers the selfish anthropoid being, with unlimited will and unlimited analysis power, which is quite far from reality.

Keywords: Behavioural Humanomics, Anthropoidal Brain And Neuro System.

For we all agree that the most excellent man should rule, i.e., the supreme by nature, and that the law rules and alone is authoritative; but the law is a kind of intelligence, i.e. a discourse based on intelligence. And again, what standard do we have, what criterion of good things that is more precise than the intelligent man? For all that this man will choose, if the choice is based on his knowledge, are good things and their contraries are bad. And since everybody chooses most of all what conforms to their own proper dispositions (a just man choosing to live justly, a man with bravery to live bravely, likewise a self-controlled man to live with self-control), it is clear that the intelligent man will choose most of all to be intelligent; for this is the function of that capacity. Hence, it's evident that, according to the most authoritative preference, intelligence is supreme among goods.

..... Aristotle (in 'Protrepticus')

I. INTRODUCTION

Anthropoid organisations are at crossroads (to explain economic behaviour) with hemato - cerebral science (in what way expanses of brain may be pertinent to management and managerial behaviour) and ethics - based business laying a duct (chromosomal perception; interrelation between hemato - cerebral discipline and preference making) that seems an inconsistent guestimate with unbounded 'scrolling' and 'interpolations' in 'disruptive hemato - cerebral' guestimates. Inquiry is witnessing an ever-increasing aggregate of multilevel research in organisational studies that assimilates delineated research domains and propositions novel lens for understanding ethics - based business practice. A recurring phenomenon i.e. disruption, global ethics - based business arena is plagued with 'non - orthodox ethics - based business replicas' and 'disruptors'. There is a 'noise' for a disruptive strategy to make techno - innovation ('technology' and 'innovation') a reality via unconventional strategy. Organisations are voyaging through 'busitagion' ('ethics - based business' and 'contagion') spells, with reality changing and evolving continuously. Global 'busitagion' order shifts have led to 'Homo - Psychoeconomicus' that replaces 'Homo Economicus' by reflecting how individual managers are influenced by psychological factors, biological factors and economic dynamics (Satpathy, J. et. al.: 2018).

Management is considered to harbour three dimensions; 'Technical', 'Conceptual' and 'Human'. (Algorithmic) judgement is observed to be some form of a tenacity to conduct in a particular mode. Naivest reason offered for is that it involves some sort of a choice or predilection / preference and is an obligation to that choice or predilection / preference. There is a need to understand, predict and control judgement dynamics in managerial behaviour. Whereas judgement model concentrates on how to makes choices amongst substitutions, it recompenses little or no attention to how one classifies obtainable substitutions or how goal often stimuluses what those accessible substitutions will be. It is a truism that currently 'data-driven' judgement making landscape is encouraging organisations to adopt a metamorphosis from contemporary to transformation routes thereby compelling sustainable trades to alter core practicalities of (algorithmic) judgement making. To reconnoiter such newfangled prospects in managerial data science, sustainable trade dynamics in its universal arrangement have escorted changes in judiciously controlled laboratory settings. This paper is responsible for making a brief introduction about the anatomy and functioning of the nervous system of anthropoid beings and about the main techniques available today to approach their study (neuroimaging, transcranial magnetic stimulation, among the main ones), these last instruments today of very high utility for advances in Neuroanthropoidomics, although still perfectible.

II. HISTORICO

'If we ought to philosophize, we ought to philosophize, and if we ought not to philosophize, we ought to philosophize; in either case, therefore, we ought to philosophize. If rationale exists, we ought certainly to philosophize, because rationale exists; and if it does not exist, even so we ought to examine why it does not exist, and in examining this we shall be philosophizing, because examination is what makes rationale'

...... (Aristotle).

'Arbitrium' (Latin), 'Entscheidung' (German) or 'Euboulia' and 'Apófasi' (απόφαση in Greek meaning capability in cooperation to measure for one's self and to be able to distinguish good reflection and cogent preferences in others**)?** From the notes of Aristotle (384 - 322 BC) who propounded systematic pragmatism, to Occam (1287 - 1347) - progresses in reason that promoted the issue resolving proposition that systems should not be proliferated unless it is a pre-requisite (gesticulating that 'plurality must never be posited without necessity'), to Francis Bacon (1561 - 1626) inductive hemato - cerebral, to Descartes (1596 - 1650) bid of injecting scientific method, resolution in the 21st Century has initiated an hemato - cerebral and rational transformation to replace svelte expressions like make up one's brain, bring to a persistence in one's brain and style a choice from available and identifiable substitutes, to list a few. Extensive, comprehensive and primordial anthropological quest, what really is a preference, ruling, verdict, judgment, resolution? Is it an inference or insistence arrived at after contemplation, maneuvered utilization or progression of determining to some degree or of agreeing to a simultaneous query or simply a skill or inclination to make preferences nippily with conviction and arrive at functional inferences? A pet child of Chester Irving Barnard (1886 - 1961), preference and preference dynamics has revolutionized the ambit of functional management theory and operational organizational studies.

Aristotle, who was of the firm judgement that Anthropoids have a rational soul that can experience sensations and thoughts with the innate capacity to absorb forms of varied objects and to relate them using the brain and logic, and present a compounded amalgamation of the several suppositions collated with logic and observation to make general, causal claims. He studied that the derivable rationality of any conflict can be determined by its architecture rather than its internal components. He believed that the study of the environment would be the major type of comprehension, if there were no other individualistic objects apart from the blended and complex innate ones. However, if there is any inanimate individualistic object, the understanding of the same dominates and is the initial credo to guide a person. It automatically becomes ubiquitous as it is initial. Moreover, it is a kind of understanding which comprehends a vital force as a vital force, a life as a life; just by virtue of its existence.

'Judgement making is an abstract term referring to the process of selecting a specific option among a set of substitutions expected to create various outcomes. Accordingly, they can be used to describe a very wider range of behaviours, ranging from various unicellular organisms to complex political behaviours in human society. Until recently, two different approaches have subject the studies of judgement making. On believe that, a normative or prescriptive approach focus the question of what is the best or optimal choice for a given type of judgement -making problem. For example, the principle of utility maximization in economics and the concept of equilibrium in the game theory describe how self-interested rational agents should behave individually or in a group, respectively. An significant lesson from cognito - biological research on judgement making is that actions are chosen through coordination among multiple brain systems, each implementing a distinct set of computational algorithms'

…….. (Dayan et al., 2006).

'Technology has had a spectacular impact on the practice of human resources in various fields, and its impact is extremely fast increasing. In-spite of that small research has done on how to apply information systems and human-computer interaction principles to designing human resource information systems. In this paper, authors focus more closely on the role that the interface between the computer and human play in the success of electronic human resource management. Specifically, we a) briefly review the individual requirements of several eHRM functions (e.g., e-recruiting, e-selection, e-learning, e-compensation/ benefits), b) consider how an understanding of human computer interaction can facilitate the success of these systems, c) reviews research on technical issues associated with eHRM, and d) highlight how applying HCI principles can increase their operation. As per the study success of eHRM depends heavily on the interface between the computer and the user (e.g., applicant, employee, manager). The design of the interfaces that support HR practices and help overcome the challenges of competing tasks and interacting with others online should lead to more successful eHRM outcomes. Scholars from the fields of information systems and human resources have come together with the goal of investigating how one can apply IS and HCI theories to the HR context to develop more robust and operational HRIS'

