The aim of this article is to reflect on the relationship between art and science so far as it concerns a symposium on neurosciences. We undertake a historical overview of that relationship, paying particular attention to the sui generis case of Leonardo da Vinci, who very often is regarded as the man who worked on art and science with equal ease. We then explain why his idea of merging these two forms of knowledge failed, considering the clear-cut distinction between art and science in his time. With this clarification, we explore the matter today. We look at Raphael’s The Transfiguration, in which the representation of the possessed boy is seen by neuroscientists as indicative of an epileptic seizure. We also look at the ideas of neuroscientists Semir Zeki and Vilayanur Ramachandran, who study particular aspects of brain function and suggest a new merging of art and science.

1. Introduction

The aim of this article is to expose the history of the concepts “art” and “science.” We do so by looking at their meanings in Greek philosophy and beyond, with Leonardo da Vinci at the center of our research. Doing so provides us the conceptual instruments with which to think about the relationship between art and science today, considering the texts of neuroscientists Semir Zeki [1–3] and Vilayanur Ramachandran [4]. We hope that this article, whose origin is in the humanities, will contribute to clarifying discussions on this topic in the neurosciences context, recording the philosophical exercise proposed by Ryle [5, p. 8]: “Philosophy is the replacement of category-habits by category-disciplines.”

2. In the Antiquity

In Plato’s early dialogues [6], we do not see a distinction between epistêmê as theoretical knowledge and technê as mere craft or skill. In the Charmides (165c), for instance, Socrates says that medicine, that is, the physician’s craft (iatríkê technê), is the knowledge (epistêmê) of health. As Plato’s thought progresses, he develops the concept of technê and emphasizes the role of reflective knowledge. However, art is still associated with knowing how to do something and science is its theoretical component. In Gorgias (465a), Socrates says that cooking “is not an art, but a habitude, since it has no account to give of the real nature of the things it applies.” The distinction appears in The Republic. In the Divided Line passage (509c-d), Socrates divides the visible world (horaton) from the intelligible world (noêton), and here science is tied to the eternal forms of the intelligible world, but art is tied to the fleeting world of opinions of the visible world. Parry discusses some subtleties of this question, but it is sufficient to say here that from this point on, art is subordinate to science, for science knows the principles of things, but art does not [7]. Science now has a normative characteristic, as in the case of the philosopher who would have a commanding knowledge in The Republic [6].

In Aristotle’s texts, we have conceptual precisions. In Nicomachean Ethics (1140a and 1139b), Aristotle says that art is “the same thing as a rational quality, concerned with making that reasons truly” and “deals with bringing some thing into existence” in the world of generation and corruption, and science is “the quality whereby we demonstrate” what “exists of necessity” and does not perish [8]. At the beginning of Metaphysics (981a), Aristotle approaches the question from another point of view [9]:

Now art arises when from many notions gained by experience one universal judgment about a class of objects is produced. For to have a judgment that when Callias was ill of this disease this did him good, and similarly in the case of Socrates and in many individual cases, is a matter of experience; but to judge that it has done good to all persons of a certain constitution, marked off in one class, when they were ill of this disease, e.g., to phlegmatic or bilious people when burning with fevers—this is a matter of art.

Aristotle emphasizes judgment and neglects practice, saying that those who have experience can succeed more than those who have art (981a): “But yet we think that knowledge and understanding belong to art rather than to experience, and we suppose artists to be wiser than men of experience; and this because the
former know the cause, but the latter do not” [9]. Therefore (981b), “the former can teach, and therefore we think art is more truly knowledge than experience; for artists can teach, and men of mere experience cannot.” The value of the theoretical part of art is evident and it leads Aristotle to judge science superior to art (981b):

At first who invented any art whatever that went beyond the common perceptions of man was naturally admired by men, not only because there was something useful in the inventions, but because he was thought wise and superior to the rest. But as more arts were invented, and some were directed to the necessities of life, others to recreation, the inventors of the latter were naturally always regarded as wiser than the inventors of the former, because their branches of knowledge did not aim at utility.

