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Neurosciences, Pharmaceuticals and Freedom: Anthropological and Theological Dialogue Regarding Human Dignity*

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Summary: Technological advances in the different areas of Biology, Chemistry and Physics have led to a better understanding of the nervous system, especially of the brain function. This new knowledge marks our vision of what we consider biological, anthropological and spiritual. Biomedical sciences and hermeneutics broaden their interest in the brain from a disciplinary and interdisciplinary standpoint in which diverse scientific perspectives and knowledge allows us to have an integral and integrating comprehension of this field. These new inquiries also interest theology not only from an understanding of the transcendent and religious vision of life, but also from an anthropology of faith, morality and ethics. Why is moral theology interested in the brain? What connections are there between morality and the brain? A first answer can be given in the sense that the implications of faith must be sought intelligently in this dialogue, though this does not signify totally reducing it to the physiology of the brain and solely to studies in link with this aspect. The interdisciplinary bridges developed around the brain confront us with human problems that demand our attention. That is why in this article as academics and investigators in the areas of biology, theology, and philosophy, from an interdisciplinary perspective, we approach cellular and molecular mechanisms that mediate

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spiritual practices and how these may seem affected by specific pharmaceutical properties. At the same time, we draw on the responsibility that neuroscience must have in assuming the concept of human dignity in its reflections, with a non-reductionist attitude. It is about a reflection on the perspective of a more global anthropology involving freedom and responsibility in the presence of the breakthroughs concerning the brain. We hope that this article opens new spaces contributing along the lines of freedom, the particularity of each individual's identity, and finally, their belonging to a human community.

Keywords: Neurosciences, neurotransmitters; embodied spirit; vulnerability; freedom; human dignity; pharmaceuticals; responsibility.

Neurociencias, farmacos y libertad: diálogo antropológico y teológico en torno a la dignidad humana

Resumen: El avance tecnológico en diferentes áreas de la biología, química y física han llevado a un mejor entendimiento del sistema nervioso, especialmente del funcionamiento del cerebro. Este nuevo conocimiento marcará nuestra visión de lo que consideramos no solo biológico sino también antropológico y espiritual. Las ciencias biomédicas, al igual que las hermenéuticas, amplían su interés por el cerebro desde una malla disciplinar e interdisciplinar en que las diversas perspectivas científicas y saberes nos permitirán una comprensión integral e integradora en este campo. Empero, a la teología también le interesa estas nuevas indagaciones, no solo desde el entender de la visión trascedente y religiosa de la vida, sino también desde una antropología de la fe, moral y ética. Pero ¿por qué a la teología moral le interesa el cerebro? ¿Qué conexiones hay entre la moralidad y el cerebro? Una primera respuesta podría darse en el sentido en que las implicaciones de la fe deben buscarse de manera inteligente, aunque ello no signifique reducirlo todo a la fisiología del cerebro y solo a los estudios relacionados con este aspecto.

Los puentes tejidos interdisciplinariamente alrededor del cerebro nos sitúan frente a problemas humanos que requieren atención. Por eso, en el presente artículo abordamos desde una perspectiva interdisciplinar, de nuestro quehacer como docentes e investigadores en áreas de la biología, teología y filosofía, los mecanismos celulares y moleculares que median las practicas espirituales y como ellas se pueden ver afectados por propiedades específicas de fármacos. A su vez, abordamos la responsabilidad que tiene la neurociencia de asumir en sus reflexiones, y en una actitud no reduccionista, el concepto de la dignidad humana. Una reflexión en orden a una antropología más global abarcante de la libertad y la responsabilidad ante los nuevos avances sobre el cerebro. Esperamos que con este escrito se abran nuevos espacios que, contribuyan en la línea de la libertad, lo particular de la identidad de cada sujeto y finalmente, su pertenecía a una comunidad humana.

Palabras clave: neurociencias, neurotrasmisores, espíritu encarnado, vulnerabilidad, libertad, dignidad humana, farmacos, responsabilidad

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Introduction

In the last 30 years, research advances on the brain have augmented in great leaps compared to previous times. This has led groups of investigators towards a multidisciplinary and interdisciplinary interest surpassing reductionist monisms and dualisms in the past, limited to explanations and disciplinary diagnostics that abandoned the most complex implications of life. As Elisabeth Hildt asserts regarding interdisciplinary results from neuroscience advances:

> This can clearly be seen in the increasing number of areas of human life in which progress in knowledge is taken into account, be it in relation to matters of free will and responsibility, moral decision making, self-understanding and identity, as in decisions at the time of purchase, involving stock market speculation, religious convictions and educational matters.[1]

To become aware of cerebral structures and their relevance in the human body does not mean per se to know the totality of their function. Based on our interest we intend to advance in two relevant aspects:

– Why is anthropological theology interested in the contributions of neurosciences in its study of the brain in the human body?
– How should physiological study be connected to the complex understanding of human nature?

Dealing with such anthropological questions that demand hermeneutics, interdisciplinary bridges and dialogues of multiple knowledges, we also find ourselves confronted to questions on freedom and responsibility of individuals in sight of neuroscientific advances. Issues such as these deepen into a major concern that must be approached from multiple academic perspectives. Hence the relevance of our exercise which perceives the need for an answer to the total integrality of the individual and resists all reduction of the anthropological problem to a sole reflection of a biological topic or a vague pharmalogical reply.

Based on an integral anthropology, that takes into account significant facts from neurosciences and knowledges, dialogues among biomedical basic sciences, philosophy, and theology, acknowledges the autonomy of sciences. In Ecclesiastical magisterium, especially in Pope Pius XII's *Humani Generis,* the doctrine of evolutionism, although originally was seen with some suspicion, is proposed as an object of study.[2] However,

[1] Hildt, "¿Cómo se relacionan el cerebro, la moral y la ética?", 71.

[2] Pius XII, Encyclical *Humani generis* concerning some false opinions threatening to undermine the foundations of catholic doctrines (1950)".

new data allow to affirm with more accuracy that the theory of evolution is much more than a mere hypothesis. Pope John Paul II stated in this respect:

> It is important to set proper limits to the understanding of Scripture, excluding any unseasonable interpretations which would make it mean something which it is not intended to mean. In order to mark out the limits of their own proper fields, theologians and those working on the exegesis of the Scripture need to be well informed regarding the results of the latest scientific research.[3]

Ecclesial documents therefore, taking note of the importance of interdisciplinary dialogue between faith and reason underline the fact that science can benefits from faith; the scientist is asked to be open to the total reality of life, with all its inexhaustible resources. Faith awakens a critical sense that hinders investigation from conforming to formulas and reductionist explanations, by ratifying that nature does not reduce itself to its material aspects, functions, and dimensions.

Faith, at the same time, asks scientists to break through the obstacles that blind them, and that in the past widened the gap between scientific and theological disciplines. Responsibility for the integral dignity of the human being must broaden the horizons of scientific studies and, in our case, neurosciences, so that we can shed light on the totality of the human person from faith and science.

Inspired by Jean Ladriere's work, a method of articulation between natural sciences and theology has been developed in other writings by mediation of diverse philosophical disciplines.[4] Philosophy manages to mediate because of its understanding of the fundamentals of knowledge that clarifies languages, objects, objectives, and the methods of natural sciences and Christian theology.[5]

In this article, philosophical mediation between the sciences and theology is the interpretation that anthropological philosophy can perform on the implicit meaning of some relevant neuroscientific results. This mediation allows the articulation among neurosciences and theological anthropology in a double movement of interpretation:

– The first movement consists of anthropological-philosophical hermeneutics that interpret several facts in brain physiology and the effects of pharmaceuticals

[3] John Paul II, "Message delivered to the Pontifical Academy of Sciences (October 22, 1996)".

