NEUROBIOLOGICAL ROOTS OF THE ART OF PERSUASION

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The work presented here provides some exploratory argument concerning what can be expected to happen, at the biological level of the description, when a act of persuasion takes place. It also describes some scientific tools and actual neurobiotechnological methods that can be used to describe the underlying phenomena that happen during a convincing act.

In recent years science and technology have made it possible to observe many aspects of the real-time functioning of the human being including his brain activity.[1] This activity is meant to be the functional seat of the interplay between rational and emotional acts. It serves our desires to achieve being in the best possible state of confidence and comfort, that can also be extended as being in the best possible state of trust and predictability in our present circumstance.

This *present circumstance* occurs as a transient state in our lives, in a matter of a window of seconds, and mainly depends on three different but connected domains: environment, psychophysiology and behavior. These three domains are always coupled in an interwoven net of reciprocal relationships, so we may expect to find that these domains reflect each other in some quantitative way in comparative measurements that we could do.

To understand nature science can only deal with measurable and experimentally repeatable experiences.

This restriction narrows its action field to a limited set of *scientifically manageable phenomena*. There is a big set of other phenomena

[1] Jeremy Geelen, *The emerging neurotechnologies: recent development and policy.* (Canada: Policy Horizon, 2012).

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that, for its characteristic of being sporadic, unrepeatable, impossible to recreate in experimental conditions, or so complex and unpredictable to be understood, fall out of the scientific domain of action.

These three domains evolve intertwined and can be observed manifested as a particular set of behavioral coupling patterns displayed by any living system. It must be reasonable to expect that some kind of match, or correlation, can be possible to find across and within the different levels of the whole phenomena in such a way that the recognition of the expected correlations can be used as an identifier of the state and a detector of the quality of the coupling state between the organism and the environment. As this kind of relationship between organisms and the environment has been traditionally studied in biological sciences as ecology, the authors decided to name this transient state of being as transiting an *ecostasis*, an ecological state that involves all the complexity levels of the biological organization, ranging from the atomic and subatomic structure to organisms and biosphere.

One of these levels of particular interest in this work is the level of the organism which, in human beings, includes consciousness and the act of being an observer with a way to make decisions and a verbal and non-verbal system to express and communicate our feelings and desires.

Among the total possible states of being of a human being, we are especially interested in what happens in a situation that involves a mutual interaction that resumes in a new state where one of the parts has declined his or her original decision making, feeling and desires according to what the other part decides, feels and desires. In other words, interactions in which persuasion occurs. This state is a transitional state, a transient period of change, between a previous state and a new one. It could be possible that the purposeful discourse (and performance made to *change convictions*) and the mental processes of the persuaded person's *self-convincing system*, is reflected in specific correlated states between some of the neurophysiological parameters of the participants.

There is recent evidence of inter-brain synchronization during social interaction,[2] that suggests that our hypothesis goes in the right way.

Our work has been to develop a study tool that allows us to explore electroencephalographic data with a high frequency and temporal resolution to map and compare intra and inter brain time-locked correlated areas of the brain cortex. The resulting interconnection map has the shape of a network of interrelated brain zones that are correlated, or anti-correlated, depending on how frequency domain co-relationships develop through time, expressing the degree and patterns of connectivity that the brain displays during a particular process.

Our first results exploring connectivity maps in single brains have shown that there are different brain patterns that characterize different states of a task performing.

For example, consecutively freehand drawings of four different motifs (a human face, a human body, objects-only and abstract creation) gives four different connectivity pattern maps reflecting the main brain areas employed in the execution of the four different drawing tasks.

These maps differ in the volume and topography of the interconnected net and in the degree of counter-regulation, expressed as negative high values of mathematical correlation between two or more areas of the brain surface. We have found that strong connectivity hubs, that can characterize particular brain states, are also trans-hemispherically modulated by different zones of the brain cortex. In some way this map reveals a pattern of communication that operates during the execution of a brain process.

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[2] Guillaume Dumas, Jacqueline Nadel, Robert Soussignan, Jacques Martinerie and Line Garnero, "Inter-brain synchronization during social interaction", *PLoS ONE* 5, 8 (2010): 1-10.