The contemplative life was superior to the active life, and the arts were subordinate to the sciences, for (982a) “the wise man must not be ordered but must order, and he must not obey another, but the less wise must obey him.” However, it seems it happened only in theory, for the history of science and techniques shows that until the 17th century, technical thought developed separately from the sciences and only in the 19th century was technology developed.1

### 3. In the Renaissance

Aristotle’s texts came back to the Western world by the 12th century. In his commentary on Ethics, Thomas Aquinas shows that Aristotelian meanings were common by the 13th century [11, lib. 6 i, 3 n. 8]: “So it be manifest that science is a demonstrative habit, that is, the demonstration from the causes” not of the particulars that exist [11, lib. 6 i, 3 n. 5] “according to the generation and corruption” but “according to the universal reasons that are necessary and forever.” Thomas [11, lib. 6 i, 3 n. 12] follows Aristotle and says that art is “the habit to produce with plain reason” and “regarding generation, that is, regarding the constitution and complementation” of something.2

However, the Italian cities prospered, and the arts began to be valued positively. Classical authors like Plato were back by the 15th century, and the approach of men of letters to philosophical tradition was “to seek out the most ancient sources unmuddied by centuries of dubious exegesis” and turn their focus away “from metaphysics towards ethics and politics in search of virtues with good classical credentials and yet relevant to the needs of their changing society.” The active life began to surpass the contemplative life.3

To have a comprehensive view of the categories of the Renaissance, it is useful to quote Franciscus Toletus’ book Commentaries with Questions in Eight Books on the Aristotle’s Physics (Commentaria una cum questionibus in VIII libros Aristotelis de physica auscultatione, 1574). According to Toletus, philosophy (philosophia) was divided into three principal parts: speculative (speculativa), active (practica), and productive (factiva). Speculative philosophy was made up of metaphysics (metaphysica), which was the study of the most common principles and properties of all being; mathematics (mathematica), divided into pure mathematics (mathematica pura), the study of entities that do not depend on motion and are abstracted from it, and middle mathematics (mathematica media), the study of entities abstracted but as still found in motion; and physics (physica) or natural philosophy (philosophia naturalis), the study of everything that fell under the senses. Active philosophy was related to direct human activities, and among its parts were ethics and politics. Productive philosophy was divided into the arts necessary for human living, those that were useful and those that provided pleasure.4

It is important to say that the word “philosophy” (philosophia) with respect to speculative philosophy was commonly used as a synonym for “science” (scientiae).

Now we have the conceptual elements with which to think about the relationship between art and science in the Italian Renaissance. In line with the aim of this article, we consider two parts of philosophy, that is, mathematical philosophy and natural philosophy, and some of the arts, the arts we now call figurative arts or simply arts.

By 1410, Filippo Brunelleschi introduced into the art of painting some elements of geometry and invented the geometric perspective.5

Leon Battista Alberti (1404-1472) put it into literary form. Alberti was one of the key figures of the period, and his treatises placed the arts in the context of the literary culture: De Pictura (On Painting, 1435), with the Italian version by the author in the following year, De re Aedificatoria (On Architecture, 1452), and De Statu (On Statue, ca. 1460). We are concerned here with the treatise that opens the systematic discourse on painting, “a subject never before treated,” as Alberti says [16, l. 1]. The treatise is divided in three books, as he explains in his dedicatory note to Brunelleschi:

You will see three books: the first, all mathematics, about the roots in nature which are the source of this delightful and most noble art. The second book puts the art in the hand of the artist, distinguishing its parts and demonstrating all. The third introduces the artisan the means through he can and shall acquire the perfect skill and knowledge of the painting.

