

Neuroethics: the brain as ethics and moral organ

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Resumo Este artigo discorre sobre o substrato anatômico e neurofisiológico no cérebro desperto que estabelece a normalidade ou o patológico de nossos atos, escolhas, decisões, resolução de dilemas éticos, caráter, emoções e consciência moral, os quais dependem de sistemas e áreas específicas. Para isso, utiliza pesquisas da moderna neuroimagem e testes neuropsicológicos que mapeiam as áreas cerebrais. Dentre essas, os lobos frontais, o sistema límbico, o giro cíngulo, a amígdala temporal e o hipocampo, cuja análise neurofisiológica demonstra que regulam o controle da normalidade psíquica, o autocontrole e, também, o controle da agressividade, violência, livre-arbítrio, responsabilidade e doença mental. Conclui que, se lesadas, essas áreas produzirão respostas anormais ou patológicas nos âmbitos da cognição, julgamento moral e pensamento ético.

Palavras-chave: Ética. Neuroética. Neurociências.



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We feel timely to bring this topic to Brazilian physicians, through this magazine, aiming at reviewing some basic concepts, often forgotten, on brain or neuropsychiatric mechanisms that govern conscience, intelligence, behavior and conduct: our brain – and not the heart, as scholars and poets wish. It is, certainly, the seat of what we consider our humanity, our personality, as well as ethics, moral, emotions and feelings, right or wrong, well or good. Brain makes us single as individuals and lends us our personality, individuality, character, ideals, memories, creative skills, and our Self, our mind and so many other functions.

Many articles have been published about the role of certain brain areas as also seat of our ethical and moral behavior, in ethical dilemmas solution, in brain manipulation by means of drugs, neurosurgical interventions, and its electric or magnetic stimulation, studying, inclusively, drug and medication dependence ^{1, 2}.

The new neuroethics discipline, lately, also denominated as *brainethics*, as Jonsen³ suggests, may be considered a major extension of applied bioethics, specifically, in the study related to treatment of these brain functions problems. These studies have attracted bioethical thoughts to sectors from philosophy, going through psychiatry, neurology, law, until public, political, and social interests. This new specialty been established by eminent scientists, who work with the most complex organ of our body. These researchers feel responsible for the understanding that nonprofessionals may have in relation to such researches and its importance in our issues. They nominate it as *ethics of brain sciences*, according to one of its definitions, which is ³: “*neuroethics is the study of ethical, legal, and social issues that emerge when scientific findings are taken to medical practice, to legal, health, and social norms interpretations. These comprise findings in genetics, neuroimaging, diseases diagnosis and prevention, either analyzed by physicians, lawyers, judges, insurance companies or legislators, and the public at large when dealing with these facts* ⁴.”

The term *neuroethics*, coined by Dana Foundation president, William Safire, it is defined as the *analysis of what is right or wrong, good or bad, in relations to human brain treatment, its enhancement, its good invasion, or worrisome manipulations, including neuroimaging, robotics, interfaces between the brain and computer, psychopharmacology and neurostimulation augmentative of normal brain functions* ⁴.

Neuroscientist Gazzaniga adds that neuroethics is more than a bioethics for the brain: *it is a reflection and analysis of social implications of diseases, normality, mortality, life style and life philosophy, informed of their underlying brain mechanisms* ⁵. Therefore, it is an effort to bioethical study life philosophy based in the brain: it is the human brain studying its own work, turning a good science into a still better with a good ethics ⁶.

Thus, modern neuroscience allowed introduction of new treatments for brain diseases and, as well, arousing of surprising and unexpected neuroscientific and technological advances, both at individual level and of medicine in general, affecting, inclusively, perception of new cultural conditioning due to new technology. In view of these advances, it is necessary definition of new features in ethical judgment in relation to medical practice of these applications regarding brainwork in health and in illnesses.

We notice that bioethics, since its origins, has dedicated, progressively, to problems related to different special organs: bioethics current age started with analysis of kidney transplant and its association to dialysis, moving afterward toward heart transplants, revival of heart stoppages, interruption lung and breathing support, and not forgetting of problems connected to brain death in donors selection⁷.