In another study,[3] we conducted experiments to find individual differences in brain activity during resting or basal state (awake but relaxed with open and closed eyes). It was found that all the participants in the study differ in their brain activity maps reflecting different individual brain basal (or default) individual brain operating systems. This results in different operating modes with different predisposition to behave in some way or another and with a different performance in the mid- and long run.

Our last results, [4] have been obtained by way of quantifying the degree of harmonic structure that can be found during the execution of a cognitive task. We have found short- and mid-term harmonic spectral patterns that reflect the long range frequency tuning and synchrony among different frequency ranges of the electroencephalogram.

During the last decades, advances of neurosciences have allowed to correlate behavioral phenomenology with some neurophysiological parameters, coming from a real-time functioning of the brain. During the last years,[5] an especial attention has been paid on the study of the neurobiological aspects of the social encounter

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[3] See Yesenia Martínez, *Neurociencia cognitiva-conductual para la selección de personal: Estudio de caso con estudiantes de la Facultad Tecnológica de la Universidad de Santiago de Chile*. Trabajo de Titulación de carrera de Tecnología en Administración de Personal. Biblioteca Universidad de Santiago de Chile, 2012; and Hernán Díaz, Lucio Cañete, Cristián Costa, Fredi Palominos y Felisa Córdova, "Neurotechnologies for education improvement: self-knowledge after opening the black-box", *Journal Plus Education* VIII, 2 (2012): 44 – 52.

[4] Hernán Díaz and Felisa Córdova, "Harmonic Fractals in the Brain: Transient Tuning and Synchronic Coordination in the Quasi-Chaotic Background of Ongoing Neural Activity. Information Technology and Quantitative Management (ITQM)", *Procedia Computer Science* 17 (2013): 403-411.

[5] Hernán Díaz and Felisa Córdova, "Harmonic Fractals in the Brain: Transient Tuning and Synchronic Coordination in the Quasi-Chaotic Background of Ongoing Neural Activity. Information Technology and Quantitative Management (ITQM)", *Procedia Computer Science* 17 (2013): 403-411.

domain in which we, human beings, spend engaged during the majority of our life. One of the aspects of this domain is related to rhetoric, the art of persuasion, or the behavioral strategy (talent) to convince a person, or a group of people, to do something that, in the beginning, was denied.

We assume that during such a process a number of procedures engaged in evaluating and re-shaping previous certainties must be in play.[6] These certainties must be, to some extent, also expressed in particular ways to process and value the incoming data and information to achieve a comprehension that annihilate the previous confronting state to accept the new one.

As rhetoric performance can make use of non-verbal elements that also interact at the cryptic emotional organizational level of a person, it is expected that some kind of functional similarity be reached in the course of the certainties changing process. We expect to find a functional similarity (correlation) between two subjects at the level of brain activity and emotional or other hidden indicators. By now, we are exploring the first of these coupled domains by mean of detecting and mapping the time course change of electroencephalographic, topological and temporal structure of the brain connectivity net during the persuading act.

We expect that, in some way, the underlying mechanism of rhetoric and persuading must be related with mechanisms concerning phenomena like ergonomics which is a process that tends to satisfy a present or future condition (state) by means of enhancing the quality of the organism-environment interaction. As this environment may contain natural and/or artificial elements, we have called *ecostasis* to the state of neurobehavioral and environmental interaction that includes the whole range of organizational complexity starting with subatomic particles to the biosphere.

It also can be understood as what is actually known in ecology

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[6] Elliot Brown and Martin Brüne. "The role of prediction in social neuroscience", *Frontiers in Human Neuroscience* 6 (2012): 1-19.

as ecosphere, but we are adding here the important participation of the observer, through the volitional and conscious decision making acts and the expression, execution and communication of feeling and desires, according to our personal tendencies or predispositions. These tendencies are rooted in genetic substrate but have been also molded and are modulated by a history of environmental encounters through life.