The importance of mathematics (in fact, geometry) to painting is clearly stated by Alberti. The first book is dedicated to its exposition, and at the end he says [16, l. 23]: “anyone who has not been most diligent in understanding what we have said up to this point will never be a good artist.”6

However, he also says that he does not write as a mathematician [16, l. 1]:

But in all this discussion, I beg you to consider me not as a mathematician but as a painter writing of these things. Mathematicians with their minds alone measure the forms of things separated from all matter. Since we wish the object to be seen, so we will use a more sensate wisdom.

Therefore, the mathematic he presents to the artist is a simple mathematics applied to the painting [16, l. 2]:

I say, first of all, we ought to know that a point is a figure which cannot be divided into parts. I call a figure here anything located on a plane so the eye can see it. Concerning things that are not visible, no one would deny that the painter has nothing to do with them. The painter is concerned solely with representing what can be seen.

1 Koyré [10] analyzes the reasons for the lack of technology until the beginning of Modern Era, among which is the contempt for the arts expressed by the Greek philosophers.

2 Cf. these distinctions in Thomas’ commentary on Aristotle’s Metaphysics [12, lib.1.1-III].

3 Vasoli [13], with extensive bibliography. The Renaissance was complex and any overview has the risk to be imprecise and erroneous. Petrarca and Ficino, for instance, valued the vita contemplativa over the vita activa, and we follow here one of the tendencies of the period suggested by the sources.

4 Wallace [14], who comments that Toletus’ book “has the merit of epitomizing the Greek and Latin textual traditions as well as the scholastic revivals in Italy and the Iberian peninsula.”

5 See the life of Brunelleschi written circa 1480 by Manetti [15].

6 The term artisan is used here but not artist, for the first is the term found in the sources, but not the second. We avoid the contemporary meaning of the “artist” tied to the romantic artist onward.
The abstract point of the mathematicians does not make sense to the art of painting, for Alberti aimed to establish a set of practical rules for the painter [16, I, 23]:

We have talked of triangles, pyramids, the cross-section as much as seems necessary. I usually explain these things to my friends with certain prolix geometric demonstrations which in this commentary, for the sake of brevity, it seemed to me better to omit.

As a man of letters, Alberti did not confuse art and science. It also appears in the social context of the painter. At the beginning of the second book, he emphasizes the art of the painter over materials [16, I, 25]:

Ivory, gems and similar expensive things become more precious when worked by the hand of the painter. And gold worked by the art of painting outweights an equal amount of unworked gold. If figures were made by the hand of Phidias or Praxiteles from lead itself, the lowest of metals, they would be valued more highly than silver.

Alberti then [16, II, 27] names Socrates and Plato as “connoisseurs of painting” and says that the Greeks, “because they wished their sons to be well educated, taught them painting along with geometry and music.” The relationship between painting and the liberal arts is clear [16, II, 28]:

Painting had such reputation and honour among the Greeks that they did laws and edicts forbidding slaves to learn painting. It was certainly well that they did this, for the art of painting has always been most worthy of liberal minds and noble souls. As for me, I certainly consider a great appreciation of painting to be the best indication of a most perfect mind.7

However, Alberti also states that painting was an activity of the “liberal minds” only in moments of leisure. Notwithstanding all his praise for painting, it was not worthy of an educated man to make his life as a painter [16, II, 28]:

Allow me to speak of myself here. Whenever I turn to painting for my recreation, which I frequently do when I am tired of more important affairs, I apply myself to it with so much will that I am surprised that three or four hours have passed.

In short, Alberti searched for the principles of painting to operate safely and suggest it was important to the painter to say how much science was in his art. Alberti states it clearly in the passage about planes and rays of light and other technical matters, at the end of which he asks [16, I, 12]:

Some will say here of what use to the painter is such an investigation? I think every painter, if he wishes to be a great master, ought to understand clearly the similarities and the distinctions of the planes, a thing known to very few. Should you ask those [who do not know] what they are doing when they cover a plane with colours, and they will answer everything but what you ask.