…….(Richard D. Johnson**)**

Aristotle believed the chain of thought, which ends in recollection of certain notions and judgements, was associated methodically in relationships such as similarity, disparity and propinquity. The first imperative was not to deliberate in a state of hurry. Second imperative was to verify all information. Third imperative was to consult and listen. Fourth imperative was to consult or at least look at the situation from the perspective of all parties who will be affected. Fifth imperative was to examine all known precedents. Sixth imperative was to calibrate the likelihood of different outcomes. Final imperative was to apply just preferences by weighing evidence and deliberating each case individually. Don't multiply entities beyond necessity. One should handpick a solution with least suppositions. This was propounded by Occam (1287 - 1347). He opined that if there are two elucidations and conclusions that make the same prognosis, the one which is backed by the lowest number of suppositions which have no corroboration, is preferred, until more evidence and authentication comes along. First mandate was that the naivest elucidation is practically constantly par aggregate. Second mandate was ceteris paribus, one ought to choose a path that develops from scarcer guesses or suppositions ('Entia non suntmultiplicandapraeter necessitate'). Third mandate as to explicate singularities by unassuming postulate conceivable. Swinburne (1997) is of the belief that the easiest conjecture propounded as an elucidation of situations is more likely to be the authentic and fact-based one, than in any other available conjecture. Also, that its forecasts are more likely to be true than those of any other available postulation. Also, that it is an ultimate deduced and self-evident hemato - cerebral principle that lucidity is an attestation for truthfulness. Influential in replacement of Aristotelian viewpoint, Francis Bacon was of the view that the most intense delusions inherent in the thinking process of Anthropoid beings are impacted and influenced by unscrupulous predilections, which tend to negatively affect the prolepsis and comprehensive power of the Anthropoid brain. Francis advocated for prospect of logical understanding grounded upon inductive hemato - cerebral and cautious reflection of measures. Individual has predilections surrounded by choice substitutions that permit to state which alternative they choose.

James A. Barham believed that on one hand, using perception about Anthropoid beings and their nature and explication of lucrative deportment dates back to the origin of the subject of economics itself. Implying that all lucrative and remunerative studies are based on the turn of brain in a prevailing perception. In order to elucidate the hemato - cerebral and neural foundation of resolution, probable to route manifold options and decide on an optimum arrangement of action, specifically in managerial framework via cognitophysiological source of numerous behaviours to infer the apparatus behind management undertakings from level of cerebrum science and consequently proposition conforming management trials and stratagems has gained ascendancy. Anthropologically 'Anthropoid' beings style preferences in a framework of restricted prudence (inadequate evidence, hemato - cerebral boundaries of brain besides determinate quantum of time for a

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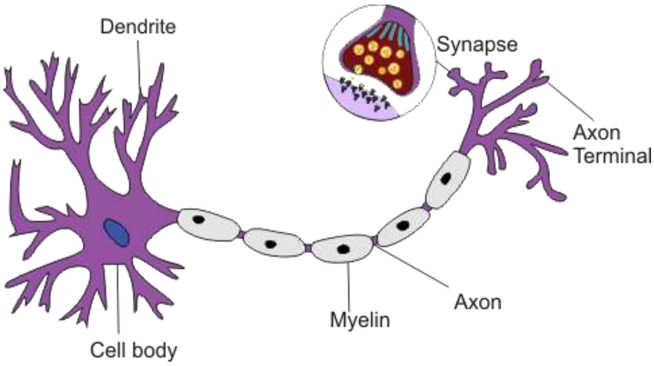
preference), subject to predispositions and clamors that lead to comport sub optimally from what neoclassical economics proposes. Behavioural economics has been displaying this portent for decades. However, disrupting convergence of hemato - cerebral cognitoscience, psychology and economics, has constructed a fusion pitch christened 'Cognito economics' ('cognitomanagement'), which with variable approaches unlike traditional is building, at augmented stride, an integrated rationale on Anthropoid resolution (Laza; 2008).

III. SCOPE AND AIM

Outcomes and inferences are inescapable part of the pursuits of a Anthropoid being, and life everyday is a arrangement of such resolutions. Conceptual elucidations propound discernible calculations. However, management had no concrete elucidations to some factual queries it could contrive in resolution techniques. Idiosyncratically, investigators are interested in suppositions, philosophies, behaviours and maneuvers to make preferences. Over the past few years, insightful management has divulged cogent and significant remedies to those queries. Investigation and monitoring has guided insightful management to arrive at irrefutable, scientifically backed elucidations, easing inferences; rather than uncorroborated suppositions. Any recapitulation of managerial effort would need elucidation of substrates, apparatuses and capricious properties of influence upon hemato - cerebral functions. Insightful resolution propositions tools for modeling behaviour. While varied functions are arriving at different indicative applications and making conclusive headway, the question of how managers map and outline resolutions via intellect support, impacts insightful managership. Some erudite studies assimilate dominions and center on incipient concerns, current deliberations besides continuing insinuations. Managers' attempt at optimal 'ethics - based business' preferences through orientation and approach - based scheming till 'response threshold' is stretched.

To introduce ourselves in the subject, and following the very complete introduction of Alfredo Navarro[i], the first thing we must know is that the anthropoid brain is made up of approximately one hundred billion cells - neurons- connected in a very complex way, formed by a body from which two types of extensions emerge: the axon and the dendrites. The axon is a filiform prolongation that can reach great distances, whose end dilates forming the synaptic ending, which adheres to the dendritic spines of neighboring neurons. The dendrites are several small and short extensions that have tiny protuberances called dendritic spines.



Neurons are surrounded by cells of the glia, which serve as support, contribute to the arrival of blood flow, coat the myelin axons, phagocytosis the remains of neurons that are destroyed and transmit the information by means of electrical impulses by the axon -presynaptic- to the dendrite of the postsynaptic neuron. The electrical impulse passes from one neuron to another through the synapse, with the participation of chemical substances, the neurotransmitters, released in the synaptic endings of the axon. There are many neurotransmitters with different specific functions in the neuronal circuit.

The endings of axons have been called biological transducers, because they convert electric energy into chemical energy. This involves the synthesis of neurotransmitters, their storage in synaptic buttons and their release produced by nerve impulses in the synaptic junction, acting also as receptors in the membrane of the post-synaptic neuron. Once the function is completed, the neurotransmitters are reacquired by the neuron that secreted them. There is a large amount of neurotransmitters: dopamine, noradrenaline, acetylcholine, etc., whose secretion is determined by the function of the different brain sectors. For example, dopaminergic neurons, which release dopamine at the terminal pole of the axon, project to many regions of the brain, committed to goal-directed behavior and motivations, including the striatum, the nucleus accumbens, and the pre-frontal cortex, participating in the emotional activity and in the act of selection. It is supposed that the release of dopamine regulates the plasticity of the neurons that produce decision actions, such as those of the prefrontal cortex.

Neurotransmitter molecules bind to specialized sites of the postsynaptic neuron. The sites are complex protein molecules located in the neuronal membrane, which expand and change their shape when they bind to the ligand (in this case, a neurotransmitter). This change in shape allows the entry of positive ions that depolarizes the postsynaptic membrane by exciting the cell. The communication between the neurons is reached when the neurotransmitter released from the presynaptic neuron affects the postsynaptic neuron by exciting or inhibiting it. Many thousands of postsynaptic sites in the dendrites of a neuron can respond with depolarization or hyperpolarization for a few milliseconds.

IV. NERVOUS SYSTEM

Brain is not augmented for signing judgements. Brain is constantly subjected to tastes, beliefs, choices, preferences and cognitive palates of any individual. Brains do not aid in judgement making based on characteristic significance but what they propose beyond other probable schemes. While making or contemplating judgements, one generally swings back and forth amongst substitutions, towards gathering support for each alternative in a manner that purportedly seems to be driven by attention. How to optimise judgement making? This is a clear case of 'attentional drift diffusion'. Catecholaminergic cognito - cadence (collection of cognitions in central nervous system) is critical for numerous aspects of behaviour Size of brain is dictated by the cerebral cortex, Special reference is towards the set of frontal lobes that are associated with executive functions i.e. (algorithmic) managerial judgement making. The continuum of cerebral cortex is functionally oriented towards (managerial) vision.

The nervous system is constituted by the nervous tissue of the organism and the associated support elements. From a structural or anatomical point of view, the nervous system is divided into two; the Central Nervous System (CNS) and the Peripheral Nervous System (SNP). The CNS is made up of the brain and the spinal cord, while the SNP includes specialized nerves, ganglia and receptors.

