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# **M**ONA LISA: A COMPARATIVE EVALUATION OF THE DIFFERENT VERSIONS AND THEIR COPIES

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## **1. Introduction**

In a previous study [1], which included stylistic and diagnostic analyses, it was found that the oil painting on canvas “*Mona Lisa with columns*”, part of a private collection in a museum in St. Petersburg (Figure 1), is a copy of the “*Mona Lisa*” by Leonardo (Figure 2) dating to a period between 1590 and 1660. Noteworthy features include the good quality, readability and expressiveness emanating from the work, which presumably is of Nordic influence, specifically German-Flemish.



*Figure 1. Photograph in the visible of the painting “Mona Lisa with Columns”, St. Petersburg (oil on canvas 63.2 x 85.2 cm)*

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Figure 2. The Louvre "Mona Lisa"

More specifically, given the importance of the subject, which includes Leonardo's well-known masterpiece, the conclusion that was reached in defining the above painting a copy of the original, involved examining, from a methodological point of view, investigations carried out in 2004 on the Louvre "Mona Lisa" by the "Center for Research and Restoration of the Museums of France", and published in "*Au cœur de La Joconde – Léonard de Vinci Décodé*". This sequence of investigations – which were certainly not aimed at authentication – were examined together with those of the National Gallery in London, thus enabling comparisons to be made with other works by Leonardo [2-3].

The use of scientific methods has made it possible to provide a reliable answer in the comparison made with what scholars have reported.

The present paper examines and compares a number of the many works depicting the same subject. The works were chosen on the basis of their acknowledged artistic quality and a series of technical data obtained by consulting diagnostic-analytical tests carried out by several laboratories.

The comparison not only has the purpose of highlighting the particular presence of the columns in the painting already examined, but also that of pointing out how, as a result of the marked and widespread attractiveness exercised by Leonardo's originality through the years, on various authors, the various works, even if well-executed, nevertheless present some significant differences and particularities in the iconography and / or technique employed.

## 2. The “*Mona Lisa*” copies

There are numerous copies of the “*Mona Lisa*”: some of good quality and others of inferior quality. Among those worthy of note are, those in the Hermitage in St. Petersburg, the Walker Art Gallery in Liverpool, the private copy known as the Vernon “*Mona Lisa*” in the United States, one in the collection of the Earl of Wemyss in the UK, and another in Salzburg. Of particular significance is the Isleworth “*Mona Lisa*” – which will be discussed later – depicting, between the columns, a younger figure than that of the Louvre, but whose pose is similar. This painting is currently being studied by the scientific community, as it is believed that it could be another autograph version by the Master, from which other copies have drawn inspiration. There are in fact, copies with a landscape similar to the Isleworth version, including that in Oslo, which have been attributed to Joos van Cleve, Gabriel Ferrier and other authors. Other interesting copies can be found in the Alte Pinakothek in Munich, Germany, the Luchner Collection in Innsbruck, and the Musée des Beaux-Arts in Tours.

In 1952, on the occasion of the 500th anniversary of the birth of Leonardo, an official count identified 61 works [4].

It is, however, likely that other copies have been added to this number over the years. Leonardo’s work has been studied in great detail: the particular characteristics of the Master, his brushwork, composition, structure. The degree of innovation that characterizes his work is the result of an extraordinary talent, praised by poets and writers of the time, and from which stems the uniqueness of his production [5].

However, from among the various copies, through careful archival and bibliographic research, it was possible to collect data on only 13 copies: for some, only a small amount of technical and historical data was available, for others, more in-depth study was possible [6].

In order to highlight the differences and similarities in the production of the various copies of the “*Mona Lisa*”, three case studies were examined: the Prado “*Mona Lisa*”, the Reynolds “*Mona Lisa*” and the Isleworth version. The latter is considered by some scholars to be an earlier version by Leonardo, in other words, a version produced before the Louvre “*Mona Lisa*”.

Owing to their differences, the following three cases provide us with a significant, but not exhaustive, informative picture of this art work.

## 3. The Prado “*Mona Lisa*”

### 3.1. *Historical anamnesis*

The Prado “*Mona Lisa*” (Figure 3), is an oil painting on wood, probably produced at the beginning of the sixteenth century.

Reference is made to this interesting portrait for the first time in the 1666 inventory of the Gallery of the Mediodia del Alcazar as’ *mujer de mano de Leonardo Abince*. The painting differs from other copies in a striking way.

In January 2012 it underwent major restoration. The results led to a surprising disclosure: the black background hid a landscape and a parapet flanked by column bases similar to those of the “*Mona Lisa*” in the Louvre. Furthermore, infrared reflectography highlighted the similarity of the preparatory drawing of the copy with the portrait in the

Louvre. These results, together with the excellent state of conservation, show the original colors of the Prado painting. However, there is no substantial evidence that Leonardo himself used a palette similar to the version now in the Louvre. The two portraits, therefore, are very different and were executed on panels of wood from different trees.



Figure 3. The Prado "Mona Lisa"

Information provided by the Prado Museum in 2010, has supported the belief that the portrait was probably executed before Leonardo left Italy for France, which would mean that it was probably painted in Rome around 1516. In fact there has never been any hypothesis that the copy in the Prado was painted by Leonardo. Bruno Mottin, head curator at the Center for Research and Restoration of the Museums of France, has suggested that the painting could be attributed to one of Leonardo's favourite apprentices, perhaps Salai or Melzi. But it is also true that neither Salai possessed the talent to paint such a lifelike picture, nor could Melzi have produced such a painting, since he was only 15 when he met Leonardo in 1506, and was therefore too inexperienced to paint this copy. On the other hand, if we assume that the painting is by Melzi after completion of his apprenticeship and as an artist in his own right, it should have been painted a few years after Leonardo's death. A further theory is that the painting was done by one of Leonardo's Spanish pupils: in this case the painting may have been completed in Spain. Another theory regarding the present location of the work is that the painting was taken by the Spaniards when they sacked Rome in 1527.