At the same time we recognize individual differences, it is known that there is a specialized map of different functions related to general brain left-right hemispheric operating system in which an occipital, temporal and parieto-frontal axis of brain areas treat the environmental encounter in a different, but complementary, way. In general terms, it can be said that while the left hemisphere is performing a detailed analysis of the situation, the right hemisphere is performing a global and long-scale evaluation of it.

The complementary way in which the left and right hemispheres work together to get a final picture defines the degree of micro and macro resolution that we will have of that picture. Individual differences in the basal (default) activation of brain cortex areas could indicate functional predispositions, or attractor functional states, that will define most probable starting points for future operation runs. It could be possible that *to see with the other´s eyes* or to share particular aspects of a theory of mind be related to a progressive transit to a functional and topological similarity in the way two people engaged in a conversation, process the information and reach to make joint decisions.

For the specific process of persuading we expect to find a progressive change toward a brain pattern similarity. With actual neurotechnologies it can be possible to see the degree of success of an intervention based on the degree of functional and topological similarity reached along the process. There are many similar processes that occur. For example, a teacher tries to make a change in his students by means of an engaging activity that involve a rhetoric (didactic) plan to persuade a change of the neurobehavioral pattern. We call this phenomenon teaching and it is through education that we

perpetuate culture and knowledge allowing us to change paradigms.

In future years we expect to see a strong ethical debate around some of the issues here exposed. As, in rhetoric, all depends on *how the things are said*, the idea to be scanned at the level of desires or hidden predispositions will face the questioning about how far we want to share our intimacy. In present days we share personal information through answering a survey of questions that is subsequently analyzed on a psychological level.

The kind of interpretation that result from this method may have two sources of strong bias: the one inserted by the subject who answers with the goal of producing a better image of him or herself, and the one inserted by the psychological interpretation, which can be biased by personal preferences of the analyst.

What may happen in a near future could be similar to what happened during the past genetic century. During this time, it seemed that, after solving and cracking the genetic code, all of our problems could be solved by genetic engineering. What happened was that the complexity and biochemical particularities of the modulatory network that governs the genetic level of organization opened a new and vast field of research in much more specific areas of genetic biotechnology. Now the century of mind and neuroscience emerges. We leave the information society and enter into a knowledge society.

We do not know yet if a partnership between engineering and neuroscience will be successful. In the long run, we will find the answers we are looking for and new questions will arise. What is important here is the ethical perspective that crosses any human activity.

Present applications of these knowledge and technologies has started with brain-controlled video games,[7] brain computer interfaces

[7] Doug Hyun Han, Nicolas Bolo, Melissa A. Daniels, M.S.W. Lynn Arenella, In Kyoon Lyoo and Perry F. Renshaw, "Brain activity and desire for internet video game play", *Compr Psychiatry* 52, 1 (2011): 88–95.

(BCI) for prosthetic and/or personal applications,[8] neurofeedback for medical treatment,[9] neuroeconomy,[10] research in decision making processes and neuromarketting.[11]

[8] R. Millán, R. Rupp, R. Müller-Putz, R. Murray-Smith, C. Giugliemma, M. Tangermann, C. Vidaurre, F. Cincotti, A. Kübler, R. Leeb, C. Neuper, K.-R. Müller and D. Mattia, "Combining brain–computer interfaces and assistive technologies: state-of-the-art and challenges", *Frontiers in Human Neuroscience* 4 (2010): 1-15.

[9] Tato Sokhadze, Rex Cannon and David L. Trudeau, "EEG Biofeedback as a Treatment for Substance Use Disorders: Review, Rating of Efficacy, and Recommendations for Further Research", *Appl Psychophysiol Biofeedback* 33 (2008): 1–28.

[10] Joelle M. Abi-Rached, "The implications of the new brain science", *EMBO Report* 9, 12, (2008): 1158-1162.

[11] Andrija Javor, Monika Koller, Nick Lee, Laura Chamberlain and Gerhard Ransmayr, "Neuromarketing and consumer neuroscience: contributions to neurology", *BMC Neurology* 13, 13 (2013): 1-12.