Therefore, the ethics of the brain emerges, the brain ethics, with the study of problems emerged when we probe and act over this organ, in circumstances in which medicine are used, and neuropsychological analyzed its higher, noble, and even sublime functions⁸. From this class of study emerged areas like, for example, the modern neurotheology and neurophilosophy – this last one as major development that aggregates the study of neurosciences and philosophy of mind that, according to P. Churchland⁹, looks for an unified theory about mind and the brain.

These modern disciplines, well developed now through neurophysiologic knowledge that we have, mainly the neuroimaging, allow us to understand how ethical and moral decisions and values modulate in our brain. The role of the limbic system and of emotions in moral choices, as well as reason and cognition in self-control and in criminal or immoral action, is what neuroscientist currently tries to identify as neuroscientific search to identify, as neuroscientific bases for ethical reasoning, which will be neuroethics major function.

It seems to us that neuroethics convoy left its station with known destination, toward explaining our moral reasoning, aiming at answering such problems. The grandiloquent free will, moral and legal responsibility and the mental capabilities that allow to control behavior, guiding attention, thoughts, emotions and actions in accordance to our intents and objectives, as well as the capacity to act according to social rules and norms.

There would be, then, differences among patients who suffer brain damage or trauma later in their lives and lost their capacity to comply with social rules and to control their behavior, and patients that suffer cerebral damage when children and became incapable to learn the same rules or to make the right choices.

These issues lead to think seriously in Aristotle's ancient theory about pragmatism of virtues as more compatible with modern neurosciences acquisitions. According to this theory, our private actions are evaluated as reflexes of individual's character, a certain disposition to act according to determined manner, based in moral judgment and intuitions¹⁰. Our brain, as seen, became an evolved system, a decision-making instrument, which interacts with the environment and it enables us to learn rules that govern its responses, fortunately in automatic manner. However, neuroscientists may not accuse it of culpability, in the same way that a clockmaker cannot blame a clock. Neurosciences will never be able to find correlation between brain and responsibility because it is something that we attribute to human being and not to brains, since responsibility is a social choice. Ethical behaviors are a subgroup of social behaviors, as it is not possible to conceive ethics out of society.

As conscious, intelligent, and creative beings, inhabiting a certain cultural environment, we, humans, were capable to create

ethical rules and norms, to code into laws and to shape their application, calling them justice; culture does the rest, establishing a certain level of freedom that enables free will to individuals. Nevertheless, what we call ethics will depend on the good functioning of certain cerebral systems. One should notice that we do not speak of centers but rather of systems, which allow complex interactions among themselves, of which emerge behaviors and cognitions related to them, such as special types of memories, decision-making or creativity, where ethical and moral attitudes are wonderful by-product. However, this also can mean that cerebral damage may result in moral losses.

Thus, certain patients with brain lesions, in determined areas, can learn, evoke and preserve its language, to deal with logic, to remember social conventions and social behavior rules, but no longer are capable to apply them into reality, in terms of moral cognition. For example, some researchers have suggested that a large proportion of sentenced individuals, at death corridor, may have injured brains, what could change our points of view about these creatures' moral and legal responsibility, events that are under study by functional neuroimaging of human brains. After all, what could distinguish the functioning of a serial killer brain, of a Hitler or of a Mother Teresa? ⁶

Although some carriers of brain lesions know what is right and wrong, good or bad, they are in jeopardy to certain aspects of

Their social emotions such as shame, humiliation, guilt, compassion, solidarity etc., a fact that jeopardizes their decision-making mechanisms, needed for suitable social performance. Consequently, such commitment makes new learning of this kind of social cognition difficult, damaging the quality of their behavior, conduct and choices, character formation, temper. In addition, what we would call moral character or *neuroconscience (sic)*, which somehow connected deeply to gratification-punishment systems: that little voice which Socrates stated of telling him, intimately, on not doing immoral things, as well as the capacity to evaluate the consequences of such acts¹⁰.