However, in a press release issued by the Prado in February 2012, it states that: "Following its rediscovery, this copy of the "Mona Lisa" in the Prado Museum, which has now been confirmed as a work by one of Leonardo's pupils or followers working in his studio while the original was being painted, has not only been confirmed as the oldest known copy of this enigmatic image, but also acquires considerable importance for its potential to cast more light on the Louvre painting."

At about the same time, conservators at the Louvre announced the re-dating of their “*Mona Lisa*” to a period from 1503-1519. The reason for this decision is unclear. Of course, if, as the Prado scientists have theorized, the copy in Spain was painted by someone who “... sitting next to Leonardo da Vinci, was trying to duplicate his every brush stroke”, it would have meant that this artist stayed with Leonardo for 16 years, a period when in fact, the Master alternated his work and travels between Florence and Milan, and Rome and France, and only rarely put his hand to the painting, a quite unlikely situation.

It is moreover known that Leonardo had already suffered from a stroke in 1514, while in Rome. In fact, when Cardinal Luigi d’Aragona visited him in 1517, the cardinal’s secretary and diarist, Canon Antonio de Beatis, reported that “... nothing good can be expected from his paintbrush as he suffers from a paralysis in his right hand.” Leonardo was known to be left-handed, but at the time was over 65 years of age and, naturally, debilitated. In addition, de Beatis reported that the portrait of the “*Florentine woman*,” now considered to be the painting the “*Mona Lisa*” in the Louvre, was “quite perfect”, in other words, completed. All these documented reports exclude the possibility that the ‘Louvre version was completed’ in the year of Leonardo’s death, in 1519.

Perhaps the main argument that highlights the non-contemporaneity of the Prado copy with the “*Mona Lisa*” in the Louvre, is that the two women are physically different: the woman in the Prado is significantly younger than the Parisian “*Mona Lisa*”, and has a more robust appearance, the hairstyle is curlier and more intricate, and the fingers of her right hand, which are slimmer and longer, have been beautifully rendered. Although the qualitative representation of the embroidery pattern is simplified, it is evident that to paint the face, hands and clothing with such finesse, must have required more than just the experience of a student.

The landscape is in some way incomplete and reproduces some of the intermediate layers of Leonardo’s original landscape, as revealed by the infrared photography of the original. This suggests that the copyist stopped working before the original was finished. Leonardo then continued to work on the original version, which remained incomplete [7-8].

### **3.2. Analytical-diagnostic investigations**

Investigations of the Prado “*Mona Lisa*” were carried out in a joint collaboration between the Prado and the Louvre in February 2012, in order to ascertain, distinguish and describe the constituent materials, and to highlight the original compositional and conservative procedures. The work has undergone invasive restoration a great many times over the centuries, including transfer of the painting from a wooden support to a textile one [9]. Analyses carried out during its last restoration led to the discovery of the original painting, an extremely important aspect in understanding the methodology employed for depicting light, in Leonardo’s workshop (Figure 4). This is the most important copy of the “*Mona Lisa*” known today.

The comparison of the Prado painting with that of the Louvre, together with technical documentation, have further contributed to a better understanding of the painting in the Louvre and to completing the sequence of known phases in its execution. The higher resolution of the images produced during investigation of the Prado copy, revealed features of the original which had previously remained undetected. In addition, data resulting from the comparative investigation of the two works has confirmed what

was already known about the way in which Leonardo's workshop operated. A description is given by Martin Kemp in his research on the existing versions of the "Madonna of the Yarnwinder", but already indicated in a letter from Brother Pietro di Novellara to Isabella d'Este after the former had visited Leonardo's workshop. In his letter, Brother Pietro claims to have seen two apprentices painting copies while the Master was busy with other matters.



Figure 4. The Prado "Mona Lisa" before and after restoration

The existence of a landscape beneath the black background was revealed by infrared reflectography and examination of the surface in raking light before restoration. This was subsequently confirmed by X-ray. Even with these tests however, it was necessary to determine whether the black substance had been added after completion of the painting, and if so, if it had caused any damage [7].

The dark background proved to be a re-varnishing done after 1750, using linseed oil as a binder.

The landscape beneath the coating of dark color, was well preserved but not completely finished, which may have been one of the reasons why it was covered. An organic layer, probably a lacquer, found between the background and the overpainting, allowed the two layers to remain separate. This information along with the solubility tests, supported the decision to remove the layer of black overpainting that bears no relation to the original conception of the painting. The recovered landscape conforms to the chromatic range and shapes of Leonardo's ethereal landscapes, apart from the obvious differences in the pictorial quality: for example, the rock in the area of the mountains, located to the right of the figure, is the same as that in the autograph drawing by Leonardo, in the Royal Collection at Windsor (c. 1510-15).

As for support, the work was carried out on a walnut panel, a support customarily used by Leonardo and his circle in Milan, as can be seen in "Lady with an Ermine", "La Belle Ferroni  re" and "San Giovanni Battista" [9-10].