On the other hand, from the functional point of view, the nervous system is divided into the Somatic or Voluntary Nervous System and the Autonomic Nervous System (ANS), involuntary or visceral. The somatic system is the part of the nervous system that responds or relates the organism to the external environment, whereas the autonomous system is in relation to the organic internal environment, performing internal regulation and adaptation functions. This system in turn includes the sympathetic nervous system (composed of thoracic and lumbar nerves) and the parasympathetic nervous system (constituted by cranial and sacral nerves). The sympathetic and parasympathetic sectors of the autonomic nervous system are functionally antagonistic. Both the Somatic Nervous System and the Autonomous System are interrelated and cooperate with each other, they do not act independently.

The function of the nervous system is to receive the stimuli that come from both the external and internal environment of the organism, organize this information and cause the appropriate response to occur. The stimuli coming from the external environment are received by the receptors located in the skin, destined to capture general sensations such as smell, touch, pressure and temperature, and by receptors that capture special sensations such as taste, sight, smell, heard, position and movement. The signals (or impulses) that reach the peripheral nervous system, are transmitted from these receptors to the central nervous system, where the information is recorded and processed conveniently. Once registered and processed, the signals are sent from the central nervous system to the different organs in order to provide the appropriate answers.

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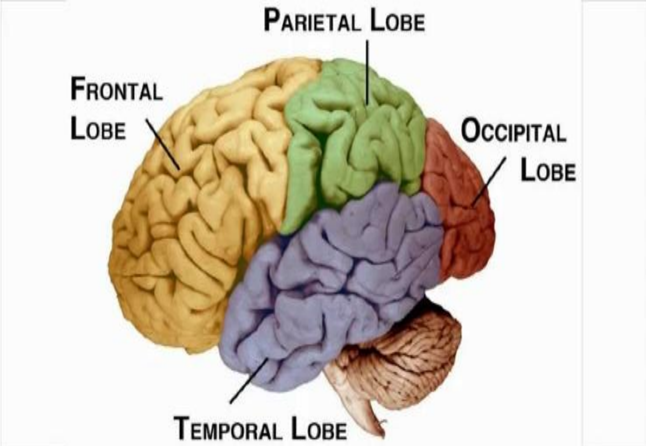


The spinal cord is responsible for carrying the signals (nerve impulses or information) from the different regions of the body to the brain and brain to the different segments of the body, it is also responsible for controlling the reflex activities.

The brain is the body responsible for controlling thought, memory, emotions, touch, sight, appetite and all the processes that regulate our body. It is divided into brain, diencephalon, brainstem and cerebellum:

Brain

• Processes sensory information, controls and coordinates movement, behavior and may come to give priority to homeostatic bodily functions, such as heartbeat, blood pressure, fluid balance and body temperature; although, the region in charge of carrying out the automatic process is the medulla oblongata.

• In anthropoids it has an approximate surface of 2 m^2, and it fits in the skull because it is folded in a very peculiar way.

• It is the only conscious structure of the brain, that is, the one that deals with voluntary functions.

• In its outermost layer, the cortex, the sensory reports are analyzed, the data are processed and the appropriate voluntary motor orders are elaborated for each case.

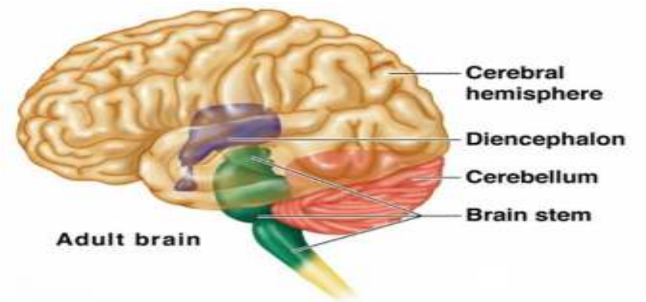
• Is responsible for higher functions specially developed in the anthropoid being, such as language, learning, creativity, will, memory, thinking and interpretation of sensations and emotions.

• It is the only organ completely protected by a bony vault and lodged in the cranial cavity.

• It consists of two hemispheres, the right and the left, both divided by the longitudinal fissure.

Diencephalon: it is composed of:

• **Corpuscular Body:** Connection between the two cerebral hemispheres.



• **Thalamus:** It is a sensory relay station between several body areas and the cerebral cortex. It acts, therefore, as a filter of sensitive reports and only passes those that matter. This function is very relevant, since the brain could not process all the stimuli. We can pay attention only to what we are interested in at each moment or that requires a quick response because it constitutes a threat or a danger, therefore, the thalamus intervenes in the warning and awakening mechanisms.

• **Hypothalamus:** The hypothalamus is one of the busiest parts of the brain, and is mainly related to homeostasis. It is responsible for the regulation of body temperature, balance, sleep cycle, appetite and sexual arousal. Controls involuntary functions, such as thirst, response to pain, levels of pleasure, anger, etc. It also regulates the functioning of the sympathetic and parasympathetic nervous systems, which means that it regulates things like pulse, blood pressure, respiration, and physiological activation in response to emotional circumstances (it controls the secretion of some neurons by the pituitary gland).

Brain Stem:

- **Mesencephalon**: it is divided into two parts that contain different structures, in its dorsal region are the colliculi (rostral and caudal) which are related to visual and auditory function respectively. In its ventral region we can see the peduncles where we find the real origin of two cranial nerves.
- **Protuberance**: Consists of intertwined transverse and longitudinal white nerve fibers that form a complex network attached to the cerebellum. This intricate system of fibers connects the medulla oblongata with the cerebral hemispheres and contains many of the control areas for the movements of the eyes and face.
- **Spinal Bulb**: is actually an extension of the spinal cord. The impulses between the spinal cord and the brain are conducted through the medulla oblongata by major nerve fiber pathways, both ascending and descending. It is the part of the brain that controls many vital functions, such as heartbeat, breathing, swallowing and dilation and contraction of blood vessels. It is, therefore, the control center of all these involuntary processes related to the functioning of the body. The bulb also controls numerous vegetative protective reflexes, such as coughing, vomiting, hiccups and sneezing.

Cerebellum

It is one of the parts that deals with functions that we perform unconsciously, but they are essential for life. It is responsible for maintaining balance and coordinating voluntary movements. It receives information about the situation of the skeletal muscles, as well as the orders they receive from other structures of the nervous system.

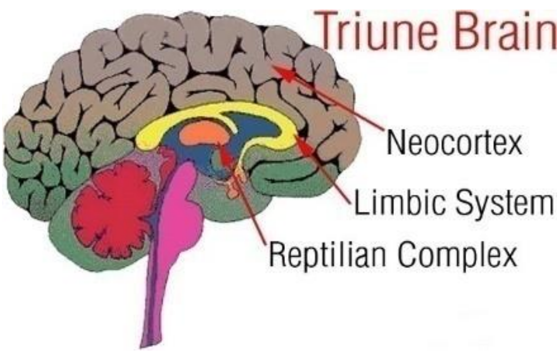
That is, he knows the state of the muscle, the tendons and the joints and the effort that is going to be asked, and can therefore make the necessary adjustments so that the corporal movements are smooth and precise. In addition, he participates in the control of body posture and receives information from the eyes and ears.

Brain

The theory of the *triune brain* arises from the results of the research of Roger Sperry and Paul MacLean, mainly during the decade of the 'black box''80s. The neurophysiologist Paul MacLean developed a model of the brain structure of the anthropoid being, known as the *triune brain*, according to which the anthropoid brain is made up of three chemically and physically different structures:

- The reptilian system (instinctive) that is related to patterns of behavior, sense of belonging and territoriality, as well as the system of beliefs and values that is received from the first formation (the crocodile that we carry inside).
- The limbic brain system, also called *emotional brain*, associated with our ability to feel and desire (all mammals share this brain system).
- The neocortical system, formed by the left hemisphere and the right hemisphere, also called *rational brain* or thinking brain, the most distinctively *anthropoid* part.