[4] Jiménez-Rodríguez, *The Articulation between Natural Science and Systematic Theology: A Philosophical Mediation Base don the Contributions of Jean Ladriere and Xavier Zubiri*, 381-481; Jiménez, [Los aportes de la teología de la creación y de la acción humana a la orientación de las ciencias aplicadas y las tecnológicas: una mediación ética y axiológica", 387-406.

[5] Jiménez-Rodríguez, *The Articulation between Natural Science and Systematic Theology: A Philosophical Mediation Based on the Contributions of Jean Ladriere and Xavier Zubiri*, 377-381.

on the nervous system. This perspective is achieved with some philosophical concepts which allow the anthropological interpretation of scientific facts.

– The second movement consists of strictly theological hermeneutics that allow interpreting philosophical elaboration from concepts that belong to the semantic horizon of theology.

We shall start the article with analysis and study of the brain, pointing out two aspects: The first, a bio-psycho-neuro-immunological approach of spiritual experiences; the second, pharmaceuticals and their cerebral implications. The third, part of the article presents an anthropological-philosophical interpretation of scientific facts. Finally, the fourth part proposes a theological interpretation and reflection.

With this we wish to demonstrate our fundamental hypothesis: interdisciplinary dialogue between neurosciences and theology clarifies anthropological topics of grand relevance for science itself, philosophy, and theology. Some examples of such topics, discussed in these writings are human vulnerability, incarnate liberty, and human dignity.

Approach Towards the Bio-Psycho-Neuro-Immunological Effects of Spiritual Experiences

In the last few years concerns, initiatives, and financial investments have increased regarding multiple scientific studies on the brain. The Human Brain Project (*Proyecto del Cerebro Humano*), reveals this fact, whose aim makes knowledge of brain functions and the treatment of neurodegenerative diseases possible. R. Yuste[6] –in an interview– answers the question about what we shall see in a few years should we reach the following goal:

> In a high definition film of a schizophrenic patient's cerebral activity, for instance, we may observe abnormal differences and patterns explaining these seizures, helping us to understand why they think the way they do. Formulating a hypothesis and attempting to derive therapies addressing the problem can be carried out. At present, we are attacking these mental illnesses not knowing the cause, and this may help a great deal, opening new fields for psychiatrists. The situation would be a complete success should we cure or change something like that.[7]

In the academic scope, theology deals with spiritual experiences such as meditation, prayer and rituals. While each is distinct, they are considered plausible due to the

[6] Spanish scientist, co-director of the "Brain Activity Map", Project, Columbia University, New York.

[7] Yuste, "La misma tecnología que curará la esquizofrenia servirá para manipular la mente."

evolution of various structures of the brain –in primates and *homo sapiens*– concerning attention span, emotions and consciousness of self.[8]

The autonomous nervous system with its sympathetic and parasympathetic divisions, regulates energy consumption, metabolism, and conservation of homeostasis. It has been determined that through meditation, the activation of the sympathetic system leads to quiescence states, while the activation of the sympathetic system induces states of excitement and alertness that make concentration possible.

Spiritual experiences at the same time activate associative areas of the cerebral cortex; for instance, the prefrontal cortex connected to planning and orientation of our actions towards future activities. To conclude, the actions of the cortex are complemented by the limbic system (hippocampus, amygdala and hypothalamus) during spiritual experiences; respectively, these regulate complex aspects of the emotions, translating them into behavior.[9]

Such certainties allow us to glimpse at a connection between religious practices, and/or spiritual ones with the biochemical foundation of the neurological system. Scientific attention has focused on the effects of meditation upon physiological parameters such as oxidative stress, and neuropeptide production, that could beneficially influence neuronal and cerebral plasticity.

It is of utmost interest, therefore, to understand the biological mechanisms mediating in these experiences, in which neuroendocrine, physiological, and immunological phenomena can occur, manifesting changes in genes codified in molecules such as neurotransmitters, hormones, and cytokines to which a follow-up based on *genomic*[10] and *proteomic*[11] techniques is performed. Hence it is inferred, at first glance, that investigations indicate meditation reaches paths that could play a beneficial role in the physical, spiritual, and psychological health of an individual, preventing the aging of their brain and mental aptitude.[12]

Such queries seek to identify the importance of these meditation techniques and their relation to biological mediators (neurotransmitters, hormones associated

[8] Tang, Hozel, and Posner, "The Neuroscience of Mindfulness Meditation", 213.

[9] Santosh S., Gupta et al, "Imaging and Neurological Changes in Brain with Spiritual Experience: A Pilot Study", 191.

[10] Genomics analyzes genetic structure and function in nucleic acid molecules of a living organism or system.

[11] Proteomics studies specific prothema (information contained in proteins), with the aim of knowing and understanding proteins, their abundance, variations, and modifications in a cell or biological fluid.

[12] Xiong and Doraiswamy, "Does Meditation Enhance Cognition and Brain Plasticity?", 63.

to stress, cytokines of the inflammatory response) to which potential benefits in the integral well-being of the individual is associated.

While it is true that little is known about the cellular mechanisms implied in spiritual experiences, brain structures suggest that both molecules and similar mechanisms are fundamental to those that take part in processes of plasticity, hormonal regulation, and stress. It has recently been determined that yoga, meditation, and "the mental health of the body", induce major connectivity and activity in cerebral regions before the cingulate cortex, adjacent prefrontal cortex, and other brain areas regulating emotions.[13]

The neurotrophic factor derived from the brain (BDNF) is of neurotrophic cut[14]: added to other neurotrophins[15], it is vital in regulating these processes in the neurogenesis, such as proliferation, differentiation, maturation, and neuronal plasticity. Defining it that way, it is understood that the BDNF is a neurotrophin that promotes development, survival and structural-functional plasticity of the neurons in the central and peripheral nervous systems.[16]

Although BDNF is expressed in other tissues, it concentrates a major degree of expression in the brain; there, it synthesizes and is liberated primarily due to increase of neuronal activity; for example, when a mental or cognitive activity is executed. BDNF may also enter the brain with free diffusion, by the blood-brain barrier.[17] Its cellular effects are permeated by the expression and activation of tyrosine kinase receptors TrkA, TrkB, and TrkC[18] found in the cellular membrane.

BDNF is much more active in areas of the brain such as the hippocampus and the cortex, which are fundamental for learning, memory, and superior cognition. This probably has to do with its capacity to cross the blood-brain barrier and the BDNF peripheral serum that correlates with those of the cerebrospinal fluids.

By this observation, BDNF is confirmed to be related to the complex regulation of multiple physiological aspects: inflammation, immunity, mood regulation, response

[13] Cahn et al, "Yoga, Meditation, and Mind-Body Health: Increased BDNF, Cortisol Awakening Response, and Altered Inflammatory Marker Expression after a 3-month Yoga and Meditation Retreat".

[14] A neurotrophic factor is a secreted protein by specific cells having a critical function in neuron differentiation, development, plasticity, neuroprotection and repair.

[15] Neurotrophins are a protein family regulating a number of development, function, and survival factors of neurons in the central and peripheral nervous system.

[16] Reichardt, "Neurotrophic-regulated Signaling Pathways", 1545.

[17] Liu and Nusslock, "Exercise-mediated Neurogenesis in the Hippocampus Via BDNF".

[18] Ibid.

to stress, and metabolism.[19] Additionally, its serum levels are directly associated with psychiatric and neurological disorders that trigger anxiety, depression, and Alzheimer, as with emotional exhaustion.[20]

In this sense, BDNF indexes are inversely correlated with anxiety experience in individuals that practice meditative yoga. That way, for example, BDNF tends to increase while anxiety diminishes. Similar results have been detected in patients who practice yoga. There, the increased levels of BDNF may explain the anti-depressive effect of this practice.