The preparation of the panel does not have the traditional plaster substrate. Instead, it has a double preparation (a more orangey inner layer and a whiter outer layer) con-

sisting mainly of lead white. Test results, published in Volume 32 of the National Gallery Technical Bulletin, conducted on other works by Leonardo, such as "*Lady with an Ermine*" and "*La Belle Ferronièr*e", show that although unusual, this type of preparation was used in Leonardo's workshop when the support was walnut [3, 9-10].

Finally, the blue pigment obtained using costly lapis lazuli, imported from the country now called Afghanistan, seems to suggest that the copy was intended for a precise destination and owner; it can therefore be assumed that it was not just a "workshop experiment". All in all, the materials used in the Prado panel are of high quality and the work has been expertly executed [7].

### **3.3. Comparative analysis**

The Prado copy is of great interest however, owing to the fact that the process used to create the "*Mona Lisa*" can be retraced from the preparatory drawings to the final layer, without any evident sign to indicate it was a copy.

The comparative analysis using infrared revealed details identical to those underneath the paint layers, which show a parallel procedure. This document reports that the figures are of the same size and shape and were probably transferred onto the respective supports using the same cartoon. The preparatory drawing of the original is not so accurate as that of the copy (Figure 5) however, which has lines that indicate how the position of the figure was moved; in addition, the intermediate phases of execution, also found on the copy, are evident.



Figure 5. Comparison between the Prado "*Mona Lisa*" and the Louvre "*Mona Lisa*"

The brushstrokes that define the forms in the original painting also appear beneath the pictorial surface of the Prado figure, though slightly displaced. They are found beneath the figure, on the waist, on the shoulders and hands, on the line of the breast, on the folds of the sleeves and on the knees.

Some of the contour lines of the initial figure in the Prado version were corrected by hand and some fine lines drawn in black pencil and brush bearing no relationship with the painted forms, are visible. However, they reflect the artist's experiments and hesitations, thus suggesting a much more complex creative process than that of a normal copy.

The most important point, however, is that each of the corrections to the underdraw-

ing in the original, can also be found in the Prado version: the change in the contour of the waistline which, as in the original, is covered by drapery on the surface, the position of the fingers, the outline of the veil and head, including minor changes to the contours of the cheeks and neck. A “traditional” copyist reproduces what can be seen on the surface, but not what is hidden beneath. The existence of these changes beneath the surface, common to both versions, reveals that the artist who painted the Prado copy saw the entire procedure used for the *“Mona Lisa”* from conception to completion (Figure 6). In addition, he included elements that Leonardo drew on the underlayers, but did not repeat on the surface, including the right armrest of the chair and some internal parts of the robe [5].



Figure 6. Comparison between the Louvre *“Mona Lisa”* and the Prado *“Mona Lisa”*

### 3.4. Considerations

These reports have led to the identification of a ‘habitué’ of Leonardo’s workshop, as the person who produced the Prado painting and that the copy and the original were executed in parallel during the same time period. As for who the actual artist was, the pictorial process is not comparable to the style of students or assistants such as Boltraffio, Marco d’Oggiono and Ambrogio Predis, who all had well-defined artistic personalities. Stylistically, however, the work can be placed in a Milanese context, approaching that of Salai or Francesco Melzi, perhaps Leonardo’s most trusted students, the heirs of his work who had direct access to his landscape drawings.

The high quality of the materials used in the Prado painting suggests it is an important commission. Diagnostic studies show that the Prado version was executed at the same time as the original, supporting the hypothesis of a “duplicate”, produced at the same time by someone who had direct access to the gradual procedure of creating Leonardo’s original work [5,11].

## 4. The Reynolds “*Mona Lisa*”

### 4.1 Historical anamnesis

In 1790, Sir Joshua Reynolds presented the 5th Duke of Leeds (a friend and member of the Society of Dilettanti), with a self-portrait, now in the Royal Collection. The self-portrait was a gift from Reynolds to the Duke, as a token of his gratitude for the copy of the “*Mona Lisa*”, an oil on wood (Figure 7), he had earlier received from the Duke.



Figure 7. The Reynolds “*Mona Lisa*”

Although certainly not by Leonardo, the painting is of considerable interest. It is a well-made copy that in some ways has elements, such as the colour, that are not easily visible in the actual painting in the Louvre. Furthermore, the fact of having been in the Reynolds collection, gives it considerable historical relevance. The painting was probably copied by a French artist in the early seventeenth century, from the original in Fontainebleau, or from a very accurate copy. From the point of view of quality, this seems to be the copy that most closely matches the original.

Reynolds was keenly interested in Leonardo, having studied him from an early age. In Italy from 1750-1752 for the Grand Tour, he spent most of the time in Rome. Here, he studied the old masters, ancient and modern art, assiduously. In the notebooks he kept during this period, Reynolds refers only three times to Leonardo, while Michelangelo and Raphael are cited numerous times. However, only a few works attributed to Leonardo were available for viewing and none were in Rome.

In one of his notebooks, Reynolds made an accurate drawing of a *Madonna breastfeeding the infant Jesus*, writing “Leonardo da Vinci / Barberini”. This painting, housed in Palazzo Barberini, is actually a copy, or a version of the “*Virgin of the green cushion*” by Andrea Solario, a masterpiece influenced by Leonardo’s work, painted between 1507-1510, and now in the Louvre.