As transit is the outcome of physical interaction of vehicles, *responsibility* is the outcome gotten when people interact. Personal responsibility is a social concept (or public) that can only exist in a social group, and not just in an individual. If someone were the sole person in the planet, there would not be any concept of personal responsibility. Therefore, responsibility is a relational concept that one has about other people acts and theirs about us. Our brains are automatic, governed by physical and chemical world laws, determined, and governed by rules, while people are personally responsible agents, free to make their own decisions and to solve their dilemmas. Thus, our brains are deterministically programmed instruments, while human beings will follow their rules and norms when living together – and the

concept of freedom of act or free will comes out from this interaction.

These features of our personality are not in our brains, they exist only in relationships produced when our brains interact automatically with other also automatic brains. Those, who follow indeterminism philosophical concept, who believe in the presence of a *ghost in machine*, represented by the soul, mind or spirit, that would allow for making choices and that determine actions and the changes in the physical world where we live, they contrast with the so-called determinists. These do not accept free will, believing that we live in a preset world, which presets fate by means of a genetic hardware that would make inevitable each action, and that cannot not be changed by will, education, environment or culture.

Neurophysiologic considerations

Benjamin Libet's experiments, published in 1999¹¹, came to bring new lights on neuroscience of determinism and freedom of will. Libet measured, in this experiment, patients' brain activity while doing a conscious and voluntary hand movement, using a technique known as *event-related potentials* or ERP. The subject looks at a clock and at the same moment makes the decision of bending his wrist, set his attention to a black point, and communicates it to an examiner, who correlates this movement with the instant that brain waves ERP is recorded.

By measuring brain activity, the researcher noticed that before making movements of the hand, about 500 to 1,000 milliseconds, a brain wave activity that he called *promptness or preparation potential*, which would represent the conscious decision of moving the hand: *t time*.

Libet observed that before *t time*, when patient becomes conscious of his decision of doing the movement, his brains had already been activated by preparation or promptness potential, which takes in average 300 milliseconds. This means that if this brain potential installs before we are conscious of the decision to move the hand, our brains know already our intent even before we are conscious of it. Author concluded that it takes 50 to 100 milliseconds for the neural signal to go through the trajectory from the brain to the hand, so it moves; 100 milliseconds are left for the *self-consciousness* to agree with the unconscious decision or then to ban it. This would be the moment when free will would acquires its *veto power* and that, analyzed according to Locke's theory on free will, would imply stating that our conscious mind would not have the freedom of decision, but rather of *non-decisions*¹⁰.

Therefore, a normal person would ever commit a violence, crime or would have a violent behavior. These would be committed by patients carriers of antisocial personality changes (AAP), condition characterized by dishonesty, impulsivity, aggressiveness and lack of remorse or guilt. To those assailed by

such condition would miss this inhibitory mechanism or *veto*, usually associated with a dysfunction of brain frontal lobes, important for the performance of normal social behavior. Thus, without the frontal lobe function, there would be a loss in the capacity to use non-decisions or veto against bad decisions or choices, as would happen in the brain of criminals or serial killers, incapable of inhibiting their violent impulses due to injuries involving their frontal lobes orbital ventromedial and inferior function ^{11,12,13,14}.

Mirror Neurons

Rizzolatti et al¹⁵ in their neurophysiologic works described how the cerebral hardware makes the mental simulation software to work. This mechanism enables us to decide if it is permitted to cause harm to akin, imagining, before, how would be been hurt or to observe the outcome of someone hurting his akin (the ill-famed golden rule). They denominated this brain circuitry as the *mirror neurons system*, which represent a crucial role in moral judgment and in Rawls sense of justice. This is system is not exclusive to human species regarding morality, consisting of the first one to unleash moral emotions.

These authors were able to replicate in humans the same studies of electric recording of the premotor cortical neuron activity already undertaken with monkeys, showing deficits in response, mostly in autisms. Thus, they suggested that such *mirror neurons* are responsible for understanding certain acts

and actions, as well as for understanding other people's actions, enabling imitating them.