Such results may be due to the participation of areas of the frontal cortex that mediate in this meditative exercise and maintain those processes of plasticity mediated by BDNF. Additionally, BDNF levels in the central nervous system may be regulated by the autonomous nervous system when parasympathetic activation of the vagus nerve, product of deep breathing, yoga, and meditation increase the liberation of neurotrophin.

Of those hormones associated to stress, the hypothalamic-adrenal gland axis (HPA), a neuroendocrine system whose activation directly related to the cortisol, lies upon the stress response. A relation between excessive adrenocortical activity and high levels of basal cortisol with a progression of psychiatric illnesses and other pathologies is clearly evidenced.

Cortisol, a glucocorticoid secreted by the suprarenal glands responds to the adrenocorticotropic (ACTH) released from the anterior pituitary gland. It is a trustworthy marker of the HPA activity that keeps up a robust circadian rhythm reaching, after awakening within a range of 30 minutes, a response to cortisol (*cortisol awakening response, CAR*), and gradually diminishes throughout the day.

Therefore, though basal cortisol levels are a trustworthy index of relative activation of the sympathetic nervous system usually measured towards the end of the day or at night, an important and independent correlation also exists between the homeostatic aptitude of the autonomous nervous system and the variations of those levels of circadian cortisol with sympathetic hyperactivity demonstrating a reduction tendency. In this sense, those who practice meditation and concentration have an augmented CAR, related to the increase of morning alertness and stress resilience, and at the same time with an improvement in habits in sleep quality.[21]

[19] Papathanassoglou, Miltiadous, and Karanikola, "May BDNF be Implicated in the Exercise-mediated Regulation of Inflammation? Critical Review and Synthesis of Evidence", 521.

[20] Sertoz et al, "The Role of BDNF and HPA Axis in the Neurobiology of Burnout Syndrome", 1459.

[21] Wust et al, "The Cortisol Awakening Response—Normal Values and Confounds", 79.

It has been demonstrated that stress diminishes plasticity in the prefrontal cortex, the hypothalamus, and amygdala, producing structural changes decreasing the dendritic tree of neurons and the hypothalamus volume, and additionally increasing the amygdala volume. Meditation and yoga contrarily increase grey matter density in the hippocampus, reducing the amygdala density. These changes are considered associated with sympathetic system regulation decrease, with the HPA axis, and with the increase of the parasympathetic system activity; these lead to the increase of BDNF and cortisol reduction.

Finally, inflammation is another vital biological mediator for health and well-being. In the last 20 years, investigations have shown that pro-inflammatory corporal states have to do with a tendency towards mental disorders such as depression or anxiety and with a broad scope of chronic diseases.[22] The decreases in the activation of inflammation during lacking periods of active infection in general is associated with a better condition of physical and mental well-being.[23]

However, acute inflammatory responses are also adaptive; hence the general diminution of pro-inflammatory immune mediators (and the increase of anti-inflammatory mediators) are not always a symptom of health and well-being; instead, a healthy homeostatic balance between pro- and anti-inflammatory signaling is a lot more adaptive.

It is possible to infer then that inflammatory states can be measured by circulating pro- inflammatory cytokines such as Interferon Gamma (IFN- γ), Interleukin-1 (IL-1β), Interleukin-6(IL-6), Interleukin-8(IL-8), Interleukin-12(IL-12), and tumor necrosis factor (TNF-α), besides anti-inflammatory cytokines like interleukin-10(IL-10).[24] Assessments of cytokine levels in subjects that practice deep meditation as well as those who opt for Tai-chi, are surprising; these exercises not only increase anti-inflammatory cytokine production (IL-10) but also of pro inflammatory cytokines (TNF-α, IFN- γ IL-6 and IL-8, amongst others).

Such results are evident in the cytokine basal levels of its practitioners. So, for example cancer patients with high indexes of pro-inflammatory cytokines, the reduction of this type of molecules after practicing yoga is higher if compared to healthy individuals with low anxiety levels.

[22] Strawbridge et al, "Inflammation and Clinical Response to Treatment in Depression: A Meta-analysis", 1532.

[23] Elenkov et al, "Cytokine Dysregulation, Inflammation and Well-being", 255.

[24] Black, "Stress and the Inflammatory Response: A Review of Neurogenic Inflammation", 622.

In synthesis, research developed up until now shows that spiritual experiences such as meditation and prayer can have a beneficial effect over the state of health. Practice of meditation implies physical postures, silence (outer and inner), the repetition of a word or phrase, and movements associated to "spiritual" aspects. An example of this is the praxis of prayer and yoga that incorporates physical postures, controlled breathing, mantra repetition, emptiness or "no thinking", and body sensation. These events due to mechanisms not yet clearly determined, regulate neuromodulators such as BDNF, inflammatory response and the HPA axis that, by means of cortisol, more control and optimal development signifies a healthy brain.

Considering the scientific facts mentioned, we may glance at a series of anthropological and philosophical implications:

1. Discussed facts show the insufficiencies of reductionist and materialistic anthropologies stating religious beliefs and spiritual experiences are produced by mere neural activity. They also show serious limits of a dualistic vision by which the interaction between matter and spirit in the human being is lacking or null. We propose the hypothesis that anthropology of an integral and holistic nature does more justice to neuroscientific facts presented.
2. The anthropological aspect of human vulnerability emerges from these reflections on anxiety, depression, and the variability of states of emotion.
3. Brain plasticity itself and changes in the nervous system due to interaction with the environment show the unfinished character of the human being: always open to change. Members of the human species are receptive individuals that build their lives with freedom from decisions made and influenced by feelings and states of emotion. These topics shall be deepened in the third and fourth sections.

Drugs and their Cerebral Implications

Drugs influence the operative functioning of the brain and the quality of life of the individual. In speaking about the integral health of people and the function of medications, it is necessary to place them into two specific areas: pharmacokinetics and pharmacodynamics. The former deals with what the body does to the drug; the second with what the drug[25] does to the body.

[25] Drugs: "a substance with an exactly known chemical composition able to produce effects or changes on a determined physiological property of whomever takes it. It may interact with protein macromolecules, called receptors, located in the membrane, cytoplasm or nucleus of a cell, giving place to an action or

The central nervous system is a fundamental unit of the brain, constituted by complex neuronal systems that regulate the functioning of other systems in the organism and to itself. Physio-pharmacological investigation, still increasing, intends to find alternatives with new medications[26] optimizing the relation between the dosis of a drug administered to a patient and its usefulness in the treatment of a determined type of brain illness.

Nonetheless, we cannot leave behind the implications of drug consumption,[27] chemical substances with evident neurological effects that, besides causing irreversible brain damages in those that take them, they become an issue in mental health in social and world environments.

From those areas mentioned –pharmacokinetics and pharmacodynamics– all medication requires an index of appropriate concentration, in a determined site of action to optimize the functioning in the body. It is necessary therefore, to determine the amount to be administered, depending on absorption speed, distribution, fixation or localization in the tissues, biotransformation and excretion.[28] This internal process, called pharmacokinetics, involves basic physical chemical factors: cellular membranes, weak electrolytes and pH influence.[29]

Absorption describes the speed with which a drug abandons its administration region, and at the same time the speed with which it performs its action. Bioavailability in the meantime indicates the degree with which it arrives to the site of action[30] or the biological liquid through which it does it.

evident effect. Pharmaceuticals may be human-made substances or produced by other organisms" (Clinical Evidence, "Farmaco, droga, medicamento: definiciones").