Leonardo’s technique of overlapping colors to intensify areas of light with thin layers of light coloured pigment, or vice versa, to darken areas of shadow with layers of light brown, is repeatedly emphasized by Reynolds: this interest in the Tuscan artist most certainly had an influence on the art and techniques used by Reynolds for his paintings.

As for the origin of the Reynolds copy, a late owner of the painting, Sir Abraham Hume, states in the catalog of his collection (1829) that the painting had 'very probably' been owned by Jonathan Richardson (1665-1745), the English portrait painter and collector of drawings by old Masters. Richardson's essay on the theory of painting (1715) must have influenced the young Reynolds in his successive speeches, so much so that Reynolds bought many of his drawings.

As mentioned earlier, the painting was given to Reynolds by Francis Osborne, the 5th Duke of Leeds (1751-1799), who served as Foreign Secretary under William Pitt. Reynolds says in his catalog that he asked the French secretary of the Académie Royale, through 'Monsieur Barbier', if the "*Mona Lisa*" was still present in the King's study; the answer was that the work was still there, but not considered to be an original and so of little prestige. The response must have encouraged Reynolds in his opinion that the painting in his possession was actually the original.

Sir Abraham Hume (1749-1838), a famous collector of old masters, bought the painting when Reynolds' ancient masterpieces went up for sale in 1795. In his catalog, Hume refers to Reynolds' opinion that the painting was an original in spite of the painting in Paris, which he considered to be a fake.

When Waagen saw the Reynolds "*Mona Lisa*" in Hume's collection, he described it as '*a new, very delicate and beautiful copy*'. Hume bequeathed most of his collection, including the "*Mona Lisa*", to his nephew, John Hume Cust, Viscount Alford (1812 -51), son of the first Earl of Brownlow. After Hume's death, in 1838, his grandson moved the collection to Ashridge Park, Hertfordshire. The painting was exhibited at the British Institution in 1823 and at the Royal Academy Winter Exhibition in 1902 [6].

#### **4.2 Analytical-diagnostic investigations**

Analytical and diagnostic investigations have shed new light on the history of the copy and how it was produced. The Courtauld report relating to the above investigations which came out in 2005, found that the artist must have been highly qualified, as demonstrated by the refined preparatory drawing, his use of pigments, including the sophisticated use of azurite for the sky and mountains, and also by the excellent condition of the paint film. The materials and techniques are consistent with traditions in northern Europe from the end of the sixteenth century until the early seventeenth century.

It should also be noted that the right edge of the three horizontal panels, on which the work was painted, was cut after the *imprimatura* was applied. The panel was probably originally designed for a larger painting, possibly a landscape. Ian Tyers used a dendrochronological dating method for the support and concluded that the three panels came from two oak trees of eastern Baltic origin, felled around 1602 and probably originally used before 1634 [5].

#### **4.3 Comparative analysis**

The comparative analysis carried out by Matthew Landrus involved overlapping the outlines of the copy with those of the Louvre painting. The comparison shows that the majority of the contours and proportions in this work coincide with that in Paris. This suggests that the painting may have been copied from the original, or from an exact copy, through a mechanical process: it was probably traced with great accuracy on the

original painting. This thesis is supported by the fact that there is no trace of a *quadratura* on the drawing beneath the painting. There are proportional coincidences in the composition of the sections, both in the upper (head and landscape) and the lower sections (hands and sleeves), suggesting that the copying process was done section by section. Some outlines are not precisely accurate and do not perfectly match the original forms, they are, nevertheless, almost identical, and the differences can be attributed to unintentional slips during the tracing operation.

#### 4.4 Considerations

Among the copies of a high standard listed by Frank Zollner and André Chastel, the Reynolds seems to be the best, even if the face of the painted figure lacks the softness and radiance of the original. The cheeks appear a little too wide and the chin too short, but the face is delicately painted with a composed expression. The hands too, are well painted. The technique of using opaque layers of paint, however, is very different from the original.

The dress is of a color closer to black than dark green and the garment's folds must have been painted when the original was already difficult to read. The sleeves seem to have a reddish-brown enamel glaze tending to yellow, while the original, from descriptions, must have been yellow, but now appears as a dull gold [9, 12].

The landscape and the mountains, even if summarily painted, are more accurate than those of other copies and have more details. The modelling of the parapet and its linear decoration appear accurate. The chair armrest is difficult to see, but in the underdrawing appears to be accurate. The base of the column to the right of the female figure appears to be very precise.

An interesting detail copied from the original that does not appear in other copies, is the shadow projected forward from the base (unclear in the original).

The Reynolds copy, like many others, enlarges every detail. Martin Kemp suggests that copyists were unnerved by the 'daring' way Leonardo had just hinted at the columns, and so increased their size to create a more conventional setting.

It is Reynolds and Hume who make the claim that their copy is better than the original because it has colors and details that are not easily visible in its present condition, as if obscured by discolored paint [6].

The Reynolds "Mona Lisa" was probably painted by a French court artist in Fontainebleau or a visiting artist at the beginning of the 17<sup>th</sup> century.

The copy is slightly wider than the original with columns flanking the figure, whereas in the Louvre "Mona Lisa" the columns are only suggested. The woman, in reality, is sitting in a room in front of a window, in the style of Renaissance portraits.

On the cleavage of the figure is a decoration which is part of the smock worn under the *gamurra* (typical female dress of that period). Similar frills appear in four copies: in one of Leonardo's treatises on painting in 1651; in a print by Jean Masard of 1806, which came out after the drawing of Bouillon; in the first French edition of the complete paintings of Leonardo; in the engraving by Calamatta.