The artisan who directed the workshop that produced the two principal doors of Florence’s Baptistry, Lorenzo Ghiberti (1378–1455) wrote, at the end of his life, I Commentarii (The Commentaries) [17], text that points directly to the culture of one of the most important artisans of the 15th century. The first commentary introduces the arts and describes their history in Antiquity following Vitruvius and Pliny. The second commentary describes the figurative arts from Giotto onward and is based on Ghiberti’s own expertise; it finishes with his autobiography, the first known of an artisan, which shows his prestige in that society. The third and longest commentary is a compilation of natural philosophy texts, mainly De Aspectibus by Alhazen, Perspectiva by Bacon, and Perspectiva Communis by Peckham. The book is unfinished maybe because of Ghiberti’s lack of formal education. At the beginning of the first commentary, Ghiberti [17, I, II.4] elaborates a program to educate the “perfect artisan”:

It is necessary he is of great mind (ingegno), taught in discipline (for the mind without discipline or the discipline without mind cannot make the perfect artisan). It is convenient he possesses letters, skilled in writing and taught in geometry, and has knowledge of many stories and have heard carefully about philosophy, and taught in medicine and have heard on astrology; and have full knowledge on perspective and, last but not least, be a perfect draughtsman—and so be the sculptor and the painter.

Ghiberti continues and states the importance of anatomy [17, I, II.8]:

It is necessary for him to have known the discipline of medicine and to have seen anatomies, so that the sculptor knows how many bones exist in the human body when he wants to do the statue of the man, and that he knows the muscles that exist in the body of man, and so all the nerves and ligaments.

However, he accepted the traditional distinction between art and science, for he says that sculptures and paintings [17, I, II.2] “are done with some meditation which is done with matter and reasoning” and “the things done with proportion and reason can be demonstrated and explained.” Ghiberti then considers the artisan within his own limits, for his aim was to make the “perfect artisan” [17, I, II.10]:

But the sculptor cannot and should not be a grammarian as Aristarchus was, but to be a good practitioner in the theory of the said art, that is, the drawing, like Apelles and Miron who were better than the others; and the more he will be good practitioner in it, the more perfect will be the sculptor and the painter. But he does not need to be physician like Hippocrates, Avicenna or Galen, but he needs to have seen their books and anatomies, and have by heart all nerves and ligaments that exist in the statue of the man; we do not need to much the other things of the medicine.

Like Alberti, Ghiberti searched in the sciences for the principles of painting to operate safely and to the painter says how much science was in his art.

After this brief exposition, it is possible to say that there was interaction between the arts and the sciences in the 15th century, an interaction based on the application of some knowledge of the sciences to some arts. In this context, the arts were supposed to be subordinate to the sciences, as architect Francesco di Giorgio Martini wrote regarding those who do not operate from a knowledge of the sciences [18, XXXIX]:

And it is necessary that this architect be practical and conscious, and with good memory; and that he had read and seen many things, and prepared to the things that follow, but not as many arrogant and presumptuous people who are founded in mistakes and, by the force of their speech, they demonstrate false things that corrupt the world.

If, however, the applications produced a new art and posed new problems to artisans, these problems were solved in their productive context, for they had to produce paintings and sculptures, but

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7 The liberal arts had their origin with the Greek sophists and were theoretical disciplines, notwithstanding their name. The Greek language did not have a word to distinguish activities like playing the harp, cooking, mathematics, and many others, so that the word technê meant productive activities and educative activities as well, the latter related to the political life of the Athenian citizen.
not theories. As in Antiquity, the thinking habits of artisans were independent of the thinking habits of a natural philosopher. Anyway, we have here the first formulations on the relationship between art and science.

4. Leonardo da Vinci

Leonardo da Vinci (1452–1519) tried to surpass these limits and strove to unite art and science. Formed in the workshop of Andrea del Verrocchio (ca. 1435–1488), Leonardo had, like his contemporary artisans, drawing as the main instrument to express and develop his ideas. In that context, Leonardo elevated the art of drawing to new standards.