Transcranial magnetic stimulation, a fad today in neuroethics and behavioral studies, is used as a way to study needed skills to imitate actions, movements and behaviors, that constitute the basic system for learning by imitation, activated by neuronal complex mechanism¹⁶. As evolutionary precursor of language – since gesture -, representations of meanings and of speech itself, such mechanism is basic in the research of the biology of moral reasoning as it can reveal how brains is able to understand the world. All and each one of these features is necessary for the full development and use of the moral faculties and judgment of our own actions: if they are morally permitted, mandatory, or prohibited.

These findings allowed other scientists to study injuries in these areas by means of transcranial magnetic stimulation over the frontal lobes. Some of these works show that patients with such injuries manifest incapacity to control or inhibit emotions, such as hanger, aggression, violence etc. If normal individuals are capable to control these feelings, psychopaths are not and, inclusively, they fail in establishing distinction between moral and social transgressions, treating them as alike, also showing themselves as incapable to solve ethical conflicts or dilemmas and conventions, instances that often could be circumvented by pharmacological psychiatric treatment ^{15,16}.

Neuroanatomic considerations

Major studies published recently by Koenigs, Damásio et al¹⁴ showed that injuries in prefrontal cerebral cortex jeopardized moral judgment. It has to do with limbic areas and, therefore, they related to emotions mechanism, particularly needed for normal generation of emotions of social type. It is located bilaterally in prefrontal ventromedial cortex portion, zone that comprises these emotions and feeling to the conscience.

Thus, carriers of injuries in this area had the tendency to think and to solve ethical dilemmas in a more utilitarian way in neuropsychological tests such as having to sacrifice a son or a life in order to save other lives. Subject chose, in a colder way, the decision that would harm the lesser number of people, such as the case of known imaginary dilemma of families living in the basement, hiding themselves from Nazi soldiers who searched in order to kill them. One baby starts crying and the sole way to shut him up and to avoid finding all others is to hold the child's breath long enough that would kill him. What to do? For carriers of injuries, the right decision would be to kill the child. What mother would allow this? In this study, which checks the weight of emotion in moral judgment, authors concluded that this type of injury leads patients to show less empathy, guilt, compassion, shame or regret.

However, for situation without dilemmas, the responses of the injured were very similar

to normal voluntaries, showing that studied brain area so crucial for normal judgments between right and wrong, providing support to major role of emotions in generating such judgments, constituting a crucial neural substrata for intuitive-affective moral judgment, but not for the conscious-rational ones, where one can conclude that moral emotions are crucial for moral cognition^{13,14}.

We know that the prefrontal cortex is fundamental for other major faculties, like planning, decision-making, emotions, attention, space-temporal memory, and recognition of a combination between intention and execution. Thus, functional magnetic resonance (fMRI) in normal subjects, the presentation of scenes that evoke moral emotions activates ventromedial area and the superior temporal sulcus. It must not be forgotten, however, that adequate functioning of the whole limbic system, jointly, is crucial for the normal moral judgment⁶.

Amygdale, for example, is part of the complex limbic circuit of the temporal lobe, related to positive emotions gratification circuit, modulating permanent cerebral storage of important events memories related to survival, and causing specific emotions, in recuperation of familiar facial expressions.

Hippocampus is crucial for learning and remembering specific events, although permanent memories may be located

in other areas of cerebral cortex, associated with hippocampus cortex, entorhinal and perirhinal area, which, in moral judgment, may facilitate conscious remembering of facts and memories that enable past events to affect current decisions.

Cortex gyrus cinguli has a series of sub regions with different functions, like regulation of attention, motivation, detection, and execution of ill intentions, associated with the anterior cingulate cortex. Its rostral activation, associated with the nucleus accumbens, caudate and ventromedial nuclei and the orbitofrontal cortex, is necessary for cooperative behavior among subjects submitted to certain moral dilemmas. This gyro is crucial also in cases when organism needs a fast and efficient control of its ethical and moral behavior or in abstract moral reasoning ².