There is no lace trimming on the original. There are darker areas above the breast line, that could be the remains of some lace trimming rather than a shadow from the top of the dress. Kemp has stated that this kind of detail is the last to be painted and the first to be lost in any restoration.

The Reynolds "Mona Lisa", is currently on exhibition in the Dulwich Picture Gallery.

The Gallery director has said that the original in the Louvre has lost much of its original color, the tones having become very dark. This worsening condition may be due to the technique used in this situation by the Master, which was to create overlapping layers of infinitely thin color, a process that had gone on for years. The change in the original tone of color, also because of the age of the painting, has made it hard to read.

Instead, more traditional techniques have been used on the Reynolds "Mona Lisa", and the painted surface has suffered "much less. It still has a surprisingly bright background and in this case too, as in the original, a pigment obtained with lapis lazuli (extremely expensive) has been used to create the intense blue of the sky [6, 12, 13].

## 5. The Isleworth "Mona Lisa"

### 5.1 Historical anamnesis

In 1550 and also in 1568, Vasari declared in one of his writings that Leonardo had left the painting of the "lady on the balcony" unfinished. The version in the Louvre, however, had already been completed by 1517, when it was shown by Leonardo himself to the Cardinal of Aragon in Cloux. In this regard, the critical confrontation between the oil painting on canvas, the Isleworth "Mona Lisa" (Figure 8), and the Louvre "Mona Lisa", proves to be of great importance in determining, as some scholars sustain, that the Isleworth "Mona Lisa" may be an original by Leonardo.



Figure 8. The Isleworth "Mona Lisa"

Further proof of the possible existence of another version of the portrait is represented by a pen and ink drawing, depicting a young woman on a balcony with columns, by Raphael, dated around 1504 and probably executed when he was in Florence to observe Leonardo's work (Figure 9) [14]. When working, many students also took into consideration this drawing, as well as taking inspiration from the study of Leonardo's portrait of the "Mona Lisa". According to some historians, it was actually the Isleworth "Mona Lisa" and its composition, that influenced Raphael's style. Since the compositional elements in it are unique and do not appear in any other painting, this "Mona Lisa" must have been nearing completion when Raphael saw it in 1504.



Figure 9. Raphael, "Head and shoulders of a woman", Paris, Louvre, inv.3882 (pen and brown ink, 22.2cm x 15.9cm)

Several scholars have therefore hypothesized that the two versions of the "Mona Lisa" have generated copies. The Louvre "Mona Lisa" has been the basis for numerous copies throughout the centuries. In contrast, each copy in which the columns appear may have been inspired by the Isleworth version: for example, the Oslo "Mona Lisa" (Figure 10) seems to be a direct copy of the Isleworth, as is also the "Mona Lisa with Columns" in a private collection in St. Petersburg, Russia (Figure 1).

When comparing the Isleworth "Mona Lisa" with all other paintings of the same subject, additional impressive features are found that can only be attributed to the hand of a great master. Among them are the details in the rendering and design of the embroidery on the dress, which suggest a brilliant mind [5]. Furthermore, results from the innovative method of computerised regression analysis, which incorporates forensic techniques, have confirmed that the portraits are of the same woman at different ages, the difference between the one and the other being approximately 11 years [5].



Figure 10. The Oslo "Mona Lisa"

### 5.2 Analytical-diagnostic investigations

The beginning of the sixteenth century marked a period of transition that was extremely significant for artists' materials. Venetian and Flemish masters' knowledge of the new media became widespread. Artificial oil paints and pigments began to be popular. In fact Leonardo had used oil as a binder since his apprenticeship under Verrocchio. Until then, wood had been the most important support for painting and before 1470 important works were almost never painted on canvas in Western art. Both "*Lady with an ermine*" and "*La Belle Ferronnière*" were painted on walnut panels from the same block of wood. On the contrary, the "*Mona Lisa*" in the Louvre is painted on poplar wood, a wood most often used in Lombardy and Tuscany.

It should be remembered that Leonardo was not only a great inventor and innovator, but also someone who assiduously experimented with new ideas and technologies. Canvas was already being used in 1500 by many Italian artists. It is worth noting that a small work of art, executed on parchment in 1490, has recently been authenticated as the work of Leonardo. This is particularly noteworthy, given that until now no known finished works of Leonardo are on this material. In his book "*The Beautiful Princess*", Martin Kemp writes: "He uses a medium that has not been previously observed in his work, but that is closely connected with his interest in the French artist Jean Perreal. It bears witness to his spectacular exploration and development of new media, tackling each commission as a new technical and aesthetic challenge... "[5].

In his “*Treatise on Painting*”, Leonardo describes in detail not only how to prepare the canvas for painting, but also how to paint on it (“*The mode of painting on canvas..*”) [5, 8, 12].

Leonardo probably developed the technique of working on canvas during his apprenticeship in the workshop of Verrocchio. One of the first references to the work of Leonardo on canvas is by Giorgio Vasari, according to whom the master often used linen or Rensa canvas, which was suitably prepared, to use in his studies. The Isleworth “*Mona Lisa*” consists of a hand-made linen cloth, a material with which Leonardo had had significant experience before 1500, and is actually similar to the material used for his studies on drapery.