[26] Medication: "... a particular pharmaceutical formula which has gone through a technological process of manufacture determining its bio availability and stability according to its final pharmaceutical aim and absorption time ion the body. Due to its pharmacological properties, it may be used in people or animals to prevent, relieve or improve the patient's health, or to alter physiological states in the body" (Pérez Landín, "Concepto de medicamento")

[27] Drug: "any gross mixture of components with which in fact, has a pharmacological activity, its identity is unknown from its other components and its concentration. When speaking of drugs, we are referring to all substances shoes entity has n ot been chemically identified by neither its composition nor its pharmacological effects, that in many cases are irreversible for the body" (Clinical Evidence, "Fármaco, droga, medicamento: definiciones").

[28] Action mechanisms with which Pharmaceuticals cross the membranes, are vital, and the physical chemical properties of molecules and those membranes affecting the transference. Molecular size and shape, solubility in the absorption site, the degree of ionization, relative solubility in lipids of ionized and non-ionized forms (Goodman and Gilman, *Manual de farmacología y terapéutica*, 21).

[29] To this regard, to complement, see Goodman and Gilman, *Manual de farmacología y terapéutica*, 21.

[30] According to the anatomic site in which absorption is produced, with its physiological and pathological functioning, bioavailability is affected; hence the importance in the election of via administration

As far as the brain is concerned, drug administration in the central nervous system (SNC), from the circulatory torrent, is peculiar for the restriction between the entrance of substances into the cerebrospinal fluid and the extracellular space of SNC.[31] Drug molecules must cross the endothelial cells and perivascular cell membranes before reaching SNC neurons[32] or other white cells. Nevertheless, the blood-brain barrier (BBB) –adapted to exclude medications or other foreign bodies due to its metabolic complexity and its route in transporting solutes to the transcellular via[33]– is a limiting factor.

Drug dosage in the brain raises a series of implications. One, is that all medication administered in this organ, depending on its distribution, fixes itself proportionately in those concrete sites of cellular action, responsible for the activation of its effect in the body. However, this distribution may be restricted because of drug fixation to plasmatic proteins that may either accept or reject it, depending on its molecular structure.[34]

At the same time drugs may accumulate in tissues in concentrations much higher than expected in relation to some factors of functioning,[35] and may also prolong its action in the body. Therefore, the drug process is crucial for the brain.

[enteral(oral), parenteral (intravenous, subcutaneous and intra muscular)] with which a pharmaceutical should be correctly administered (Goodman and Gilman, *Manual de farmacología y terapéutica*,21).

[31] Endothelial cells of cerebral capillaries differ mostly from tissues due to the lack of intercellular pores and pinocytotic vesicles (catchment of extracellular matter). Narrow unions predominate consequentially; aqueous fluid is reduced representatively. This condition is not particular to the SNC capillaries (narrow unions also appear in many muscular capillaries). That particular tendency of pericapillary glial cells may also contribute in the slow diffusion of organic acids and bases in the SNC (Goodman and Gilman, *Manual de farmacología y terapéutica*, 29).

[32] Glial cells are nerve tissue cells, and constitute an inter neural matrix in which there are a great variety of crashed and fusiform cells differing from neurons, principally because they do not form synaptic contacts, their membranes contain ionic channels and receptors able to perceive environmental changes. Active signs give place to transmitter release though they lack the properties that produce action potential. (Taleisnik, *Neuronas: desarrollo,lesions y regeneración*, 6).

[33] BHE (Hematoencephalic barrier) elaborates such a process, whether by passive diffusion, mediated transport by transporting proteins, by mediated transcytosis by receptor or by ABC transporters. BHE becomes a great block in brain pharmaceutical administration due to its great impermeability. (Dominguez; Álvarez; Suárez-Merino; and Goñi-de-Cerio, "Afecciones neurológicas y barrera hemato encefálica. Limitaciones y estrategias para la liberación de fármacos al cerebro", 213).

[34] Albumin, particularly, in the case of acid compositions and acid glucoproteins α1for basic compositions (Goodman and Gilman, *Manual de farmacología y terapéutica*, 29).

[35] It is important to keep the required pharmaceutical concentration, in the function diffusion balance resulting from pH gradients, intracellular constituents' fixation or lipid distribution (Goodman and Gilman, *Manual de Farmacología y terpéutica*, 28).

Presently, in various researches in course on cerebral illnesses, the BBB –as mentioned[36]– continues to be a limiting factor. To be able to pass through the BBB that releases the therapeutic agent in the brain requires implementation of two techniques: the invasive method and the non-invasive method.

The Invasive Method

This method is efficacious though it requires a surgical procedure raising risks for the patient. Such a procedure may include an intra-cerebral-ventricular injection (ICV) in the cerebrospinal fluid, the intra-cerebral infusion through improved release technique by convection (CED), the intra-cerebral implants or the disruption of the BBB integrity.[37] In all cases, the effect of the drug diminishes exponentially due to the distance between the region of interest and the site of liberation. Therefore, precision when injecting and fixating the medication determines an adequate treatment. Nonetheless, sometimes it is the only way to avoid potential adverse effects produced by the systemic release of much more aggressive drugs.

With this method, the risk of uncontrolled and prolonged permeability increases in the BBB may be lethal, since it leads to an augment of intracranial pressure and the release of neurotoxic constituents towards the plasma of the brain tissue; for instance, when entering into SNC of the albumin, a neurotoxic substance for the astrocytes that, in non-pathological situations, is found in the interstitial liquid of SNC in concentrations that are too low.[38]

[36] During the last century, longevity in society has increased considerably; in the last fifty years, life expectancy has increased by 30 % and is expected to reach 50 % by year 2050. Life expectancy together with the rapid population growth in the first half of the twentieth century is read as a 300 % increase in adults over 60 years of age. Concretely, it is forecast that in ten years this group will represent 15 % of the total population. Alzheimer (EA) or Parkinson's (EP) besides progressive are irreversible because effective treatment has not been gotten for them. (Domínguez; Álvarez; Suárez-Merino; and Goñi-de-Cerio, "Afecciones neurológicas y barrera hemato encefálica. Limitaciones y estrategias para la liberación de fármacos al cerebro", 214).

[37] They possess a number of limitations in connection with the administration and diffusion in the brain. in the ICV case, its diffusion is very low. only a small pharmaceutical concentration may reach its target since the interstitial liquid plays against the pharmaceutical diffusion and the cerebral spinal cord liquid is constantly renewed, returning the pharmaceutical to the bloodstream; not to mention the difficulties that could arise in a surgical intervention. Likewise, the CED technique there are regions in the brain that are complicated to saturate by infusion, concretely the infiltrated tissues surrounding the cavity because the pharmaceutical release is subject to the correct positioning of the catheters (Domínguez; Álvarez; Suárez-Merino; and Goñi-de-Cerio, (afecciones neurológicas y barrera hemato encefálica. Limitaciones y estrategias para la liberación de fármacos al cerebro, 218.)

[38] Ibid.

Non-Invasive Method

This procedure may include the nasal route, a systemic release, or the use of colloidal transporters.[39] The investigative course is focused then on how to improve the efficacy of the drug release systems in the brain and its models to test its safeness.

Drugs in these procedures have scientifically proven efficacy. Likewise, they generate collateral and secondary effects that should be known by the patient: an elevated frequency of primary alterations, such as psychological reactions that modify emotions and knowledge, be it a part of their intrinsic action or a toxic effect, when due to an accumulation in its dosage, without the due supervision, will lead to an overdose in the patient.[40] It is also found that abuse in depressors and anxiolytics generate addiction that put life at risk and may even cause death. Their non-medical regulation, self-prescription, undue consumption, and addiction to them affect the normal functions of the brain.

