

REVIEW ARTICLE

The pineal gland as physical tool of the soul faculties: A persistent historical connection[☆]

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Abstract

Introduction: The anatomic seat of the human soul has been a controversial matter of discussion in the philosophical, theological and scientific fields throughout history. One of the more known hypotheses on this subject was proposed by Descartes, for whom the soul would host in the pineal gland, a brain body with a special location that would adequately address the functionalism of the human body.

Development: In this work, we discuss the historical influences which made possible the Cartesian model of the relationship between spirit (*res cogitans*) and body-machine (*res extensa*) and the technical bases of his dualism doctrine. In philosophical terms, Descartes supported Augustine approaches and in physiological and anatomical terms adopted some theories of the classical Antiquity, essentially the proposals of Alexandrian pneumatic school (Herophilos, Erasistratus) in relation to the animal spirits. Descartes might also have known the hypotheses of some contemporary anatomists (Diemerbroeck) which established the location of *sensorium commune* in the pineal gland.

Conclusions: Although Cartesian theories had strong criticism even in his time, some aspects of these postulates remained up to mid 19th century.

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PALABRAS CLAVE

Glándula pineal;
Alma;
Descartes;
Dualismo;
Espíritus animales;

La glándula pineal como instrumento físico de las facultades del alma: una conexión histórica persistente

Resumen

Introducción: La ubicación anatómica del alma humana ha constituido un controvertido motivo de discusión en los ámbitos filosófico, teológico y científico a lo largo de la historia. Una de las hipótesis más conocidas sobre este tema fue propuesta por Descartes, para quien el alma se

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alojaría en la glándula pineal, órgano cerebral cuya especial localización le permitiría dirigir adecuadamente el funcionamiento del cuerpo humano.

Desarrollo: En el presente trabajo, analizaremos las influencias históricas que posibilitaron el modelo cartesiano de relación entre el pensamiento (*res cogitans*) y la extensión (cuerpo-máquina) y las bases técnicas de su principio de dualismo espíritu-materia. En materia filosófica, Descartes se apoyó en los planteamientos de San Agustín y en materia fisiológica y anatómica adoptó gran parte de las teorías vigentes desde la Antigüedad clásica, fundamentalmente las propuestas de la escuela neumática alejandrina (Herófilo, Erasístrato) en relación con los espíritus animales. Asimismo, también podría conocer las hipótesis de algunos anatomistas coetáneos (Diemerbroeck), que establecían la localización del *sensorium commune* en la glándula pineal.

Conclusiones: Aunque desde el primer momento las teorías de Descartes tuvieron serios detractores, algunos aspectos de éstas perduraron hasta mediados el siglo XIX.

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Introduction

Theories on the anatomical location of the spiritual component of man have their roots in the earliest manifestations of philosophical thought and the birth of religions, although the scientific community has not been impervious to the development of this debate. Indeed, one of the most interesting and elaborate hypotheses about the corporeal seat of the human soul was advanced by a great figure of the scientific reform in the modern period, the French philosopher René Descartes (1596–1650).¹ In this area of physiology, Descartes left much of his legacy in his posthumous work, *L'Homme* ("Man", 1664). This is perhaps the most influential work in the conception of human neuropsychophysiology throughout the 17th century and can be considered the first European textbook on this subject.²

The central axis of the Cartesian neuropsychophysiological doctrine is the ability of the soul to direct the human body from a physical seat, whose location would be the pineal gland. In the most purely Cartesian mechanical version, the pineal gland would also be responsible for an adequate communication between the human machine and its environment, for which Descartes drew on the Galenic concept of *spiritus animalis*.^{3,4} However, we must bear in mind that neither this localisationist hypothesis nor its pineal location were original contributions by Descartes. Indeed, the pineal gland is one of the organs to have aroused the most interest among research scientists throughout history. Its unique topographic location, individual character within an organism dominated by paired structures and morphological appearance have made this organ the subject of many physiological theories about the functionalism of the human body and philosophical principles that connect with its spirituality. In fact, this function as a spiritual link was already present since ancient times in Hindu philosophy and Vedic literature. According to these, humans have a "third eye" or mystic body (the pineal gland), corresponding to the sixth *chakra* (*ajna*), which provides a "window" into the spiritual life of each individual.

In this study we analyse the historical background which led to the elaboration of the Cartesian hypothesis proposing

the pineal gland as the seat of the soul and the scientific basis supporting it.