The main features of the linen cloth used for the Isleworth portrait of the “*Mona Lisa*” are simple “tabby” weaves with an average count of 18 threads per cm<sup>2</sup> in the warp and 16 threads per cm<sup>2</sup> in the weft, that cross one another regularly, with some variation in thickness. The result is a deformation in which the warp is slightly tighter than the weft. It is no coincidence that Leonardo’s studies on drapery (now in the Louvre), dating back to 30 years before had almost identical features. Just like the cloth of the “*Mona Lisa*”, the cloth in his studies was hand woven.

In 2005, the painting of a “*Young Christ*”, oil on thin cloth, probably linen, was presented by Alessandro Vezzosi as an unpublished work by Salai. In 1504, Salai was introduced to Isabella d’Este as a talented and worthy pupil of Leonardo. It was also at this time that canvas was used in Leonardo’s studio, and during this period that the Isleworth “*Mona Lisa*” was painted. In 2011, Vezzosi presented other paintings with a canvas support from the same period by Salai. This lends further credence to the idea that this material was used in Leonardo’s studio in the late fifteenth century.

It is evident that from the time of Leonardo’s work on, the use of canvas as a support became more common not only among Flemish and Venetian masters, but also among German, Dutch, Florentine and other Italian masters [5].

A more particular detail is the presence of a lining: it was commonly used on very old canvases to reinforce the original support by connecting it to a second new canvas or ‘lining’. The lining not only strengthened the original support, but helped in the overall preservation of the picture. In the case of the Isleworth “*Mona Lisa*” it was made to adhere by means of a mixture of glues: a combination of Venetian turpentine, flour paste and gum as a plasticizer. The original canvas was cut slightly when the lining was applied, but the rough edges with the original paint have not been touched. The lining consists of a uniform fabric, obtained industrially, using a flat tabby weave, with an average number of 14 threads per cm<sup>2</sup> in the warp and 14 threads per cm<sup>2</sup> in the weft. The canvas is attached to a wooden frame, known as the stretcher, with nails. Since there are no holes from nails in the previous lining, it can be assumed that the current stretcher was inserted when the painting was lined [3, 5, 8, 15].

The base ground layer is of a red-brown colour, a combination of red-brown ochre calcite and some grains of quartz. Using this as a base color, the artist was able to create a sense of warmth throughout the whole of the painting. The pigments are mainly earths. The obvious lack of strong colors contributes to the intrinsic beauty of the picture: all the chromatic elements are in organic harmony and contribute to accentuating the beautiful skin tones. Part of this effect is in fact due to the undercoat of reddish-brown.

It is not the only painting where Leonardo used this technique. For example, it can be seen in “*Lady with an Ermine*”, which underwent diagnostic tests at the National

Museum in Warsaw between 1952 and 1954. They revealed that the background of the painting is a combination of bone black, earth of burnt umber and natural sienna. The portrait was executed in Milan in 1490, it is therefore likely that pigments similar to those used in Florence were available [22-23]. "La Belle Ferronnière" was examined in the laboratories of the Louvre in the early fifties. In his book, "Leonardo da Vinci – The Complete Paintings", published in 2003, Pietro Marani reports on investigations carried out by Sylvie Beguin, the renowned French curator, which revealed a thin paint surface and an *imprimatura* of red earth already found in Leonardo's work.

Marani later declared that the microscopic examination of the Louvre "Mona Lisa" had revealed there were at least two colors in the preparatory layer: blue beneath the upper section, in the landscape; red beneath the lower section. Leonardo had used the same two-tone earth for, "La Belle Ferronnière", "The Musicians" and "Saint Anne" [16].

In 1974, the American conservator and scientist, H. Travers Newton, was in Florence to attempt to find out about any remains of the "Battle of Anghiari" by Leonardo which might be present under Vasari's frescoes in Palazzo Vecchio. According to the writer, Charles Nicholl, all the core samples showed a layer of red pigment under Vasari's plaster and a number of them showed other pigments, among which were those found in the same red preparation. Two of them are typical of Leonardo's painting technique: a copper carbonate green, similar to that used for "The Last Supper", for which Leonardo provides a recipe in his "Treatise On Painting", and smalt blue, found in the "Virgin of the Rocks" in the Louvre. Furthermore, traces of azurite were found, an unsuitable pigment for frescoes, which makes this particular fresco an unconventional work [8-9].

Based on these studies, it can be stated that in the painting "The Battle of Anghiari" (c.1503), the use of a red ground is predominant, as is true of the Isleworth "Mona Lisa" of the same period, and has the same red base. The dates of the two commissions are also the same, so it is conceivable that the palette was the same. The background landscape in the Isleworth "Mona Lisa", also has traces of enamels and azurite, as mentioned above in the results by H. Travers Newton.

A recent analysis of the pigments in the famous "Last Supper" by Leonardo has drawn significant attention. During restoration of the painting, Antoinette Galone from the Politecnico di Milano, revealed the presence of traces of calcite (calcium carbonate) in the preparatory layers. It also identified a number of pigments that demonstrate the work can be attributed to the Renaissance period.

In 1998, at the Congress of the " International Institute for Conservation of Historic and Artistic Works "in Dublin, Jill Dunkerton and Marika Spring of the National Gallery in London, presented additional information:"With reference to the tinted and coloured preparations, the thin pigmented layers found immediately above the plaster may be part of some monochromatic underdrawings ...".

The first layer of gray, found in many Italian paintings of this period, corresponds to materials found in samples from the Isleworth "Mona Lisa".