[39] The nasal passageway offers a rapid absorption to the blood circulation system and avoids the first metabolic screening in the intestinal wall and the liver; substances such as neurotrophins, neuropeptides, polynucleotides or chemotherapies may reach SNC in effective concentrations; while in the systemic route (oral, gastro enteric, sublingual) administered pharmaceuticals by this via have some optimal physical-chemical characteristics allowing the BHE go through by passive diffusion through the transcellular via or as well have the necessary structural properties to be a substrate of one of the transporting systems in the capilar cerebral endothelium, like protein transporters. However, these transport systems are not always of assistance to the passing of pharmaceuticals through the barrier. BHE contains various bombs with a union dominion to ATP (ABC transporters) that give back a multitude of pharmaceutical to the bloodstream from the brain; in the last decades, colloidal transporters have been used increasingly since they combine a high efficacy around when passing through BHE and a minimum alteration of their own characteristics. They are characterized by the specificity increase surrounding cells and tissues, improving pharmaceutical bioavailability increasing their diffusion by biological membranes and protecting at the same time pharmaceutical colloidal systems allow pharmaceutical access non-transportable enzymatic inactivation through BHE, masking their physical-chemical features through encapsulation in these systems. In general, this type of transportable pharmaceutical include micelles, liposomes, and, nano-composite (Domínguez; Álvarez; Suárez-Merino; Goñi-de-Cerio, "Afecciones neurológicas y barrera hemato encefálica. Limitaciones y estrategias para la liberación de fármacos al cerebro", 218).

[40] The treatment used in primary form, for example, for certain psychiatric illnesses, are placed in three categories: *antipsychotics* or *neuroleptic pharmaceuticals*, used in serious psychiatric illness treatment such as psychosis. It also has a favorable effect over the affective tone and thinking attitude, but its use may have the risk of provoking collateral effects that are illnesses to neurological illnesses. *Pharmaceuticals that stabilize emotions* (especially lithium salts and certain anticonvulsionants) and *antidepressives* (Agents that give the mood a pickup, used to treat affective disorders and other related conditions. *Anxiolithic-sedative agents*, particularly benzodiacepines, used in the treatment of states of anxiety. Pharmaceutical use is made difficult therefore in psychiatric treatment, product of diagnostic insecurity that characterizes the psychiatric clinic, ever since 1924, Lewin presented a fascinating list on the history and and characteristics of many psychoactive components (Domínguez; Álvarez; Suárez-Merino; y Goñi-de Cerio (Afecciones neurológicas y Barrera hemato encefálica. Limitaciones y estrategias para la liberación de fármacos al cerebro", 381-382).

This second section shows us some anthropological and philosophical repercussions. Firstly, possible emotional and cognitive modifications through use of drugs and through anti-depressive and anxiolytics demonstrate human vulnerability. The possibility of addiction to drugs and pharmaceuticals demonstrate the fragility of this human capacity called freedom. Finally, use and abuse of pharmaceuticals not only affect brain functions but also affect the human being as a whole.

The need for medical regulation and the possible adverse consequences of pharmaceutical and drug abuse invites a reflection on human value and their integral dignity, always at risk of harm. These issues shall be pondered upon in the following two sections.

Anthropological and Philosophical Interpretation of Neuroscientific Facts

To achieve an intended interpretation, certain concepts, and philosophical categories are needed to allow accurate understanding of what expressed by the sciences. We shall start with a philosophical reflection upon the relation between human matter and spirit. From this understanding we shall discuss the following topics: freedom and responsibility, vulnerability, and finally, human intrinsic (inherent) value.

Matter - Spirit Relation Beyond All Reductionist and Dualistic Pretension

Among various global anthropologies that have existed and formed part of the current debate among philosophers and neuroscientists, are reductionist materialism and dualism. The anthropological paradigm of reductionist materialism affirms that all mental function is totally explained by neurological mechanisms and biochemical processes.[41] Jean Pierre Changeux, neuroscientist, in his book *L'homme neuronal*, states that mind, equivalent in French to spirit, is nothing else but an interaction of charged ions and the intervention of neurotransmitters at the synaptic level.[42] For the author mentioned, religious or mystical experiences are hallucinations.[43]

Another global anthropology is the dualism of interactionist character. John Eccles, a known neuroscientist, states that mind and brain are independent entities.[44]

[41] Ganoczy, *Christianisme et neurosciences*, 73 y 320.

[42] Changeux, *L'homme neuronal*, 51.

[43] Ibíd., 183-185; 190

[44] Eccles, *How the Self Controls its Brain*, 9.

Matter and spirit in a human being are two orders of existence with completely different and independent ontologies.[45] Despite the interaction between both realities, the soul is unique, created by a spiritual, divine and supernatural act, and implanted in the embryo at a certain moment between conception and birth.[46]

Both postures have difficulty in explaining the already described phenomena of the relation between matter and spirit in operations such as conscience, memory, intellect, feelings and freedom. Why do spiritual actions or operations such as meditation and prayer affect the neurological system? Why do pharmaceutical and drug interventions affect intelligence, emotions, and freedom?

These matters and other similar ones have led to the elaboration of a third general anthropology that affirms the existence of an inseparable integration between what is spiritual and material in the human individual. Gerald Edelman and Antonio Damasio are found in this integral and holistic anthropology.

Edelman, against dualism, poses that: "the mind arises as a result of physical interactions across an enormously large number of different levels of organization, ranging from the molecular to the social".[47] Against reductionism, this neuroscientist states that neurons are necessary though not sufficient to explain the mind.[48] The human mind is embodied and not immaterial and immortal.[49]

Similarly, Damasio considers the soul or human spirit embodied; they are not things but "a complex and unique state of an organism".[50] According to this neurologist, the spiritual experience is real, produces harmony, and makes it possible for the body to function in the highest level possible of perfection.[51] Spiritual experiences attained by means of prayer, rites and religious narratives show that our spirituality is embodied.[52]

From a more philosophical perspective, Xavier Zubiri states that the human psyche (he prefers this term to soul to avoid confusion with dualism) is essentially (not only gradually) different from that of animals.[53] Human psychic notes and attributes, such as intelligence and volition (will), have a material base ("matter makes of itself

[45] Ibíd., 167

[46] Eccles, *How the Brain Controls its Brain*, 180; Eccles, *Evolution of the Brain: Creation of the Self*, 237.

[47] Edelman, *Bright Air, Brilliant Fire: On the Matter of the Mind*, 140.

[48] Ibíd., 34.

[49] Ibíd., 171.

[50] Damasio, *Descartes' Error: Emotion, Reason, and the Human Brain*, 252.

[51] Damasio, *Looking for Spinoza: Joy, Sorrow, and the Feeling Brain*, 284-285.

[52] Ib´d., 285-286.

[53] Zubiri, *Sobre el hombre*, 460.

the psyche") but are irreducible to such materiality (matter cannot make the psyche on its own").[54]

According to Zubiri, matter in the human being by an act of elevation that we understand as a major structural complexity, is superior to mere biochemical functions, and for this reason is able to achieve attributes such as intelligence, will and freedom.[55] Pedro Lain Entralgo states that –in agreement with Zubiri– human acts such as intelligence, will, and freedom are at the same time organic and psychic.[56] What is organic and psychic cannot be reduced to each other (against reductionist materialism), nor can they be divided (against dualism).

We may synthesize this anthropological vision in the formula that the human spirit is an embodied spirit or spiritualized matter, understanding the latter as a personal, conscious, intelligent matter able to make free decisions.

One of the consequences of this embodied spirit or spiritualized matter is its vulnerability. Anxiety, stress, and depression demonstrate that this organic-psychic human reality is structurally fragile. Pharmaceuticals themselves, helping the individual with one type of fragility is able to induce another. Our own decisions may generate behavior and addictions that when causing neurological modifications, compromise our freedom, degrade our emotions, and feelings, and even cause death. Philosophical reflection upon finitude and contingency is confirmed. This leads us into our next anthropological-philosophical topic.