Moreover, Leonardo invented a new mode of drawing, the sketch, and it was a flexible extension of his thoughts expressing new ideas in teeming abundance; rapid confusion of scribbled alternatives superimposed on each other was his way of permitting chance configurations to aid the inventive process (Fig. 1). He was aware of it, as indicated by the following passage from Libro di Pittura [26, §189], circa 1490–1492:

Oh you that compose histories do not articulate with precise lines the members of these histories, for it will happen to them as it happens to many and various painters who wish every mark of charcoal as definitive. And these painters can acquire richness, but not praise in their art (arte), for many are the occasions in which the animal represented does not have its members appropriate to the mental modes, and once those painters have done a beautiful and finished composition, to them it will be injurious to change the members up or down. They do not deserve praise in their science (scientia). So painter, compose your figures without care and observe more the movements of the parts of the animals that compose the history that are appropriated to their mental accidents than the beauty and finishing of the parts.

In this period of his life, Leonardo began to enlarge his culture, studying matters like optics, physics, and anatomy. He wrote his first notebooks, including studies on optics and his first known anatomical studies. From that time onward, Leonardo took a very distinctive path, diverging progressively from the artisans and the physicians.

In a context in which science was close to the written text, Leonardo began to invent the anatomical illustration. The folios representing the human skull (K/P 42 recto and verso, K/P 43 recto and verso), for instance, show Leonardo (literally) opening the experience to demonstrate specific matters. During the same period, Leonardo wrote ambitious plans to demonstrate the figure of man (“On the Order of the Book”, K/P 81 verso). Leonardo’s emphasis was to figure the human body, and the expression “to figure the causes” resumes his distinctive approach to human anatomy (one of his notes stresses the importance of making figures of the origin of some conditions and diseases like epilepsy; cf. K/P 39 verso and K/P 80 recto). He did not forget the importance of the words, but his anatomical science was a science to be seen. And so it was until circa 1515, after dozens of folios containing different matters of the human body based on tradition and his dissections, and full on new modes of visual demonstration, that he resumed by 1510 (K/P 154 recto):

Thus in fifteen entire figures you will have set before you the microcosm on the same plan as, before me, was adapted by Ptolemy in his Cosmography; and so I shall afterwards divide them into limbs as he divided the whole world into provinces; then I will speak of the function of each part in every direction, putting before your eyes a description of the whole form and substance of man, as regards his movements from place to place, by means of his different parts.

However, what he did was deeper than to illustrate anatomy. In fact, the folios of the human skull that he drew dal naturale are not common in his corpus of anatomical studies. Since his beginnings as an anatomist, he used his new mode of drawing, sketching the forms as in the studies of the cerebral ventricles (K/P 4 recto and K/P 32 recto, for instance), in which he gave sensible forms to the speculative ideas of medieval philosophers. Some years later, in the folio with the “figure of the common sense,” which he did after injecting wax into the brain of an ox, it is possible to see Leonardo sketching the forms with charcoal before he used ink, and the result is evidently idealized (see figure of this supplement. Another folio of the period shows Leonardo’s brainstorming on the forms of the stomach (Fig. 2), and the late folios with sketches of valves and other structures of the heart also make this idea evident (Fig. 3). The optical analyses that Leonardo had written by 1490 made his art of drawing informed by knowledge of the light and shadows on the bodies, and his anatomical investigations made his art of drawing informed by the matters he drew, such as muscles and bones. His aim was, in fact, to be liberated from the experience in order to recreate the human figure, as he wrote in a folio with studies on the muscles (K/P 148 verso, circa 1510):

When the two muscles a and r pull, the leg is carried forwards and the two muscles b c are relaxed and d is elongated; and

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describe this rule on the action of all the muscles and you will be able to reconstruct, without seeing the living, almost all the actions without error.