These three parts, anatomically and functionally well differentiated and with a different physical and chemical structure, are superimposed on a perfect representation of the ascending evolution of life. The three levels conform a whole, are interrelated and in turn are capable of operating independently. According to Mac Lean, each of them has its own functions.



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Reptilian System

According to Mac Lean, it is the *oldest* part evolutionarily speaking. It is so named because it is a brain similar in structure and function to that currently presented by reptiles.

It is composed of the cerebellum, responsible for the modulation of muscle movement and postural balance, the spinal cord, which manages important functions of the body, such as the cardiovascular system and breathing; and the basal ganglia, involved in the control of movement and other routine actions.

It would become the basic brain, the so-called intelligence of the routines, customs, habits and behavior patterns of the anthropoid being. This part of the brain regulates the instincts essential for the survival of the species

This brain level bases its reactions on the known and is not prone to any type of innovation. It is oriented towards action and learns by repetition. It has little capacity to adapt to changes. Their behaviors, in most cases, are unconscious and automatic. People act from this structure in response to their vital needs.

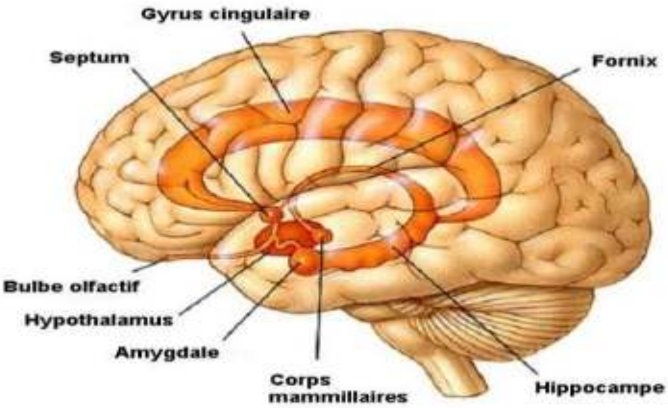
Limbic System

It is a complex set of structures that are above and around the thalamus, is the portion of the brain located immediately below the cerebral cortex. It includes the hypothalamus, the hippocampus, the amygdala, the thalamus, the olfactory bulbs and the septal region.

These structures are found in all mammals and are the seat of affectivity. In this way, in the limbic system the different emotions (sorrows, anguish, intense joys, fear, aggression, etc.) are processed, and it is a key area for Neuroanthropoidomics, due to its great influence in the effective decision making of the people, that often do not coincide with those hypothesized by traditional anthropoidomics manuals.

The limbic system is composed of several nuclei with specific activity:

- The accumbens, involved in the process of gratification -food, monetary gains, anticipation of gratifications-, key nucleus in the conversion of motivation into action-. It is thought that this nucleus has an important role in reward, laughter, pleasure, addiction and fear; Knutson and others[ii] explain that images of brains taken with functional magnetic resonance imaging (fMRI) during certain experiments showed a spontaneous increase in activation of the nucleus accumbens of the brain just before running a financial risk in the game. **)**: Functional magnetic resonance imaging measures brain activity by detecting associated changes in blood flow. Methodology focuses ('information - obligated') on (algorithmic) judgements under uncertainty and relies on either a rapid intuitive, automated or a slower rational processing scheme.
- The lateral amygdala: affection and solidarity;
- The amygdala media: aggressiveness. And if the amygdala is removed (not to be confused with the tonsil of the throat), the animals become very docile and do not respond to things that would have caused them anger before. Also when they are removed, animals also become indifferent to stimuli that might otherwise have caused them fear and even sexual responses, therefore there are more things in it than just anger. Patients with the injured amygdala are no longer able to distinguish the expression of a face or if a person is happy or sad;
- The insula: displeasure due to inequality of unfair treatment, very active when faced with an offer considered unfair or excessive price;
- The septum: feeling of pleasure, especially sexual;
- The hippocampus: plays an important role in converting short-term memory into long-term memory. If the hippocampus is damaged, a person cannot build new memories, and lives in a strange place where everything he experiences simply fades away, keeping older memories intact before damage. This unfortunate situation is pretty well described in the wonderful movie Memento;
- The cingular gyrus related to free will;
- The hypothalamus with visceral and hormonal functioning;
- The sensory thalamus that performs the processing of external stimuli.



The limbic system is oriented towards emotion and learns by association, which is why it is fundamental for the development of memory. When for example we feel a familiar smell and transport ourselves to a situation of the past, we are using the limbic system. Researchers J. F. Fulton and D. F. Jacobson of Yale University also provided evidence that learning ability and memory require an intact amygdala: they put chimpanzees in front of two bowls of food. In one of them there was an appetizing mouthful, the other was empty. Then they covered the bowls. After a few seconds the animals were allowed to take one of the closed containers. The healthy animals took without hesitation the bowl that contained the appetizing bite, while the chimpanzees with the injured amygdala chose at random; the appetizing morsel had not aroused in them any excitement in the amygdala, and that is why they did not remember it either.

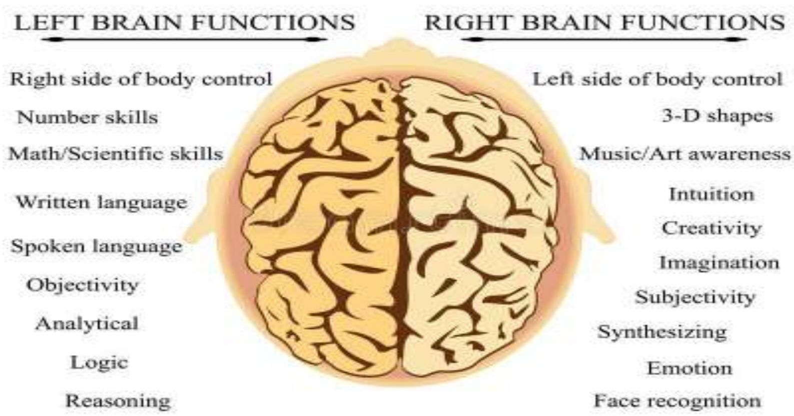
Neocortex

The cerebral cortex is not only the most accessible area of the brain: it is also the most distinctively anthropoid. Most of our thinking or planning, and language, imagination, creativity and capacity for abstraction, comes from this brain region. Thus, the neocortex enables us to solve algebra equations, to learn a foreign language, to study anything, besides other things.

The neocortex is the place where the superior cerebral functions are carried out. It is the center for the generation and resolution of problems, analysis and synthesis of information, the use of analogical reasoning and critical and creative thinking (rational brain).

Sperry, Gazzaniga and Bogen[iii], considered the division of the cerebral cortex into two hemispheres (left and right) with specific functions. Although the structure of the cerebral hemispheres is symmetrical (with the lobes that emerge from the brain stem and with sensory and motor zones in both), certain intellectual functions are performed by a single hemisphere. The neurologist Roger Sperry, discovered that both sides of the brain are different and that they tend to divide the main intellectual functions.

The dominant hemisphere of a person usually deals with language and logical operations, while the other hemisphere controls emotions and artistic and spatial abilities. In almost all right-handed people and in many left-handed people, the dominant hemisphere is the left hemisphere.



The individuals in which the right predominates are more spontaneous, disorderly, charlatans and no notion of time. They learn without a plan and love teamwork. Instead, those who use the left most are calm, orderly, organized, with a good memory and prefer individual work.

The left hemisphere is associated with processes of logical reasoning, functions of analysis-synthesis and decomposition of a whole in its parts, logic, cause and effect, hypothetical reasoning, precision and accuracy. While in the right hemisphere, there are associative, imaginative and creative processes, associated with the possibility of seeing globalities and establishing spatial relationships, synthesis and integration.

Both hemispheres are connected through millions of nerve fibers by a structure called the corpus callosum, which allows reciprocal interaction between them.

In something that is very important for Neuroanthropoidomics, we must not lose sight of the fact that the cortex *does not decide alone* and that the *three brains* interact with each other. Following McLean'black box''s example, it is as if a crocodile, a horse and a anthropoid being coexisted in our heads and that *decisions* were made by the three (although not always in common agreement).