Incarnate and Vulnerable Human Freedom: Task and Responsibility

Neurosciences, genetics, psychology and medicine show findings of scientific investigations that indicate limitations and conditionings of freedom. The first section of this article shows the interaction between spiritual acts related to religious practices, with a biochemical-organic base of biological mediators (neurotransmitters, hormones associated with stress, and cytokines in inflammatory response.) In the second section of this article, pharmaceutical effects are verified in the modification of emotions, of the neurological system, and in their impact on human conduct.

Alongside these statements, we may point out other data. There are genetic factors related to violent temperaments and drug addiction.[57] Thanks to recent

[54] Ibíd., 465.

[55] Ibíd., 468.

[56] Laín Entralgo, *Cuerpo y alma*, 192-193; 195-196.

[57] Sanz, *Entre Libertad y determinismo: genes, cerebro y ambiente en la conducta humana*, 45, 58-61.

advances, neuroscientists have detected that homicides manifest inferior activity in the frontal lobe and a higher one in the thalamus.[58] They have additionally determined that neurotransmitters play an important role in moods like anxiety or depression, and these, condition freedom.[59]

Addicts frequently have a reduced frontal lobe volume and neurotransmitters exercise a determinant impact on such dependence.[60] Other investigations show that vis a vis moral situations a number of regions of the brain are activated, especially those that keep a close relation with emotive states.[61]

These findings, in conjunction with others not mentioned here due to limited space, leads us to reflect on the statement made by some followers of reductionist materialism, that freedom is a simple illusion, for the human person is determined by biochemical processes and electrical currents in the brain, by genes, by unconscious processes and involuntary acts.[62] This leads to the need to clarify what we mean by "freedom", a polysemic notion that lead to misunderstanding. Let's consider some of its definitions or basic descriptions.

In first place, freedom is defined by some as the absence of coercion and need.[63] This definition opposes freedom to any determination and to outer or inner conditioning of the individual. From this perspective, it is understood that scientific findings mentioned here are interpreted as an invalidation of freedom, known as "the total freedom from all conditioning."

Another definition of freedom is the "fundamental principle or ability to take matters into our own hands".[64] This manner of formulating it deals with the ability to deliberate and ponder a decision. This definition does not indicate that freedom is in contradiction to conditionings and with deterministic or unconscious processes in the human being. What it does demand is then, the non-absolute determination and the ability to make deliberate decisions. Therefore, it is a "freedom from total and absolute conditioning", a freedom "to be able to deliberate an option or decision."

[58] Ibíd., 47.

[59] Ibíd., 69; 71-72; 74.

[60] Ibíd., 61

[61] Ibíd., 110.

[62] Rubia, *El fantasma de la libertad. Datos de la revolución seudocientífica*, 71-74.

[63] Sanz, *Entre libertad y determinismo: gene, cerebro y ambiente en la conducta humana*, 149.

[64] Gevaert, *El problema del hombre. Introducción a la antropología filosófica*, 206.

A third definition of freedom conceives it as "the ability to incarnate certain values in one's own actions".[65] It expresses an axiological dimension, which relates with the second definition, for it opens the possibility to deliberate those values that we want to embodied in our decisions, actions and projects. This vision and some conditioning processes or involuntary acts are not mutually exclusive. It deals with a "freedom to" incarnate values.

A fourth definition of this concept is the "ability to respond to others".[66] This perception enhances the ethical dimension of freedom and its relation with responsibility. Additionally, it is framed within interpersonal and social relationships. It deals with the "freedom for the purpose of" responding to someone or to social dynamics.

As can be seen, the first definition enters into conflict and contradiction with the limitations and conditionings caused by biochemical and organic processes described by neuroscience. The remaining three visions, that complement each other (the ability to deliberate and make decisions, the ability to incarnate values, and the ability to respond to others), take into consideration some possible neurological and socio-cultural conditioning and point out personal, embodied, social, and historical features of a limited but real freedom.

Human freedom, therefore, is not unconditioned, ahistorical, or abstract, but is performed in a personal, corporal-organic reality and in historical-social contexts, concretely in the world. Contrary to what dualism states, the human being is a personal body (corporal-organic personal aspect), which implies that human freedom is embodied. That is the reason for its vulnerability to certain organic and biological conditionings: illnesses, genetic heredity, neurological conditions, etc.

Moreover, we are conditioned by prior decisions that close certain possibilities but open others. Those same decisions and actions become habits or vices whose foundation is organic, as demonstrated in neurosciences. Habits or vices reinforce, allow for growth, limit or diminish our freedom, a freedom conditioned by the unconscious and limited by involuntary acts. Due to its social, incarnate and worldly character, freedom is permeated by geographical, historical, social and cultural context in which we live.

Due to its historical character, it matures into a personal process with the possibility of surpassing some social, economic, psychological and cultural conditionings that alienate the individual, without necessarily implying or demanding the goal of total and absolute liberation at a given moment in their personal history. Freedom is

[65] Ibíd., 212.

[66] Ibíd., 213.

a process that is continually conquered. That is why it will never be fully achieved.[67] Without these conditions, situations and limitations, we would be anything else but human, embodied spirits and spiritualized matter.

Contributions made by neuroscientific investigations currently prevent the denial of the existence of those mechanisms that condition human freedom. However, this conditioning is not absolute. Antonio Damasio considers that the human being has the capacity to avoid an immediate automatized response.[68] We can assess our past to learn from it, and even if it conditions us, we are not condemned to its repetition.

At the same time, we imagine and evaluate possible open futures.[69] Besides, human beings make use of physical determinisms of the world to transform their surroundings and therefore create culture. This implies that constrains are not total; instead, in face of limitations and organic, social, psychological, and environmental conditions, freedom is the capacity that essential and concretely "codetermines one's own acts".[70]

Determinism and freedom do not maintain an anti-thesis relationship; they have an inseparable co-existence.[71] Incarnate freedom is a process of conquest and of integrating strengths and involuntary impulses. This effort demonstrates the fragile reality of our freedom that is neither given nor done. Our corporal and organic reality shows a finitude, our vulnerability, and indicates that freedom is something that may degrade itself on account of a habit or may be lost in an accident or illness; likewise, our intellect and life may vanish.

In some circumstances a free act can be experienced as an effort that occasionally carries suffering along with it. To grow in freedom and avoid its degradation is at all times a human being's responsible task.

The Irreducibility of the Human Being to an Instrument

An anthropological and ethical concern is to avoid reducing the human person, open and vulnerable, down to an object or instrument. This implies respect and care following Kant's formulation of categorical imperative, also called the reciprocity thesis: "Act so that you use humanity, as much in your own person as in the person

[67] Ibíd., 207.

[68] Damasio, *Self Comes to Mind: Constructing the conscious Brain*, 307.

[69] Damasio, *Looking for Spinoza: Joy, Sorrow, and the Feeling Brain*, 271-272.

[70] Gevaert, *El problema del hombre. Introducción a la antropología filosófica*, 206.

[71] Ibíd., 219.

of every other, always at the same time as end and never merely as means".[72] Thus, Kant links morality with freedom and autonomy.

To reduce a human being to an instrument, and not to acknowledge his freedom, is to lacerate morality. In the contemporary theory of value, an end value (also called "intrinsic value"), is distinguished from the mean value (also called "instrumental value"). Manuel Garcia Morente, a Spanish philosopher says:

> …Mean values (instrumental values) are what things possess whose value consists of being useful for achieving other values. End values (intrinsic values) are what they have worth within themselves without needing to be used to obtain other values.[73]

From this perspective, the human person (an organic, psychic, incarnate spirit and spiritualized matter, with a vulnerable and incarnate freedom) has an end value (intrinsic) and cannot be reduced to an object with mean value, as would a material instrument.

Up to this point, anthropological philosophical reflection operates as the hermeneutics of neuroscientific facts. The next section deals with theological hermeneutics.