The pineal gland as the valve of the psychic activity of the soul in classical antiquity

In general terms, philosophers in classical antiquity regarded the soul as an independent body which comprised two types of properties integrated into a single entity: purely theological properties, chief among which was its immortal nature, and physical and psychological properties, responsible for certain intellectual functions such as thought, memory, perceptions and dreams. In "The Republic", Plato (427–347 BC) distinguished between three kinds of soul: an appetitive soul responsible for the basic needs of human beings such as food and sex; an emotional soul, responsible for emotions and sensory perceptions; and a rational soul with an immaterial and immortal nature, linked to higher functions such as knowledge, both general and abstract.⁵ In his dialogue *Phaedo*, Plato defended the theoretical immortality of the soul⁶ and stated that the body was its temporary "prison" or "grave". Only after death was the soul released and could then travel to the world of ideas. This theory represented the culmination of Pythagorean postulates (5th century BC) considering the soul as a "separate reality" from the body, and metempsychosis, the capacity of the soul for reincarnation or transmigration after death.

Meanwhile, for Aristotle (384–322 BC) the soul (*psykhé*) was the most important principle or substantial form of living creatures and was co-extensive with the body, so that all living things would have a soul. However, he also divided the soul into three types: vegetative (the souls of plants), sensitive (shared by humans and animals) and rational (or intellectual), unique to humans. Aristotle, as heir of the Platonic concepts, continued to place the centre of psychic life and sensory perception (*sensorium commune*) in the heart, specifically in the region called *phren* (the connection between diaphragm and pericardium). By contrast, for Aristotle the brain was just a simple gland that secreted mucus or phlegm through the nose, although the intellectual faculties of the soul (fantasy, anamnesis and mneme) resided in the cerebro-ventricular system.⁷

However, the vision of the soul held by the great figures of classical medicine was much more materialistic. Hippocrates of Cos (460–377 BC), considered the leading figure of ancient medicine, believed that the soul was intimately connected with the body, eliminating many of its supernatural connotations. For the Hippocratic school of thought, the various parts of the body, including the soul, were formed by mixing the four humours (blood, phlegm, yellow bile and black bile or *atrabilis*) in different proportions. Furthermore, following the tenets of some pre-Socratic philosophers such as Alcmaeon of Croton (540–500 BC), Hippocrates defended the position of the brain, rather than the heart, as the focal point of feeling and reason. One of the treatises in the *Corpus Hippocraticum* (5th and 4th centuries BC), titled “On the Sacred Disease”, relates how the *pneuma* from the outside air is conducted to the brain via the ethmoid to induce the development of intelligence and how the brain is the location of the *psykhé*.⁸

The humoralist doctrine of the *Corpus Hippocraticum* was questioned by members of the school of Alexandria, mainly Herophilus of Chalcedon (325–280 BC) and Erasistratus of Ceos (310–250 BC), who tried to build a new anti-Hippocratic physiology based on the stoic legacy of pneumatism.⁹ Erasistratus commented how air (cosmic *pneuma*), after being carried from the lungs to the heart, became transformed into *zootikon pneuma* (*spiritus vitalis*, in Latin) and was subsequently carried to the brain through the blood. There, within the cerebral ventricles, it became *pneuma psychikon* (*spiritus animalis*, in Latin). For Erasistratus, the coordinating centre of psychic life (*hegemonikon*) was located in the cerebellum (*parenkephalis*) and the meninges, while, for his part, Herophilus located the seat of the soul in the *kalamos*.¹⁰ Indeed, according to Ariens-Kappers,¹¹ the first specific reference to the pineal gland within the frame of Western culture must be attributed to Herophilus. He proposed that this organ exercised valvular control functions, working as a sphincter which regulated the flow of *pneuma psychikon* from the middle ventricle to the posterior ventricle.¹²

Much of the Greek philosophical–physiological heritage was collected by Claudius Galen (131–200 AD), who went one step further and estimated that all levels of mood, including the highest, were fully material. On this point, the master from Pergamon shared the view of other philosophers, such as his fellow Roman Titus Lucretius Caro (99–55 BC), for whom the *anima* (soul) belonged entirely to the body and perished with it. In his long poem *De rerum natura*,¹³ Lucretius rejected the Platonic and Pythagorean positions of immortality and reincarnation of the soul and contemplated death as the end of the ability to perceive. Following the humoral hypothesis, Galen defended the Aristotelian view that the soul, like the body, was formed by a mixture of the four humours. Moreover, Galen modified the pneumatic theory and developed a physiological doctrine which endured until the time of Descartes.¹⁴ Following Plato, Galen divided the soul into three parts: concupiscible, irascible and rational (respectively located in the liver, heart and brain), and described human powers (*dynamis*) corresponding to the three levels of spirit or *pneumatas* (physical or natural, vital and mental). These spirits were very subtle material substances which circulated in different body fluids. Thus, the pneumatised blood within the heart was taken to the *rete*