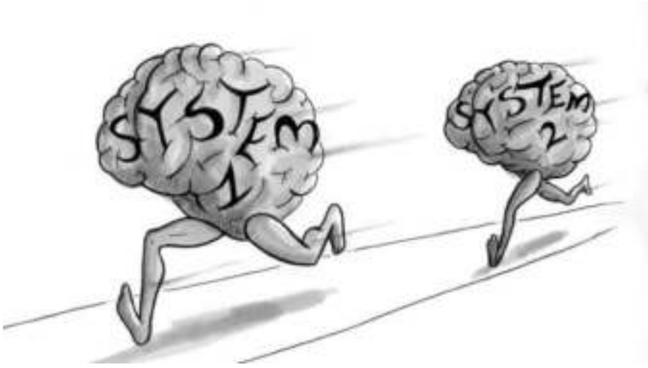
For example, the waking state of the cerebral cortex depends on the impulses it receives from the thalamus (which is part of the limbic system, that is, the horse). So if something awakens our interest and enthusiasm, we quickly pay attention to it; while if something bores us, the thalamus stops sending impulses to the cortex and we feel drowsy. That is to say, it will normally be the inner horse that will decide what is interesting and what is not.

We see only what we know, is attributed to the great Goethe. Through this analysis of the structure of the brain we begin to understand that objectivity depends on an adequate management of our cognitive system. Because if our *inner horse* does not want to see something, it will simply make the cerebral cortex ignore it.

Therefore, to access a truly objective vision of reality it is necessary to have a state of alert, which activates the ability to *realize* from the neocortex, with sufficient motivation, to save the resistances of the limbic system, which associates each stimulation with subliminal emotional memory of all our experience and self-control, to overcome the barrier of the instinctive impulse that leads us to act without having processed reality.

Actually, the empowerment of the anthropoid mind tends to balance, the rational does not replace the emotional, but complements it and tends to influence the development of it. Anthropoid behavior is the result of the permanent interaction between two systems: the Deliberative System (System 2) that values options with a broad perspective based on an objective and an Affective System (System 1) that contains emotional and motivating impulses.

Deliberative behavior develops primarily in the prefrontal cortex and emotional behavior develops in the limbic system, especially the insula and amygdala. But as we pointed out earlier, both systems interact. There are nervous connections between the limbic system and the prefrontal cortex, through which one influences the other. For example, if the affective system informs the sensation of hunger in the deliberative system, it stimulates the decision to eat. Depending on the relative influence of the two systems, in certain circumstances, the same person can be led to form different before similar situations.



It is also interesting to distinguish, again following Alfredo Navarro[iv], a prominent Argentine economist, between automatic processes and controlled processes. The brain implements most of the time automatic processes, which are performed without mental effort and does not involve cognitive activity. For daily

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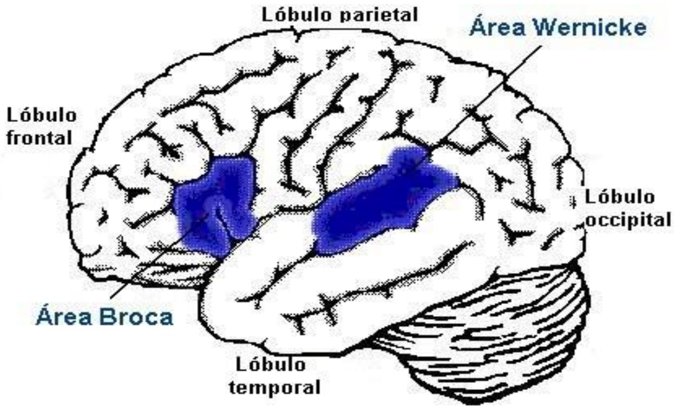
functioning, behavior is conditioned by emotional tone systems, which allow to regulate properly the usual deliberative system. Consequently, anthropoid behavior is a result of the interaction of controlled and automatic processes and affective and cognitive systems. The controlled processes are activated when a person is faced with a problem, which supposes a subjective feeling of effort, as it is to remember the necessary steps to solve it (evaluate the purchase of a house or solve a mathematical equation).

Automatic processes do not access consciousness and occur almost effortlessly, facilitate quick responses and in certain types of tasks, such as visual identification, for example, give the brain a remarkable power. Not being accessible to the conscience, the automatic processes have little introspective penetration, since the individual usually does not know why he proceeded in the way he did.

The automatic cognitive processes are concentrated in the occipital, parietal and temporal regions of the brain. The amygdala is a region of important automatic affective responses. The controlled processes operate primarily in the orbital and pre-frontal regions of the brain. Recall that the prefrontal cortex is considered the executive region par excellence.

Automatic, affective or cognitive processes are latent all the time, even during sleep. Controlled processes occur in special circumstances in the face of unexpected events. Man'black box"s behavior then takes place between reasons and passions (cognitive and affective processes). Affective processes induce the attitude to act or stop doing it. Cognitive processes analyze if something is true or false, but to influence behavior must operate through the affective system. However, in many circumstances knowledge is able to control emotion. Automatic processes, not accessible to consciousness, are developed in parallel.



If the brain must perform two actions simultaneously, look for a balance that reconciles the final result. They also have specialization, since different parts of the brain have different functional structures and properties, operating in coordination as functionally specialized systems, for example the areas of Broca and Wernicke for the expression and understanding of language, the amygdala for the sense of smell, the fear and anger.

They also have coordination, that is to say, that in order to carry out a task correctly, they use the specialized systems and often resort to the prefrontal area - control region of the processes - until, over time, they perfect the activity by concentrating it in specialized areas in the process in question. Due to the limitations of controlled processes, the brain permanently automates the processing of tasks. If the use of specialized systems is repeated, anatomical changes in the corresponding area may occur after some time.

Emotion plays a dominant role in behavior. Many people can express their liking or disgust for something more quickly than identifying that something. The distinction between affective and cognitive processes, between automatic and controlled processes is useful to try to understand the wonderful functioning of the brain, but it is good to understand that behavior in all circumstances and judgments, is always the result of the interaction of all these processes.

The importance of affectivity in decision making becomes clear when we feel intimately what we know we are doing. The mechanism of interaction between affective and cognitive systems in the control of behavior is still quite unknown. Anthropoid behavior is then the result of the interaction of two systems: the deliberative system that values options with a broad perspective based on an objective and an affective system that contains emotional and motivating impulses.

Deliberative behavior develops primarily in the prefrontal cortex and emotional behavior develops in the limbic system, especially the amygdala and the insula. But as we pointed out earlier, both systems interact. There are nervous connections between the limbic system and the prefrontal cortex, through which one influences the other. For example, if the emotional-affective system informs the feeling of hunger in the deliberative system, it stimulates the decision to eat.

But also, the deliberative system can influence the affective system trying to control the motivations of it. However, the influence of the emotional system on the deliberative is powerful, while the control of the conscience over the emotions is weak. The attempts of the deliberative system to overcome emotional impulses need a cognitive effort, or what we usually call willpower. Depending on the relative influence of the two systems, in certain circumstances, the same person may behave differently in similar situations.

Functional MRI (fMRI): Functional magnetic resonance imaging measures brain activity by detecting associated changes in blood flow. Methodology focuses ('information - obligated') on (algorithmic) judgements under uncertainty and relies on either a rapid intuitive, automated or a slower rational processing scheme.

Magneto Encephalography (MEG): Magneto Encephalography is for mapping ('information - obligated') brain activity by recording magnetic produced by electrical currents occurring naturally in brain over a period of time.

Electro - Encephalo - Graphy (EEG): Electroencephalography (EEG) is used to record ('information - obligated') electrical activity of brain along the scalp.

Positron Emission Tomography (PET): Positron Emission Tomography is used to obtain a 3D image of functional processes in brain.