It can therefore be said that the reddish brown ground in the Isleworth "Mona Lisa" is compatible with other famous paintings by Leonardo, providing evidence of his creative ability and detailed knowledge of pigments. This talent enabled him to overcome the challenge of reproducing natural colours, in other words, the way colours should be perceived by the human eye in real life. The reddish-brown ground can also be seen in many of his drawings and studies, some of which are in the Royal Library in Windsor and the Uffizi Gallery Museum in Florence.

The successive layer, which is grey with a slight purplish hue, is made from calcium

carbonate, lead white and bone black. The same colours and techniques are again mentioned by Leonardo in his Treatise.

In the 1996 National Gallery Technical Bulletin (Vol. 17), in the article “*Giampietrino, Boltraffio, and the influence of Leonardo*”, L.Keith and A.Roy wrote: “In Leonardo’s paintings, the overall pictorial unity, produced using a tightly controlled, restricted range of tones, was a central feature. The sculptural plasticity of the London National Gallery’s cartoon of the “*Virgin and Child with Saint Anne*” and “*St. John the Baptist*”, together with the use of a restricted palette, illustrate Leonardo’s primary concern with the creation of depth through the manipulation of the *sfumato* and not of colour. In his painting, while developing techniques to exploit colour by decreasing its intensity so as to create aerial perspective, the intrinsic beauty of certain naturally high-key pigments was, as a rule, deliberately and consistently subordinated to the constraints dictated by his great discipline in the use of *sfumato*” [5].

In order to identify the complete range of pigments and other media used, as well as determining some of the techniques used in preparing the support, two campaigns of analytical investigations were performed on the painting: the first in 1977, by Hermann Kuhn, under the supervision of the Swiss Institute for Art Research; the second, in 2005 by Maurizio Seracini. The results are not only consistent with each other, but are compatible with the palette used in the version of the Louvre. Reflectographic investigations performed in January 2011 by Pascal Cotte, show that the painting has some clear preparatory drawings below the painting surface. This therefore means that it is not a direct copy.

Leonardo’s interest in geometry is well-known and well-documented. In this regard, the Isleworth “*Mona Lisa*” is perfectly in line with the “golden ratio”. The painting has also been subjected to two different sets of dating analyses: radiometric ( $^{210}\text{Pb}$ ) and radiocarbon [5].

$^{210}\text{Pb}$  dating was carried out on a sample of white lead in order to determine whether the work was executed pre- or post- 1750: the chemical composition after this date changes. The materials present in the examined sample indicate a date prior to 1750, a date that includes the early sixteenth century.

Radiocarbon dating conducted on the canvas indicates, with a probability of 95.4%, a date no later than the 1500s. This is in line with the hypothesis of the painting being executed at the beginning of the sixteenth century.

### 5.3 Comparative analysis

When comparing the two versions of the “*Mona Lisa*” by Leonardo, some significant differences immediately come to notice, which suggest that Leonardo’s intention from the very beginning was to paint two separate portraits [5].

Firstly, the different dimensions: the Isleworth version is 64.5 cm wide and 86 cm high; the Louvre version has a slightly irregular width of 53.3 cm at the top, and 53.4 cm at the bottom, with a height of 79.2 cm on the right, 79.1 cm on the left and 79.4 cm in the middle. As for the support, the Isleworth painting is on canvas, the Louvre version is on poplar wood.

Though representing the same woman, their ages are different: in the Isleworth version the woman is 22 or 23; in the Louvre version the subject is 11 or 12 years older.

As for the composition, the young Mona Lisa in the Isleworth version is sitting in an open loggia framed by two columns, one on either side.

The woman is sitting turned to face the viewer more directly. Her head and right

shoulder are tilted slightly forward. Her neck muscles are tense, allowing the artist to emphasize this angle with superb effects of light on the neck.

Despite the smaller size, in the Louvre version the mass of the figure leans further forward. The female figure occupies more space, the geometry being further accentuated by the effect of the glaze, a technique perfected by Leonardo after 1508. There are slight traces of the pillars at the edge of the picture, but it is possible they were not part of the original composition. They may have been added by a restorer who had taken into consideration the Isleworth version. The woman is sitting more upright, making the neck appear more relaxed.

One of the predominant features of Leonardo's portraits is the contrast between the warmer tones of the hands and pale complexion of the face and chest.

In the Isleworth version the hands are thinner, the fingers more slender and the index finger of the right hand is more relaxed than in the Louvre version.

The background in the Isleworth "Mona Lisa" is markedly different. It has remained largely unfinished (as is the area of the sky). This topic is discussed in several original texts and is also mentioned by Vasari. Reference is made to an unfinished "Mona Lisa" and no mention is made of any type of landscape. Originally, the group of trees on the left side was reflected in a small blue lake. A trace of blue is visible beneath the paint, indicating that the area was completely repainted during a restoration carried out by someone whose talent by no means matched that of the original master.

Leonardo's imaginary landscapes in the Louvre "Mona Lisa" remain a mysterious enigma. The landscape below is certainly more comprehensible and, in this regard, some scholars have come to identify the place through recognition of the famous bridge behind the figure. The landscape higher up is pure fantasy. Carlo Pedretti wrote that: "*The landscape in the painting in the Louvre, is more in line with Leonardo's scientific views in 1508 or later versions.*"

This comment further explains the dating of the painting, which can be considered as one of Leonardo's last works. It is interesting to note that Leonardo uses the device of the background with numerous rocky masses on many occasions and can be found in the "Annunciation" of 1472-1475 and the "Madonna of the Carnation" of 1478-1480.

#### 5.4. Considerations

Results from previous analyses indicate that all the pigments found were already available and in use at the beginning of the sixteenth century.