mirabile of the brain and transformed, in the lateral ventricles (considered by Galen as a single paired ventricle which he called anterior ventricle), into the psychic *pneuma* or *spiritus animalis*. This *pneuma* then passed to the spinal cord and nerves (thought to be hollow) as an agent which induced the *dynamis psykiké*, from which muscular action resulted.^{15,16} From the aetiopathogenic perspective, a contemporary of Galen, Aretaeus of Cappadocia (1st and 2nd centuries AD), was a great promoter of the pneumatic doctrine, which was perfected later by Descartes. This doctrine explained disease as a dyscrasia in the correct balance of the four elementary qualities (heat, cold, dryness and humidity), resulting in an alteration of the dynamics of the *pneuma* or *spiritus*, the refined product of inspired air, through bodily ducts.¹⁷

Indeed, Galen was the first author to carry out a detailed description of the pineal gland which survived until present times¹⁸ and he also coined the term *konareion* (“pineapple” in Greek; *conarium* in Latin). In his work *De anatomicis administrationibus*, Galen described the anatomy of the *conarium* in great detail, but relegated its functional role to that of a mere pseudoglandular lymphatic organ, serving as an anchor for the mass of cerebral veins which run along the posterior and dorsal diencephalon. These hypotheses were put forward in his eighth book *De usu partium*. Galen believed that, in its flow through the ventricular system, the superior vermis of the cerebellum, and not the pineal gland as Herophilus thought, was the anatomical structure which acted as a kind of valve capable of closing the aqueduct of Sylvius and preventing the passage of psychic *pneuma* to the posterior ventricle, the location of memory.¹⁹ One reason for confusion inherent in this theory may come from the synonymy used by Galen to designate the *vermis superior cerebelli*, which he indiscriminately referred to as *epiphysis*, a term used in modern times to refer to the pineal gland. According to Galen, and quite correctly, the pineal gland was an extracerebral organ devoid of motility, so it could not act as a valve.

In summary, medical approaches in classical antiquity regarding the relationship between the pineal gland and the soul did not respond to an assimilation phenomenon, but rather to a symbiotic phenomenon of shared functions. In this model (except in the correct Galenic view), the pineal gland acted as an instrument of spiritual flow control. In other words, it served as a guardian of psychic activity, rather than a guide.

The soul and the pineal gland in the medieval model of the three cells

The dichotomy between medical and philosophical interpretations of the essence of the soul lasted throughout the medieval period. However, the Aristotelian and Galenic approaches were both developed, enriched and systematised during the Middle Ages, thanks largely to their passage through the Byzantine and Islamic cultures, leading to a new neo-Galenic model, which reached its maturity during the Renaissance.

With the rise of Christianity, first during the patristic period and then during the scholastic period, the theological properties of the soul gained greater prominence, which

defended previous neurophysiological aspects, such as the movement of animal spirits through the nerves. Nevertheless, his work already offered glimpses of a clear attempt to separate the physical and mental animals. In fact, Vesalius refuted all the classical theories which located psychic functions in the ventricles.²⁵

The role of animal spirits as a communication tool between the upper strata of the self and corporeality was a source of scientific debate which lasted until the early modern period. In fact, many scientists from the same period as Descartes shared his physiological vision and even preceded him in its dissemination. Such was the case of Andrés Velázquez (1553–1615) in Spain and Robert Burton (1577–1640) in England. In his “Book of Melancholy” (1585), Velázquez argued that “vital spirits are themselves instruments of the soul: all movements and affections of the soul are represented by, and we come to understand them through, movements of the spirits” (p. 313).²⁶ For his part, Burton, in his famous “The Anatomy of Melancholy” (1621), stated that “spirit is a subtle vapour produced from the blood and is the instrument of the soul to carry out its actions, a common tie or medium between the body and soul” (p. 49).²⁷

Similarly, the theory regarding the pineal organ as “guardian” of the flow of animal spirits continued to be defended by many authors, including Giacomo Berengario da Carpi (c.1460–c.1530), Jean Fernel (1492–1558) and William Harvey (1578–1657). In 1522, Berengario published his work *Isagogae breves*, describing the cerebral ventricles, choroid plexus and pineal gland, which he called “appendix of thought”.²⁸ Eventually, however, it was the great Vesalius who finally rejected the valvular concept of the pineal gland. According to Bargmann,²⁹ this author offered the first graphical representation of the human pineal gland (Fig. 3). He also rejected concepts on other anatomical structures, such as the *vermis superior cerebelli*, as proposed by Galen and Qusta ibn Luqa, or the choroid plexus, whose valvular role was proposed by Mondino de Luzzi (1275–1326) in his work *Anathomia* (1316).