Theological interpretation: Possibilities and Limits

Currently, interdisciplinary works exist and advance between neurosciences and other disciplines. These works include advancements of so-called "neuro-theology"[74] and "neuro-ethics".[75] In addition, there are other works that relate brain functions with religious experiences.[76] This section presents a truly theological reflection considering scientific facts and their anthropological-philosophical interpretation on topics dealing with matter-spirit, human vulnerability, Christian liberty, and human dignity in theological terms.

[72] Kant, *Groundwork for the Metaphysics of Morals*, Ak 4:429, 46-47.

[73] García Morente, *Ensayos sobre el progreso*, 55.

[74] See Newberg, *Principles of Neurotheology*.

[75] Schleim, "Tras la búsqueda moral última. La investigación del cerebro en camino de la mano amiga para conseguir la autoridad moral", 53.

[76] Múnera, "Neuroteología y la naturaleza de la experiencia religiosa", 4-7.

Integral Vision: The human Being Created as a Matter-Spirit Unit

The Judeo-Christian tradition, in opposition to platonic and Cartesian dualism, is characterized by an integral, holistic, and unitarian vision that neither separates nor opposes organic (biochemical and physiological aspects) to the spiritual (intelligence, free will and religious practices such as prayer and meditation.) This also rejects the reductionist vision, for it starting point is the belief in creation and God's call for the human being to a transcendental relationship.

Biblical anthropology does not conceive a separation between body and the soul. This anthropology describes aspects or dimensions that belong to all human individuals and does not refer to separate or independent substances. For this reason, when referring to terms that translate as body (*basar*), soul (*nefes*) and spirit (*ruah*), Scriptures see them in terms of the totality of the human being.

Basar (body) is the outer aspect of the human being, skin and bones. It expresses the idea of a body but also of the total human being on their weak and fragile side.[77] That is why *basar* expresses not an independent material substance but our total condition as finite and vulnerable creatures.

Nefes (soul or life) refers to the breath of human life found in the blood.[78] It may allude to respiratory organs or even is used as a personal pronoun: I, you, he. *Nefes* is not only the principle of biological life, it is also the human being as a person and living creature.

Ruah (spirit) is the breath that comes from God, the source of life. This breath, a gift from God, gives lucidity and wisdom to the human being.[79] *Ruah* is the aspect of human life under the influx of God.

The magisterium of the Catholic Church, when articulates the Scriptures with the theological tradition (dogmatic, systematic, moral and pastoral), accounts for an anthropology in accordance to revealed mystery. Hence, recent magisterium affirms the material-spirit unity of the human being and rejects reductionist materialism. The Second Vatican Council states, in *Gaudium et spes,* the following: "Though made of body and soul, man is one. Through his bodily composition he gathers to himself

[77] McKenzie, "Aspectos del pensamiento veterotestamentario", 77:64, 634-635.

[78] Ibíd., 77: 66, 635-636.

[79] Moriarty, "Isaiah", 16:25, 725.

the elements of the material world; thus they reach their crown through him, and through him raise their voice in free praise of the Creator".[80]

Benedict XVI, likewise, emphasizes the intimate human unity (body and soul) in face of the challenge of eros overcome when unified:

> Should he [human being] aspire to be pure spirit and to reject the flesh as pertaining to his animal nature alone, then spirit and body would both lose their dignity. On the other hand, should he deny the spirit and consider matter, the body, as the only reality, he would likewise lose his greatness.[81]

Gassendi, the epicurean, amusingly addresses Descartes with a greeting: "Oh, Soul!" To this Descartes responds; "Oh, Flesh!"[82] Facing dualistic tendencies that accept two realities separately, Benedict XVI points out:

> Yet it is neither the spirit alone nor the body alone that loves: it is man, the person, a unified creature composed of body and soul, who loves. Only when both dimensions are truly united, does man attain his full stature. Only thus is love –*eros*– able to mature and attain its authentic grandeur.[83]

From then on, faced with a current technocratic spirit, one can perceive a tendency towards reducing problems and phenomena regarding the inner life, to only the psychological and even mere neurological scope. Faced with this reductionism, it is convenient not to lose a holistic perspective and integral understanding, yielded from the contribution of the Judeo-Christian anthropology. If that contribution is lost, the inner life and consciousness, materiality and human spirituality become void; the human depths that saints have known to probe into- are progressively lost.

For the magisterium, the problem of development is intimately connected to an integral and holistic vision of the human being, without which our "self" can be seen reduced to the brain, and our progress may be confused with an emotional well-being. From a major and integral comprehension of the "self", *Caritas in veritate*, affirms that "*Development must include not just material growth but also spiritual growth*, since the human person is a 'unity of body and soul'".[84]

[80] Second Vatican Coucil, "Pastoral Constitution *Gaudium et spes* On the Church in the Modern World (1965)", 14.

[81] Benedict XVI, "Encyclical Letter *Deus Caritas est* On Christian Love (2005)" 5.

[82] Ibíd., 5; see also Benedict XVI, "Encyclical Letter *Caritas in veritate* (2009)".

[83] Ibíd., 5.

[84] Benedict XVI, "Encyclical Letter *Caritas in veritate* (2009)", 76.

On Karl Rahner's side, from a theological perspective, he identified the human spirit with consciousness[85], which is not purely something spiritual and independent from matter. For Rahner, consciousness has a material constitutive base that does not operate as something external or superficial but as an intrinsic necessity.[86] Hence, human consciousness itself is featured as "a sufficiently elevated material organization".[87]

Christian Freedom: A Responsible Task and Consequence of the Encounter with Christ the Liberator

The Holy Scriptures -as Leon-Dufour puts it- suppose that the human being has the ability to make free decisions.[88] Human freedom is the condition to be able to respond to God's call as an invitation to a personal relationship. The Book of Genesis illustrates the human being as being created in God's image and likeness to become the interlocutor of the divinity in the alliance relation.[89] At the same time, the Book of Ecclesiastics does not accept any type of fatalist determinism that annuls all human freedom (Si 15: 10-20). Human beings are responsible for their choices due to divine help.

In the New Testament, Saints Paul and John restate freedom. For the Roman Empire, the freedom was sustained by civil freedom, and for stoic philosophy, it was the consequence of an intellectual and moral task that eliminated all passion. In the New Testament, freedom is not an abstract or ahistorical ideal, but the outcome of the following of Christ, of a personal contact with him[90]:

– For Paul, Christ calls us to freedom: that is why he liberated us (Gal. 5:1,13). That is why he invites us to avoid falling again into the slavery of our instincts, vices, of that oppressing force called sin. (Rom. 1-3.)
– For the Gospel of John, truth sets us free (John 8: 31-32). It does not deal with an abstract and theoretical truth. It is a unique and personal truth: Jesus himself. The encounter with him, Incarnate Word, is what liberates us and makes us free.

[85] Rahner, "Natural Science and Reasonable Faith: Theological Perspectives for Dialogue with the Natural Sciences", 52.

[86] Ibíd., 40-43.

[87] Ibíd., 40-41.

[88] Léon-Dufour, "Liberación, libertad", 483.

[89] Pröpper, "Libertad de Dios".

[90] Léon-Dufour, "Liberación, libertad", 485.

Thus, in the Sacred Scriptures, freedom is a relational freedom: free from instinct, from oppressive sin, and freedom to enter into a relationship with God and with others in Christ. This implies that Christ is the Liberator that allows us to face God in order to exist and live as the Father's children.[91] Because of Christ, we have freedom from oppression and a freedom to enter into constant deliberation and discernment (Sir. 15:14, 1Cor. 10:23). It is a freedom to place ourselves at the service of others (Gal. 5: 13). It is a responsible freedom.