These and other considerations allow to cognate neuroethics as a *science of our moral dilemmas*, such is the amount of neural mechanisms that serve as substrata to process these phenomena. These culminate in current bioethics, with its multidisciplinary and transdisciplinary topics, demanding great effort from us to build a philosophy of life based in our brain, toward universal, global, planetary ethics. Let us consider an almost absurd example: we know what nuclear and atomic bombs can do, but then, why do we continue to build them? Here is a truly ecumenical dilemma for the coming future of a moral society. What would be the neurologic of this fact before the grandiloquent sanctity of human life?

Should or should not we make a decision in view of this astronomic moral dilemma since not making a decision would be *illogical*.

After all, from what we have seen so far: *we are our brain!* Brain death modern concept came out of this last notion and which is so important in case of transplants¹⁰.

What shall we say about death at long-term that we daily cause? The chronic and insidious grievance that humanity inflicts to itself with daily pollution of the air, watersheds, seas, and land. The deadly liberation of gas and toxic products in the air that we breath, in water that we drink, in vegetables that feed us, which, with industrial activity and aggressive agriculture cause lung diseases, pneumoconiosis, autoimmune diseases like thyreoditis, multiple sclerosis, systemic lupus, skin diseases, rheumatoid arthritis, and even incurable neoplasia?

What shall we say about uncontrolled deforestation of thousands of square kilometers of forests that produce the oxygen that we breathe? On the other hand, of the atomic power plants imitating Chernobyl. Such events could provide subject for another article in this magazine. Fortunately, there are texts in our language that give alert over these dangers, like jurisconsult J.R.Nalini's monumental work: *Ética ambiental (Environmental Ethics)* ¹⁷, a work that should be mandatory in all schools, mostly in universities, as well as among legislators. It shows, to society, the suicide committed by those who despise Gaia and the environment that we live: *what would be the neuroethics of these brains that submit us to a hellish Future?*

Consequently, it seems to us that an universal ethics is possible and imperative. After all, all brains are neuroanatomically and neurophysiologically equal. It is up to us to look for and to understand it. After all, we are sure that our specie, for centuries, looks for a utopia of some human natural order to believe – a global bioethics¹⁰.

Final considerations

In view of the mentioned neuropsychological progress during the last 30 years, these events provides for appearance of a new specialist: the neuroethicist. This new specialization would lead us to study ethical implications of our interventions on the brain. Current and future challenges to monitor, to map, to stimulate or to change brain functions through radiological imaging, drugs or advanced neurosurgical techniques that modify our cognition, humor and, even, invading the privacy of our thoughts – like modern lie detectors used in judicial matter or in antiterrorist groups.

This new bioethics science, in the future, should also become a *neuroscience of ethics* that, under brain functions perspectives, ever more known, shall involve philosophical notions such as free will, self-control, violence, personal identity, and intentions, as the outcome of a new and better knowledge about moral cognition, attempting to search for answers for so many future questions.

There are, as we may conclude, a multitude of questions and few answers. In the future, ethics will become the true forum, with global participation – an invitation to the professional and non-professional to look for a reeducation or *neuroliteracy* of the public and media. Thus, in diverse moral judgments, that now we know been generated by set brain areas, neuroethics shall be so crucial as genetics, since it involve human mind, allowing: studying ethical though neural basis and moral experience of duty; to clarify free will and responsibility biological basis; to identify a predisposition for a psychopathic or violence; to verify neurologists, neuroscientists and neurosurgeons roles on decision about terminality of life, brain death and transplant; to discipline or to define if the brain is the cause or consequence of mind properties, attributed to genetics, environment or to both; to understand better mental diseases and normal people's mind; to foresee the possibility to occur a degenerative disease like Alzheimer, Huntington etc.; to identify the effects of psychosurgeries, surgery of epilepsies, Parkinson's disease and surgeries for pain and grievance; to research on stem-cells implant ethics, fetal tissues or nervous tissue (black substance, for example) in the brain; to set an interface between brain and machines or limbs prosthesis or organs; to study molecular mechanisms of memory and drugs that stimulate it; to decode the mystery that makes us humans and to prevent that we become dehumanized; to study drugs that reach targets and cerebral structures and their