On Cartesian sources and inspirations related to the physical seat of the soul

As Hall rightly noted,³⁰ the irreconcilability between Greek classical theories and the Christian dogma shaped the philosophical work of Descartes. In this sense, we must bear in mind the position of some of the great priests and doctors of the Church, such as Saint Augustine or Saint Thomas Aquinas, on this issue. For Augustine of Hippo (354–430), human beings were composed of body and spirit, although the body was not the prison of the soul since the soul was present in every part of the body (*De Trinitate*, 400–416). Similarly, Saint Thomas Aquinas was a great defender of Aristotle and from him he took the hylomorphic theory and made it anthropological. Saint Thomas believed that the soul and body formed a single substance (*Summa Theologiae*, 1265–1272). The doctrine of these two Catholic philosophers was considered the official dogma of the Church for many centuries, including the time when Descartes lived. Thus, his work has always been linked with a vivid Augustinian influence.³¹ However, although the Jesuits taught

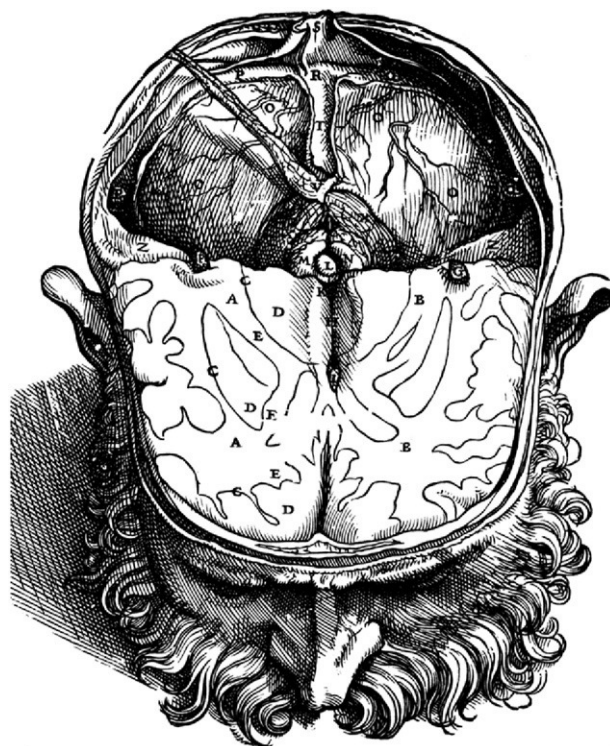


Figure 3 Illustration of the brain corresponding to the second edition of *Fábrica* by Vesalius (1555), which shows the location of the pineal gland (L), exactly in the centre of the cranial cavity.

Descartes their scholastic orthodoxy, the French philosopher partially rejected it, since he did not share such openly holistic approaches.³² This was evident in the sixth of his “Philosophical Meditations” (1641): “... on the one hand, I have a clear and distinct idea of myself, given that I am only a thinking thing and not an extensive one. On the other hand, I have a different idea of the body, given that it is only an extensive thing and not a thinking one. Thus, it is true that I, that is, my soul, through which I am what I am, is entirely and truly distinct from my body, and it can be or exist without it” (p. 192).³³

While Descartes always defended the originality of his philosophical hypotheses, in physiological and anatomical matters he adopted many of the theories which had been in existence since classical antiquity.³⁴ These included the proposals of the pneumatic school of Alexandria in connection with animal spirits (*copula animae cum corpore*), which were later “Christianised” by Saint Augustine. These spirits were responsible for the peaceful harmony existing between the will of the immaterial mind or soul (*res cogitans*) and the movement of the body (*res extensa*) and represented the biochemical basis underlying the Cartesian neurophysiological doctrine.³⁵ However, the nature of these spirits is quite obscure in the works of Descartes. They are described as subtle fluids, like tiny, fast-moving particles which circulate through the interior of the cerebral ventricles and the nerves; in short, a kind of “quintessence” originated from blood fluid by rarefaction. Ultimately, for this harmonious relationship between the mind and the body to be successful, it was necessary for the human soul to have