Leonardo’s art of drawing was more than an application of knowledge of the sciences, but an instrument to elaborate scientific matters. Therefore, the old distinction between art and science vanished and it is possible to think about an “art–science” (in the absence of a better term). In fact, the expression “to demonstrate” is common in Leonardo’s late anatomies and has a meaning close to “to figure.” So Leonardo’s anatomical drawings had a new meaning and value with respect to the rare contemporary anatomical illustrations, and they were “drawing concepts.”

If, however, to introduce knowledge of science into the arts made its operations successful (or, at least, more successful than those without that knowledge) and raised their status because of the possibility of speaking about how much science was in an operation and in the result of an operation, the culture of that period did not permit the synthesis Leonardo was proposing. Remembering the Greek categories, art was the disposition to produce in the world of generation and corruption, and science was the disposition to demonstrate what exists of absolute necessity and is eternal, so the art–science of Leonardo was a disposition to produce–demonstrate, a disposition that was not just a mental one. Leonardo’s science was tied to the matter and its results were sensible forms, but not concepts abstracted from experience, which were the very objects of knowledge since Plato and Aristotle. Leonardo’s science had no place in the structure of the knowledge of the period, and he did not have a disciple as an anatomist. He tried to do a similar operation with the art of painting, and the results were similar.

5. After the Renaissance

At the beginning of the 17th century Galileo initiated the Scientific Revolution and his science, experimental and mathematical, was progressively separated from speculative philosophy. It was there that science and philosophy began to have the meanings they have today [29]. In this context, if we consider the old meanings of art and science, part of the old distinction began to disappear. In Leonardo, we see the first hints of a systematized technique [30], and the first scientific instruments of XVII century were “embodied theories,” to quote Koyré, who wrote that the beginning of the technology was there [10]. In the middle of the 16th century, with the German chemical industry, we have technology as we understand today, and contemporary technoscience seems to consolidate theory and practice—for better or worse. During this period, the arts acquired the meaning they have today as related to fine arts [31,32]. In this context, we see sporadic relationships between science and art, like applications of perspective to painting and scientific studies on optics [33].

6. Art and science today

Now that our meanings are clarified, we can think about the relationship between art and science today. We can think about historical investigations. For instance, considering Raphael’s The Transfiguration (Pinacoteca, Vatican), we see at its lower part the
apostles performing the miracle with the possessed boy. Today we see in that a representation a person with epilepsy. There are other such examples like this, for example, Three Miracles of St Zenobius by Sandro Botticelli (National Gallery, London). Here we can think that some arts (in this case the art of painting) had the function of illustrating concepts of natural philosophy (and, then, the sciences), as in the case of the anatomical books after Andreas Vesalius’ De Humanis Corporis Fabrica (On the Fabric of Human Body, 1543).

We can also think about scientific investigations. Ramachandran [4] studies the relationships between the brain and the arts and searches for “artistic universals,” which would be constant across a variety of cultures. He suggests 10 “universal laws” like “peak shift” and “grouping.” As always with Ramachandran, the proposal is very interesting and maybe those universals are like the syntactical rules that, although present in all natural languages, permit the existence of thousands of variants. Zeki [1,2] studies the “visual brain” and searches for the neural basis of beauty. He coined the term neuroaesthetics and asked: “What is art, why has it been such a conspicuous feature of all societies, and why do we value it so much?” Zeki [3] emphasizes that the central problem of neurobiology is to understand how the brain makes abstractions. The function of the brain is to seek knowledge, and its “capacity to abstract is a critical step in the efficient acquisition of knowledge; without it the brain would be enslaved to the particular.” This capacity is reflected in the arts, for all art is abstraction, an opinion he shares with the painter Constable whom he quotes: “The whole beauty and grandeur of Art consists ... in being able to get above all singular forms, local customs, particularities of every kind. [The painter] makes out an abstract idea more perfect than any one original.” From it one can think that art is a specific form of knowledge that permits us to be close to the abstract ideas the brain elaborates. Both authors use the word art in our contemporary meaning. Here we see relationships between art and science, but their approach is, above all, scientific. Ramachandran and Zeki make theories, and the distinction continues.