consequences, and molecules like DMT (N,N-Dimethyltryptamine), and, finally, to understand neural basis for spirituality, the so-called neurotheology⁸. Concerning DMT, which, like endorphins, is produced by Man's pineal gland, it is a true endocrine psychedelic substance, also called of the *molecule of spirit*. It can produce psychological states of spiritual type, associated with death or quasi-death experiences, whose function is to maintain our brains tuned in a "normal channel" as like a TV¹⁸. Melatonin, another neurotransmitter, also produced by the pineal gland, has a major role in sleeping, cancer, aging, jet lag, and dreams mechanisms – which, unfortunately, have been little studied.

In this view, it is worth highlighting neuroethicist role. As already seen, ethic undergoes evolution from technology also. Consequently, neuroethicists will have particular responsibility in the new bioethical debate, since there is a *bioethics for the brain*, helping the public at large avoiding not only wrong conceptions about what neuroscience can do, but also to understand about what it cannot do. They will be responsible in putting into context neuroscientific and neurotechnologies

advances in the right place and to set away unnecessary fears related to them, helping to discern on neuroimaging use in computerized tomography (CT scanner), magnetic resonance, positron emission tomography (PET scanner), single photon emission computerized tomography (SPECT), cerebral mapping, magnetic electroencephalography (MEG) etc., in clinical or surgical neurotechnology and in psychiatric pharmacology¹.

It must be mentioned that Neuroethics Society was established in 2006, chaired by Professor Steven Hyman, one of Harvard University Board members. This recently established society has published in its supplements of *The American Journal of Bioethics* (Ajob) and its mission, according to its current chairperson, is to promote neuroscience development and responsible application and its unprecedented advances, achieved in the last decades in basic sciences of brain and mind. Thus, one hopes to contribute in the treatment of psychiatric and neurological disorder, with participation of academic researchers, scientists, and physicians interested in social, ethical, and political implications produced by neurosciences advances.

Resumen

Neuro-ética: el cerebro como órgano de la ética y de la moral

Este artículo discurre sobre el substrato anatómico y neurofisiológico en el cerebro despierto que establece la normalidad o lo patológico de nuestros actos, elecciones, decisiones, resolución de dilemas éticos, carácter, emociones y consciencia moral, los cuales dependen de sistemas y áreas específicas. Para eso, utiliza pesquisas de la moderna neuro-imagen y testes neuro-psicológicos que mapean las áreas cerebrales. De entre éstas, los lóbulos frontales, el sistema límbico, el giro cíngulo, la amígdala temporal y el hipocampo, cuyo análisis neurofisiológica demuestra que regulan el control de la normalidad psíquica, el autocontrol y, también, el control de la agresividad, violencia, libre-arbitrio, responsabilidad y dolencia mental. Concluye que, si lesionadas, esas áreas producirán respuestas anormales o patológicas en los ámbitos de la cognición, juzgamiento moral y pensamiento ético.

Palabras-clave: Ética. Neuroética. Neurociencias.

Abstract

Neuroethics: the brain as ethics and moral organ

This article discourses about the anatomic and neurophysiologic substratum of the awaken brain, that establishes the normalcy or pathological side of our acts, choices, decisions, resolution of ethics problems, character, emotions and moral conscience, which depend on specifics systems and areas. In order to do that, it utilizes researches from modern neuroimaging and neuropsychological tests that map brain areas. Among these, the frontal lobes, the limbic system, the cingulated cortex, the temporal amygdala and the hippocampus, and based on neurophysiological analysis, demonstrates that they rule the control of the psychic normality, the self-control and also the control of aggressiveness, violence, self determination, responsibility and mental disease. It deduces that, if lesioned, these areas will reproduce unusual or pathological responses in cognition, moral judgment, and ethical thought fields.

Key words: Ethics. Neuroethics. Neurosciences.

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