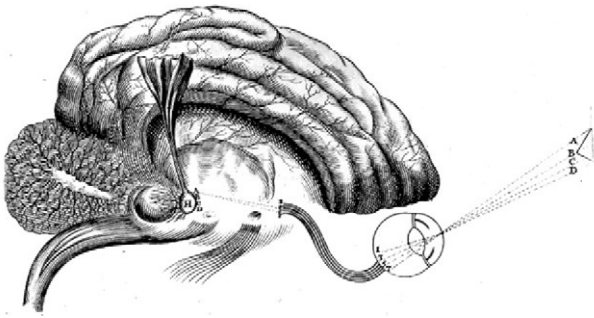


Figure 4 Anatomical location of the pineal gland according to the theories of Descartes and the interpretation of the illustrator, Florent Schuyl (Figure 34 from *De Homine*, 1662).

a physical and corporeal seat from where it could carry out that mysterious communication. Thus, Descartes established the seat of the soul in the innermost part of the brain, that is, the pineal gland (Fig. 4).³ Perhaps the reasons that led the philosopher to consider this choice were purely anatomical, since he believed that all cephalic and sensory organs were duplicated, except for that small and unique gland located geometrically in the centre of the brain (*primus inter pares*) and suspended upon the channels containing the animal spirits. Its central location would enable the process of integrating perceptions and feelings from duplicate organs. In this sense, Descartes seemed to be familiar with the work and opinion of the famous Ysbrand van Diemerbroeck (1609–1674), who was an anatomy professor at the University of Utrecht and a contemporary of the French philosopher. Diemerbroeck postulated the pineal gland as the possible location of the *sensorium commune* and believed that all kinds of sensory stimuli converged on it.³⁶ However, this hypothesis had been previously raised by the Italian physician Girolamo Fracastoro (1483–1553), who noted the necessity of a single cerebral organ which could act in the integration and coordination of all sensory perceptions captured by the body. According to Fracastoro, that organ was the *conarium* and it held the capacity for reasoning.³⁷

One of the great controversies of the Cartesian philosophical doctrine is the way in which thought (*res cogitans*) and extension (body-machine) are influenced.³⁸ This subject was approached by Descartes in his last work published during his lifetime, *Les passions de l'âme* ("Passions of the soul") (1649).³⁹ In order to answer this question from a strictly mechanical standpoint, Descartes made one of his greatest anatomical mistakes and ascribed the power of movement to the pineal gland (Fig. 4). According to his words "... it is not completely united to the substance of the brain, but only pinned to small arteries whose walls are rather weak and flexible; the gland is suspended as from a balance..." (Article 72 from "Man") (p. 89).⁴⁰ Thus, "... any action of the soul results in, by the mere fact of wanting something, making the gland, to which it is closely linked, move in the necessary way to produce the corresponding effect on the will" (Article XLI of "Passions of the soul") (p. 106–107).³⁹ In short, for Descartes every change in the position of the pineal gland corresponded to a different perception of the soul.³⁵ In any case, the capacity of the epiphysis for

movement, in order to regulate the flow of animal spirits, was also assimilated to the role of a valve in mechanical terms. However, this valve concept did not originate from Descartes, for it had been proposed by Jean Fernel, a modern defender of the Galenic medical system (*Universa medicina*, 1554), one century earlier. Nevertheless, Lokhorst and Kaitaro³⁷ defend that the anatomical structure mentioned by Fernel was not the pineal gland itself, but the cerebellar vermis (as also postulated by Galen and Ben Luca), so in this case the approach of Descartes would be completely original.