We understand "responsible" as "the response" to God's call to enter into an Alliance with him. Moreover, to be "responsible" is to "answer" within love, to our neighbor's needs. Besides, through freedom we are responsible for that sin which subjugates us (James 1: 13-17). Freedom is our calling, founded on love and to love. The theological vision of freedom is based on that biblical perspective. In accordance to the Second Vatican Council document, *Gaudium et spes*:

> Authentic freedom is an exceptional sign of the divine image within man. For God has willed that man remain "under the control of his own decisions,"(12) so that he can seek his Creator spontaneously, and come freely to utter and blissful perfection through loyalty to Him.[92]

That is why freedom is linked with human dignity and with the ability to relate to God who calls humanity towards fulfillment. This is not achieved in an instant since freedom is conditioned, limited and vulnerable. The *Catechism* of the Catholic Church states: "Imputability and responsibility for an action can be diminished or even nullified by ignorance, inadvertence, duress, fear, habit, inordinate attachments, and other psychological or social factors".[93]

The Dignity of the Human Individual: A Gift from God

From a theological point of view, the irreducibility of human persons is connected to their dignity, due to the creation of the human being as an image and likeness. Based on the Scriptures, *Gaudium et spes* teaches us that the human person has been created to the image and likeness of God with the ability to know and love their Creator.[94] Hence, following the psalmist (8): "What is man that you should heed him? Or the

[91] Ibíd., 486.

[92] Second Vatican Council, "Pastoral Constitution pastoral Gaudium et spes On the Church in the Modern World (1965)" 17.

[93] Catholic Church, "Catechism of the Catholic Church" 1735.

[94] Second Vatican Council, "Pastoral Constitution pastoral Gaudium et spes On the Church in the Modern World (1965)" 12.

son of man that you should look after him? You have made him a little less than angels and crowned him with glory and splendor."- they know their role and become aware of their responsibility, of their existence in this world. They are conscious of their contingency and vulnerability, but also of their surroundings and of themselves which makes them responsible for their own integrity and the care for their dignity. Dignity is not something that the individual gives himself, but receives from God.

The dignity of the human being is made manifest in his corporeity (against dualism) and in his relation to the Creator, that is not reduced to a mere physiological function (against reductionist materialism). For the magisterium, the body-soul unity renders the human being a synthesis of the material universe.[95] In the human person, the evolving world cries out to freely praise the Creator. On that foundation the meaning and value of the corporeal is saved. Therefore, human beings should not, therefore, disregard their corporeal life, but ought to consider their own body as good, as a creature of God that should rise from the dead on the last day.

Based on the bodily unitarian perspective, integral persons enter into their own hearts; "God, Who probes the heart,(7) awaits him there; there he discerns his proper destiny beneath the eyes of God"[96], and saves the human experience that is not reduced to a material plane, but widens it also towards a spiritual development that unites them to their creator.

The fulfillment of human dignity in all its corporal, spiritual, and social dimensions is found in Christ, incarnate Word, Image of the invisible God (Col:1, 15). He is the perfect man that gives back the divine image and likeness to Adam's descendance, deformed by sin. In him, the assumed human nature, not absorbed, has been raised within us to an unequalled dignity.[97]

This fundamental equality among all people demands an ever growing recognition of the common dignity- we have the same nature and origin. Redeemed by Christ, we enjoy the same calling or vocation and an identical destiny.[98] The convocation or vocation must be interpreted as a responsible calling to all, included assumed scientific tasks.

That dignity is reflected in God's intention to save the human being as a totality and not only on one of his features. The magisterium states that the individual must be saved in all his dimensions. This also indicates that, when society is renewed, human

[95] Ibíd. 14.

[96] Ibíd. 14.

[97] Ibíd. 22.

[98] Ibíd. 29.

persons are saved in their totality. Their dignity must be understood, in this sense, as an integral salvation: "the focal point of our total presentation will be man himself, whole and entire, body and soul, heart and conscience, mind and will".[99]

Dignity, likewise should be understood as the care of the person, in body, spirit, inner self and relationships, created in the image and likeness of the Trinitarian communion, fulfillment and salvation is not conceived as a simple process of a few solitary individuals, but as a whole community process.[100] Besides, adds Pope Francis, the whole material universe is the language of God's love, of his immeasurable love for us, where, soil, water, mountains and everything else is God's tenderness.
In *Laudatio Si'*, Francis affirms:

> The history of our friendship with God is always linked to particular places which take on an intensely personal meaning; we all remember places, and revisiting those memories does us much good. Anyone who has grown up in the hills or used to sit by the spring to drink, or played outdoors in the neighborhood square; going back to these places is a chance to recover something of their true selves.[101]

The human task of responsibly looking after the identity and integrity of human beings, their dignity in the midst of their vulnerability, is not an easy one. This is a continuous concern of the biblical tradition from its start, as shown in Genesis in God's question to Cain: "Where is your brother?" But also the parables in the New Testament as in the passage speaking of the Good Samaritan, where love of neighbor should be translated into the integral recovery of those who suffered violence.

To Conclude

Biological contributions are important to understand the basic functions of the brain. Nonetheless, they do not totally respond to the truth that comprehends the human being as a whole. To understand the human person, a global anthropology must be developed based on an encounter and dialogue among basic sciences and hermeneutic disciplines, theology included.

With this objective in mind, we approach the interaction among the spiritual actions related to religious practices and the biochemical-organic fundamentals of neurotransmitters, stress-related hormones, and cytokines of inflammatory response.

[99] Second Vatican Council, "Pastoral Constitution pastoral *Gaudium et spes* On the Church in the Modern World (1965)" 3.

[100] Francisco, "Encyclical Letter *Lumen fidei* On faith (2013)" 54.

[101] Francisco, "Encyclical Letter *Laudato Si'* On Care for Our Common Home" (2015)" 84.

Additionally, a question and a reflection arose concerning the effect of pharmaceuticals in the neurological system and its impact on the variation of emotions and human behavior. This interaction between pharmaceutical performance with a neurological base and the alteration of moods demonstrate that decisions and acts of human beings are mediated by certain biochemical-neurological conditions from which it is impossible to be distanced or disconnected from.

Based on an anthropological-philosophical perspective of global character, concepts and categories such as the relation between matter and spirit, body and the psyche, embodied spirit and spiritualized matter, vulnerability, incarnate freedom, and human irreducibility assist us in scientific data interpretation and to elaborate an integral and holistic anthropological scheme.

To conclude, a Judeo-Christian anthropological perspective that seeks to integrate those scientific facts under a holistic vision of spirituality and organicity of the one and unique human being avoids any false separation of dualistic character or reduction of materialistic kind. The theological concept developed from Christian freedom in dialogue with scientific facts by philosophical mediation places us outside of an absolutist conception, crude and ahistorical. This concept of Christian freedom may be characterized as realistic because it states that freedom, because of its vulnerability, may be hurt or lost. An example of this possibility is the uncontrolled use of pharmaceuticals.

In this article we address the issue of an embodied and finite human freedom. This freedom requires an ethics and a spirituality that renders human persons aware of their limits and fragilities. Ethics and spirituality gradually lead the way out of "the blind forces of the unconscious, of immediate needs, of self-interest, and of violence".[102] It is the finite freedom, of a vulnerable creature. At the same time, that creature has a dignity whose foundation is God himself.

The last section of the article adds, the character of human dignity in its corporeity and spiritual dimension, as a being created in the image and likeness of God. Human dignity has a relational character since it is based on God and at the same time impels us towards the achievement of our dignity and integrality, in communion with others.

Ethics and spirituality are capable to generate new virtues and embodied values in all personal-historical processes that liberate us from oppression. They allow us to recognize our limits, and makes us responsible as collaborators with the divinity in a process of self-constitution and human creation that will always remain open and unconcluded in history.

[102] Ibíd.105.

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