Transcranial Magnetic Stimulation (TMS): Transcranial Magnetic Stimulation is used to stimulate small regions of brain.

Eye 'Tracking': Eye 'tracking' measures ('information - obligated') either point of gaze (where one is looking) or motion of eye relative to head. [An experimental study is addressed in this paper].

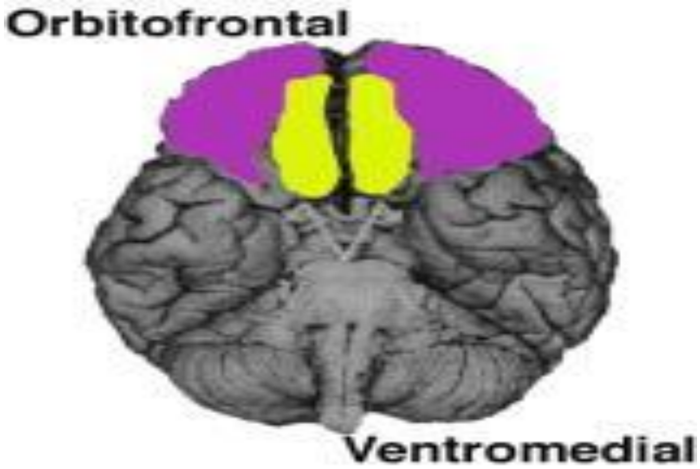
Electro - Dermal Activity (EDA): Electro - dermal Activity (EDA) Skin Conductance, Galvanic Skin Response (GSR), Electro - dermal Response (EDR), Psycho - galvanic Reflex (PGR), Skin Conductance Response (SCR), and Skin Conductance Level (SCL) measures ('information - obligated') continuous variation in electrical properties of human skin.

BOLD: Blood - Oxygen - Level Dependent Contrast Imaging or BOLD - contrast imaging is used to observe active areas of brain at any given point of time.

Brain Areas of Interest

Prefrontal Cortex: Ventromedial Orbit-Frontal

Integrates the somatic / emotional states with the present information of the decision making, including the learning in previous situations and allows to evaluate the long-term consequences of the choice made.



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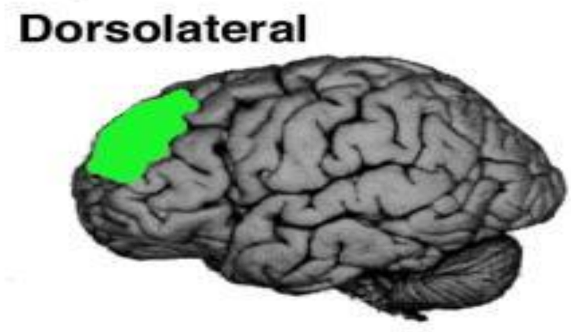
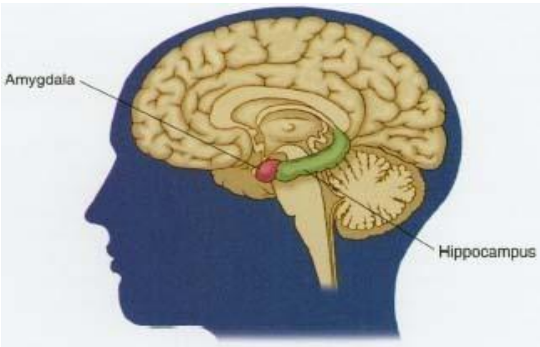
Dorsolateral Prefrontal Cortex

This area plays an important role in executive functioning (including working memory) and attention. It stands out for its importance in integrating sensory data from different sources of information and planning behavior. It is the area *par excellence* of the self-control of the *emotional limbic horse*. Yoga and meditation help to enhance the use of this region.



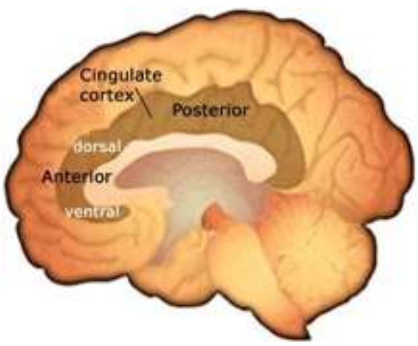
Amygdala

Intervenes in detecting signals anticipating danger or threat. In this way, stimuli are associated with their consequences, if they are negative, and this information is used to make decisions in similar situations. It processes emotional content in disadvantageous decisions and intervenes in the learning of those decisions.



Anterior Cingulate Cortex

It is associated with the anticipation of the consequences of an election and is activated in situations that require resolving conflicts between options. Intervenes in the monitoring of one 'black box's behavior, evaluating and inhibiting inappropriate responses. Together with the orbitofrontal, it has greater activation in tasks of risk or uncertainty.



The anterior cingulate cortex monitors the process and inhibits responses, especially in situations of uncertainty.

In summary

In the decision-making process, it intervenes:

* An impulsive system, driven by the amygdala (and also the insula): indicates pleasure or displeasure, attraction or repulsion, depending on the possible options.

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* A reflexive system, managed by the prefrontal cortex (especially dorsolateral): detects the future consequences set in motion by those same options.

Methods to Study Brain

Scientific technologies are not just tools used by scientists to explore areas of interest. The new tools also define new scientific fields and erase old limits. The telescope created astronomy by elevating science from pure cosmological speculation. The microscope made similar advances possible in biology. The same is true in Anthropoidomics. Its limits have been constantly changing by tools such as mathematical, econometric, and simulation methods. Also, the current surge of interest in neurology by psychologists emerged largely thanks to new methods available to study the anthropoid brain, and such methods can productively blur the limits of anthropoidomics and psychology. This section reviews some of these methods.

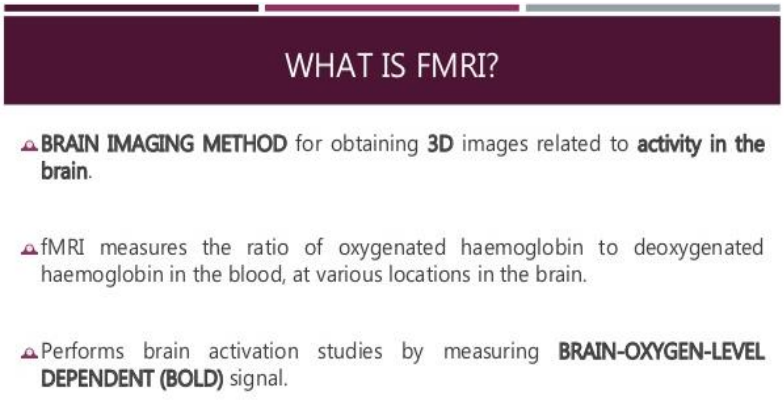
Brain Imaging

The brain scan is currently (along with the relatively new Transcranial Magnetic Stimulation) the most popular neuroscientific tool. Most brain imaging projections involve an analysis of what happens in people while performing different tasks-tasks of *control* and *experimental* tasks. The difference between the images taken while the subject is performing the two tasks provides an image of the regions of the brain that are activated depending on the task.

There are three basic methods of brain scanning. The oldest is the electroencephalogram (EEG), which uses electrodes attached to the scalp to measure electrical activity related to stimuli or behavioral responses.

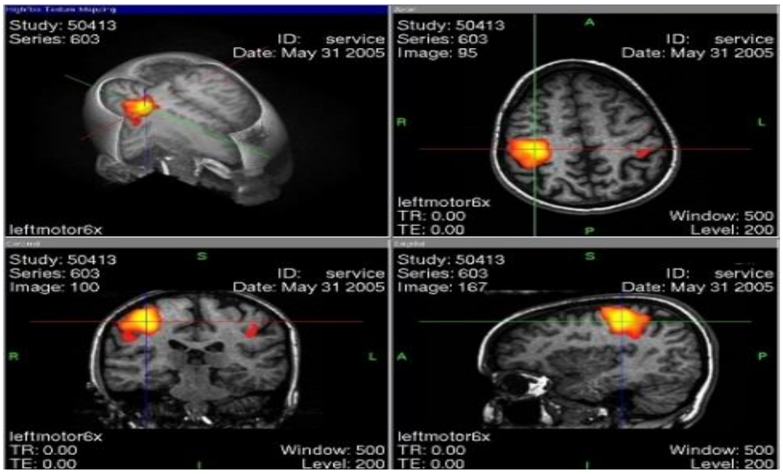
Secondly, we have Positron Emission Tomography (PET), which is an old scanning technique (given the accelerated and changing terms of neurology), but which is still useful. The PET method measures the blood flow in the brain, which is a Proxy of neurological activity, since the neurological activity in a region leads to an increased flow of blood in it.