Post Scriptum: persistence and decline of Cartesian assumptions

Although the link between the pineal gland and the human soul reached its peak in Cartesian theories, this relationship did not disappear with the French philosopher. The Cartesian hypothesis of "the pineal gland as the seat of the *sensus communis*" was quickly adopted by several contemporaries of the French philosopher,³⁷ such as Jean Cousin, who defended his thesis (*An kônarion sensus communis sedes?*) at the Ecole de Médecine in Paris on January 24th, 1641, or Henricus Regius (1598–1679), Professor of Medical Theory at the University of Utrecht, who also defended this theory in June 1641 (*Die frühe Naturphilosophie*). Even for Thomas Willis (1621–1675), the animal spirits of Descartes corresponded to the classical concept of the "corporeal soul". The scientific movements of the 18th century did not escape the influence of Cartesianism. One example is the life force principle which inspired the vitalist current during the Enlightenment.²³ Even the German politician, romantic poet and physiologist, Joseph Gorres (1776–1848), who was also a late vitalist, regarded the pineal gland as "the source of the vital spirit", "the germ of the cerebral essence", "an expression of the universe", etc.⁴¹ For its part, the mechanical hypothesis of spiritual flow control, which was then applied to the cerebrospinal fluid, lasted until the time of François Magendie (1783–1855). In a work published in 1828 (*Mémoire physiologique sur le cerveau*), Magendie stated that the pineal gland was "a valve which opened and closed the cerebral aqueduct".⁴²

However, in spite of all this, the scientific decline of Cartesian hypotheses began immediately after their publication. Early medical critics of Cartesianism included the Danish mechanistic physiologist Niels Steensen or Stenon (1638–1686). In his work *Dissertatio de cerebri anatome* (1671), he strongly criticised Descartes and refuted his theory of a rational soul seated in the pineal gland. Stenon maintained, not unreasonably, that this gland was an immobile organ adhered to the meninges and dorsal to the ventricular system, and that this would prevent its role in the convection of animal spirits.⁴³ Willis also argued that it was scarcely credible that the pineal gland was the seat of the soul and centre of reasoning. He argued that animals, which lack the superior properties of the soul such as memory or imagination, are all endowed with pineal organs, in some cases even more developed than those of humans (*Cerebri anatome cui accessit nervorum descriptio et usus*, 1664).

In addition to these reasonable anatomical criticisms about the location of the soul, there were others of a purely philosophical origin. Thus, in 1739, David Hume (1711–1776) postulated that personality was simply the sum of all sensory experiences. Therefore, attempting to physically locate or substantiate the mind was a mere illusion.⁴⁴ These ideas were subsequently defended by Immanuel Kant (1724–1804), who gave the soul a spiritual nature, so it could not be located within an anatomically limited space.¹¹

Finally, in the 19th century, precisely with the triumph of the anatomical clinical method in which the influence of Descartes himself has been postulated,⁴⁵ the Cartesian theory regarding the physiological role of the epiphysis was definitively ruled out. The *Dictionnaire des Sciences Médicales* published in 1829 by Antoine Jacques Louis Jourdan (1788–1848) stated the following about the pineal gland: "... regarding the role of the pineal organ, nothing is acceptable about the fiction of Descartes, conceived during a time of abuse of rationalism and imperfection of the natural sciences... Today, we do not need these chimeras, although we do not yet know the functions of the conarium..." (p. 460–461).⁴⁶ Thus, the spiritual role of the pineal gland, from the standpoint of science, came to an end.

More recently, some contemporary authors have openly criticised the dualistic stance of Descartes. These include the neurologist Antonio Damasio in his best-selling book "Descartes' error: emotion, reason, and the human brain" (1994): "Perhaps the most famous statement in the history of philosophy appears first in the fourth section of "The Discourse on Method" (1637), in French (*je pense donc je suis*; "I think, therefore I am"), and then in the first part of "The Principles of Philosophy" (1644), in Latin (*cogito ergo sum*). Taken literally, the statement illustrates precisely the opposite of what I believe is true about the origin of the mind and about the relationship between mind and body. It suggests that thinking and the consciousness of thinking are the real substrates of being" (p. 249).⁴⁷ According to this neurologist, the concept that mental activity is separate from the brain structure and its inner workings represents a serious error, because the brain, along with the rest of the body, constitutes an inseparable entity composed of multiple neural and biochemical pathways which connect each subject with the external environment. According to him (and many of the current scientific trends), mental activity arises from such an interaction. For Damasio, the main mistake made by Descartes was introducing an "untouchable" rationalism in science. However, in his last work published in life ("The passions of the soul"), Descartes explained that the relationship between soul and body was more than the sum of both entities. For this reason, some authors⁴⁸ refer to a "triadism" in relation to the Cartesian postulates defended in this work, as it hints about a "third distinction" or "quality" corresponding to the interaction between the two substances making up human beings, like an experience of unity, and criticise the assertion by Damasio calling it "Damasio's error".^{49,50}

In any case, despite the vast historical evolution that culminated in Cartesian theories, and the considerable scientific advance which took place during the 20th century, the intimate connection between spirit and physicality remains, at present, undefined.

Conflict of interests

The authors have no conflicts of interest to declare.

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