Without disagreeing with them, we can think of a characteristic common to art and science, a very old one and maybe older than the distinction made by the classical philosophers. The Greek word kosmos refers to anything ordered that is, by this reason, beautiful and vice versa (a Greek would think it quite strange to say “something ordered and beautiful,” for something ordered is, for this reason, beautiful). So we have this notion as central for both artists and scientists. To know, the brain processes the data from the senses and elaborates models, with which we can recognize the particulars of our fleeting experience that constantly renew the models. When we express ourselves, we express these models, so that any human expression has something of ideal—or beautiful, for our matter. In fact, we always express idealizations of the experience that are tangible forms of the beautiful. So art would be the disposition that makes the beautiful forms directly touch the senses; that is, today’s works of art and science would be the disposition that makes the abstract forms that explain the workings of the world, our theories. Now Ramachandran’s “artful brain” and Zeki’s question acquire a new meaning, for they are related not only to so-called works of art, but also to scientific theories—and those about the brain included. Feynman [34, p. 11] also suggests it:

I have a friend who’s an artist, and he sometimes takes a view which I don’t agree with. He’ll hold up a flower and say, “Look how beautiful it is,” and I’ll agree. But then he’ll say, “I, as an artist, can see how beautiful a flower is. But you, as a scientist, take it all apart and it becomes dull.” I think he’s kind of nutty.

First of all, the beauty that he sees is available to other people—and to me, too, I believe. Although I might not be quite as refined aesthetically as he is, I can appreciate the beauty of a flower. But at the same time, I see much more in the flower than he sees. I can imagine the cells inside, which also have a beauty. There’s beauty not just at the dimension of one centimeter; there’s also beauty at a smaller dimension.

There are complicated actions of the cells, and other processes. The fact that the colors in the flower have evolved in order to attract insects to pollinate it is interesting; that means insects can see colors. That adds a question: does this aesthetic sense we also have exist in lower forms of life? There are all kinds of interesting questions that come from a knowledge of science, which only adds to the excitement and mystery and awe of a flower. It only adds. I don’t understand how it subtracts.

Of course, it is very important to know what is adequate and necessary in each context. The sciences, as we understand them today, have different aims, methods, and results than the arts. However, it is important to emphasize their deep affinities, and in this context, maybe the distinction between rationality and sensibility, usually considered as opposites in philosophical discussions, has little meaning; both would be the state of neuronal connections able to perceive and produce ordered forms. The neurosciences permit us to understand neural processes, but it is important to experience them as beautiful forms. Maybe it would not be strange to Leonardo, who wrote about a “beautiful demonstration” in one of his anatomical folios (K/P 149 recto), an expression not strange among logicians and other contemporary scientists.

We have here suggestions from the past that can enrich our contemporary modes of thought. We have retained some old Greek meanings with respect to art and science as dispositions, and we have our contemporary meanings to approximate art and science in a new way. In fact, we can see it in Leonardo da Vinci, who lived in that precise historical period, the Renaissance, in which artisans began to be artists. His anatomical studies show the synthesis with respect to the old meanings, as we have seen, and with respect to our meanings as well, as anyone can see his anatomical drawings as beautiful scientific studies. Leonardo shows that the obvious idea that any process of acquisition of knowledge—in the arts and in the sciences—is tied to the world of generation and corruption, for our theories are fallible, and we always search for some form of beauty. We could even think about changing the title of this article: without the beautiful, science does not have meaning. I hope the articles in this supplement are good examples of the human search for forms of order.

Conflict of interest

The author has no conflict of interests to report that would influence the content of this paper.

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References


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10 For a comprehensive survey on anatomical illustration, cf. the virtual exhibition Historical Anatomies at www.nlm.nih.gov/exhibition/historicalanatomies/home.html.