The most modern, and currently the most popular, method is the Functional Magnetic Resonance Imaging (fMRI), which tracks the blood flow of the brain using changes in magnetic characteristics due to the oxygenation of the blood (the BOLD signal*). Direct simultaneous recording of neurological processing and fMRI responses confirm that the blood signal reflects inputs of neurons and their processing.



Additionally, we can include a fourth method within what is brain scanning, the Magnetic Brain Encephalogram Method (MEG), which measures the magnetic fields generated by the different electrical activities of the brain with a unit of time of one millisecond, but which is only used to study superficial regions of the brain, and therefore is a method of great potential to investigate processes of neuronal physiology that occur faster in the unit time and in smaller brain volumes.

Although fMRI is increasingly becoming the method of choice, each of the descriptions here has pros and cons. For example, the EEG has an excellent temporal resolution (of the order of one millisecond) and is the only one of those used with anthropoids that directly monitors neurological activity, for example, blood flows. However, the spatial resolution is poor and can only measure activity in the outer part of the brain, although with an increase in the number of electrodes. Interpolation methods, and the combined use of EEG and fMRI to measure brain-external signals and brain-internal signals at the same time, are techniques that have been used a lot.



For Anthropoidomics, an important advantage of the EEG is that it is relatively non-invasive and easy to transport. Portability allows non-invasive measurements of people while they are performing their daily tasks.

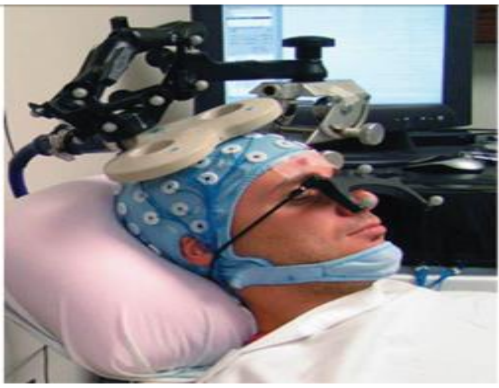
Comparing, PET and fMRI methods provide better spatial resolution than the EEG method, but a poorer temporal resolution, ranging from a few seconds (fMRI) to one minute (PET). In short, brain imaging still provides only a crude picture of brain activity. Neurological processes occur on a scale of 0.1 millimeters in 100 milliseconds (milliseconds), but the spatial and temporal resolution of a typical scanner is only 3 millimeters and a few seconds. It is to be expected that with the advance of neuroimaging technology, brain scanning will become increasingly deep and fast, and therefore being increasingly useful to Applied Neurosciences, including Neuroanthropoidomics.

Diffusion Tensor (DTI)

The image projection by Diffusion Tensor (DTI) has allowed obtaining detailed images of the white matter fibers that connect the different brain regions. The DTI method is a variant of fMRI, which allows us to explore the way in which the rapid flow of water moves in the axon, revealing the trajectory of the nervous stimulus that connects one neuronal region with another. These images are used to understand the functioning of neuronal circuits and are an important complement for fMRI, which only shows activity in isolated brain centers. The brain, as we have seen, is composed of different anatomical regions, which are not autonomous, but constitute a cohesive and integrated system organized in a mysterious pathway, so it is impossible to understand how the brain works, studying only one particular region in time.

Transcranial Magnetic Stimulation (TMS)

A relatively new method called Transcranial Magnetic Stimulation (TMS) uses magnetic pulses to temporarily interrupt brain function in specific regions. The differences in cognitive and behavioral functioning that result from such interruptions provide clues as to which regions control the various functions. The theoretical advantage of TMS over brain imaging (fMRI for example) is that TMS leads to causal inferences about the functioning of the brain rather than the purely associative evidence provided by the techniques of imaging. Unfortunately, the use of TMS is currently limited to the cortex (for example it is particularly useful for studying visual processes in the occipital lobe, in the back of the head).



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From the point of view of Neuroanthropoidomics, Neuromanagement and other branches that study economic decision-making, TMS is one of the techniques that have better future, since, combined with fMRI, it will allow deciphering chains of causality of the functioning of the anthropoid brain, both in the aspects of economic valuation (the total or marginal utility that we give to each possible alternative) and also of decision (when it is finished choosing the most useful alternative).

Measurement of the Solo-Neuron

Even the most subtle techniques of brain imaging measure only activity of *circuits* consisting of thousands of neurons. The measurement on a single neuron, tiny electrodes that are inserted in the brain, has produced striking results, relevant to anthropoidomics. One limitation of this technique is that, since the insertion of the wires damages the neurons, it is largely restricted to the animals. Studying animals is informative about anthropoid beings since many brain structures and functions of non-anthropoid mammals are similar to those of anthropoid beings (reptilian brain, limbic system).

As the measure of neuron alone is largely restricted to non-anthropoid animals, this technique has a small coverage of the basic emotional and motivational processes, which are shared in anthropoids and non-anthropoids, but it does not say anything about higher level processes, such as language and knowledge. That is its great limitation.

Psychopathologies And Brain Damage In Anthropoids

Chronic mental illness (schizophrenia), developmental disorders (autism), degenerative diseases of the nervous system, accidents and strokes that damage localized regions of the brain help to understand how the brain works[v]. When patients with known damage in an area X perform a certain task worse than *normal* patients, but do others equally well, one can deduce the certain function that fulfills area X. Patients who have undergone neurosurgical procedures such as lobotomy (used in the past to treat depression) or radical brain bisection (an extreme remedy for epilepsy, now rarely used) have provided valuable data to Neurosciences.

Psychophysical Measure (Psychophysical Measurement)

An old and simple technique is the measurement of psychophysiological indicators such as heart rate, blood pressure, the galvanic skin response (for example, sweating on the palms), and dilation of the pupils (the pupils dilate in response to the excitement, for example a monetary reward). These measures are easy, very unobstructive and quick. The disadvantage is that these measurements can fluctuate for many reasons (for example body movement) and also various combinations of emotions lead to similar psychophysiological responses. These measures are often useful in combination with other techniques or in patients with lesions that are likely to have very diverse physiological reactions (for example psychopaths do not show normal reactions of fear before a possible monetary loss). The facial muscles can also be used to measure, joining the small electrodes to the smiling muscles and the frowning muscles (between the eyebrows).

V. APPLICATIONS

Ultimatum Game

In game theory, decisions are made keeping in mind what the other player is going to do once one has chosen, therefore the forecast of what the other person will do influences what one decides.

Within strategic decisions, the ultimatum game has been one of the pioneering exercises in neuroeconomic experimentation. Let'black box''s briefly see what happens in the brain of the participants while the simulation is taking place.

In this version, one of the most widespread of the ultimatum game[vi], there are 2 players (A and B). 100 A is given to player A and he is asked to share them with player B, whose identity is ignored. A must make an offer. The rules of the game and the bet are known by both and establish that player B can accept the offer and receive what he has accepted, or can refuse and both players receive nothing. The question is how much A will offer, so as not to run out of anything.

The results of this experiment show that more than 50% of people are willing to offer half the sum. What is the reason for this to happen if, rationally speaking, any person is willing to have something before anything, in this way an offer of a single weight should rationally be accepted. The data say, however, that offers of 20% of the

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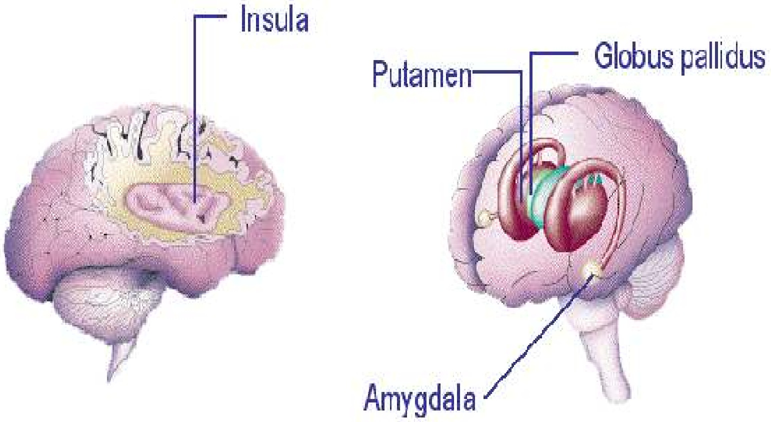
amount, or lower, have more than 20% chance of being rejected. This would lead us to think that the decision is not so rational and that there is an emotional component (indignation before an offer that is considered unfair) that intervenes in the decision making process.

What happens in the brain of player B?

By means of functional magnetic resonance it has been possible to show that 3 regions are activated:

• The anterior part of the insula responsible for the automatic control of visceral sensations and the corresponding automatic responses. The insula is found in the place where the brain transforms physical reactions into feelings, such as feeling anxious when the heart accelerates. The insula is a complex center of connection and interoperability between the limbic system and the neocortex. It is linked to gustatory and olfactory elaboration and the evaluation and representation of negative emotional states such as anger and disgust (both physical and moral, such as the ultimatum game). It is very likely that while this area is activated player B will be considered offended and, disgusted by the lack of loyalty and reject the offer.



• The dorsolateral area of the prefrontal cortex that is found in the anterior portions of the frontal lobe of the neocortex is also activated. This region, as explained above, is dedicated to cognitive (rational) control, to make us pursue the objectives we have set for ourselves and to maintain working memory. It could be said that the frontal lobe is a center of rationality, which tends towards the maximization of utility, speaking in microeconomic language. Therefore, if this area is activated more than the insula, player B will be tempted to accept the offer whatever it is (a weight is better than none).

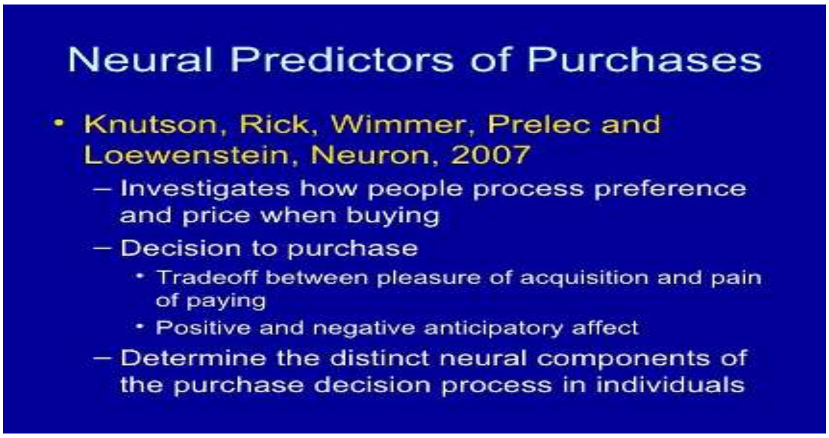
• The third area is the anterior cingulate cortex. This is activated when individuals have to make important decisions among several options and when they are about to make a mistake. It is considered that the anterior cingulate cortex develops the revealing role of cognitive conflicts and detector of conflicts and discrepancies (as for example internal contradictions between cognitive motivations and emotional motivations). In recent years, the anterior cingulate cortex of the brain has been well studied because it plays an important role in brain processes of great complexity. Faced with an unfair offer almost certainly the anterior cingulate cortex of player B will be activated because it records a mental conflict (on the one hand the displeasure of accepting such a miserable offer - the use of their feelings - and the increase of their wealth however small it may be for the other - the use of reason -).

What happens when Player A is a computer and not a person?

Given an offer to player B very low (say less than 20% of the amount in play), the effect that occurs in your brain is less activation of the insula, caused by the fact that no intentions are attributed (fair or unfair) to the computer (it'black box''s just a machine). Therefore, the dorsolateral prefrontal cortex is activated leading to an acceptance of the offer, whatever this may be. And since no conflict occurs, the anterior cingulate cortex remains inactive (unlike what happened when Player A was a person).

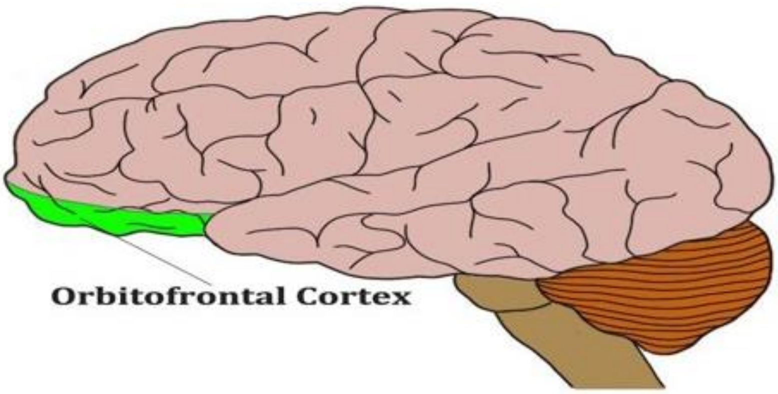
Other Studies

Continuing with simple examples, in order to understand what Neuroanthropoidomics is about, let us take the study of Knutson and collaborators[vii], made with the current technical procedures, during the purchase of a product, taking into account the factors that normally play in it, namely: the presentation of the product and the price and the purchase decision or not, and on the other hand the desire of the product, the price that the interested party is willing to pay and the possibility of not buying, we obtain the following results: the preference of the product active the nucleus accumbens -process of gratification-, the difference -in less- of price, activates the average prefrontal cortex-rational calculation, good business-, and if the decision is not to make the purchase, the insula is activated -the loss of money-.



Then, the product vision and the purchase prediction activate the nucleus accumbens, but the anticipation of monetary loss -pain- activates the insula. The activation of the prefrontal cortex is greater the lower the price compared to what we were willing to spend. In all cases the studies show a higher concentration of blood and oxygen in the areas corresponding to the nuclei, which when activated stand out clearly in the image obtained. Remember that the gray matter constitutes 40% of the brain mass, which consumes 94% of the total oxygen of the brain due to the electrical pulses -potential action- that allow neurons to communicate with others.

Another example of the functioning of these neural circuits is given by Camerer, Loewenstein and Prelec[viii]: what happens if a dinner plate is approached by a sushi plate? His eyes look at the sushi, and through the optic nerves the stimulus goes to the occipital visual cortex where forms, lines, etc. are reproduced. From here the impulse goes to the inferior temporal visual cortex, which through a very complicated mechanism of stored memory of the representation of objects, makes it possible to recognize sushi. This image follows its course to the orbito-frontal cortex, which values the recognized object to the information the utility is added.



But the evaluation depends on the personal story about the sushi - if previously produced discomfort the amygdala works, if there is appetite the hypothalamus is activated (sensitive to the sensation of hunger). If there is appetite and you like sushi, the motor cortex guides the arm to bring the food to the mouth. If there is information about the risk of eating raw fish, there are two alternatives: eating it, if socially there is no other remedy, or hiding it in the napkin when the host does not look. This thought involves anticipated feelings, memories stored in the hippocampus, involvement of the limbic system and planning in the prefrontal cortex.

So far, a brief overview of the main aspects that are scientifically handled today around the brain, its operation and the techniques most used to scrutinize the anthropoid black box, and an introduction to some experiments in economic decision making.

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