A comparison between the pigments used in the two paintings of the "Mona Lisa", leads to interesting results. The white lead, for example, is an important component in both works. As regards the young "Mona Lisa", both Kuhn and Seracini have detected the presence of lead white in each single analysis, including the grey ground (5). The Louvre report on the state of the "Mona Lisa" confirms that lead is present in the form of white lead throughout the painting [4].

Other pigments common to both works are azurite, copper blue, vermillion and umber. In fact, both paintings have a substantial amount of earth pigments, such as the different range of siennas, ochres and umbers, which was quite common for this period, when artificial pigments were not yet available. There are, in addition, many variations of black.

Burnt umber is an earth tone used in both paintings, with wonderful mineral properties. This suggests that the burnt umber, or at least a pigment rich in manganese oxide,

plays an important role in achieving the famous *sfumato* effect typical of Leonardo. The relative absence of *craquelure* in the shadows of the face may be related to the drying properties of this pigment, which originally comes from Umbria, a region famous for the quality of its pottery.

Traces of smalt were found exclusively in the landscape background of the younger version of the “*Mona Lisa*”. The popularity of the pigments used by the artist became widespread only in the second half of the sixteenth century. However, according to scientists from the Centre for Research and Restoration of the Museums of France, the use of smalt in easel painting was already well known, albeit to a lesser extent, in the second half of the fifteenth century [12].

One problem that many artists of that time faced, was the lack of availability of the pigments they needed. Creating the right colours and tones from minerals and earths, using suitable binders to obtain the appropriate texture, was a laborious process and therefore costly. Many of these pigments were imported from the major art centers of Italy, the Netherlands, France and England, but they were expensive and not always readily available. It is consequently understandable how eager artists were to learn the process of creating artificial pigments that could serve as alternatives to the traditional palette.

In Leonardo’s Treatise, there is a reference to “... a veil of colour diluted with dry cinnabar”. This is present in the Isleworth “*Mona Lisa*”, in a sample of the flesh tones, but is not mentioned in the Louvre “*Mona Lisa*”. In the latter painting, there is a small amount of vermilion in some of the flesh tones, as in the younger version. Leonardo mentions the red lake pigment as being the correct one for shadows and areas of light. Again, both paintings show traces on the young woman’s face, and in the Louvre version, on the hands [5].

Finally, the Mona Lisa Foundation (the Foundation that has made a thorough study of the work), as well as many experts, are oriented toward confirming the Isleworth painting as genuine and executed in a period that is earlier than the version in the Louvre.

## 6. Comparisons between the columns and the embroidery of the dress in the different copies

At this stage of the research, it was decided to investigate certain aspects in more detail by comparing four versions of the “*Mona Lisa*”: the Isleworth, the Oslo, the Louvre and the Prado. The investigated features relate to the presence of the columns, and the decorations embroidered on the dress found in a number of the paintings.

When looking at the Louvre version, the female figure naturally stands out from the background. This has led to the supposition that the wood panel, at one time, must have been wider, thus allowing for the insertion of the columns or other device, so as to frame the figure in a more particular composition, as the base of the columns and barely visible vertical lines would seem to indicate.

In 1959, the distinguished German art historian Richard Friedenthal stated that “... [the “*Mona Lisa*” in the Louvre] was cut by about 10 cm on each side.” This would confirm that the panel was larger by about 20 centimeters [13].

When Pedretti also declared that the architecture of the Louvre version of the “*Mona Lisa*” would have been better with columns framing the composition, he noted that: “The lady sits by the parapet of a loggia, which was originally extended at each side to include two columns framing the landscape, as in a window. These are now reduced to little more

than vertical strips, but their bases are easily visible and their foreshortening offers the only element of linear perspective in the picture. Originally therefore, the overwhelming presence of the lady was kept in check by the architectural structure of her setting "[14].

Serge Bramly writes: "The panel has lost a strip of about seven centimeters from each side: we can no longer see the two columns that originally framed the landscape, which appear in old copies and in Raphael's drawing [15].

In a later book Bramly says: "Like so many of Leonardo's works, the "*Mona Lisa*" has suffered both from the ravages of time and from rough treatment by restorers: it has been narrowed by six or seven centimeters on both the right and left "[16].

On the other hand, in his letter to Murray Urquhart of 25 February 1943, the scholar Kenneth Clark, opines that the columns were evidently intended to be part of the original design, but were added later.

However, all this speculation ended, when, in October 2004, the Louvre version was subjected to a series of diagnostic tests carried out by a group of 39 international experts. In the report concerning the edges of the poplar support, results showed that over the centuries, the sides of the panel had actually been trimmed a little, but only on the unpainted part: "Careful examination of the side edges in section reveals open burrow holes caused by parasites, which indicate that the plank's width was trimmed a second time. This trimming clearly only involved the bare wood and not the painted layer" [2-17].

Additional documents of the Louvre on this matter, state: "The absence of any preparation on the covered edges thus provides us with irrefutable testimony of the original dimensions of the painting itself". The report contains the following conclusions:

- it is clear that the "*Mona Lisa*" in the Louvre, originally had no columns [2];
- it follows, therefore, that any version or copy of the "*Mona Lisa*" in which the columns are represented, must have originated from another painting, probably the younger version of the "*Mona Lisa*" (Isleworth). This painting may have inspired the artist who later included the columns in the Louvre version [5];
- many scholars currently believe that the matrix of the copies with columns, is the Isleworth "*Mona Lisa*", the composition of which provides for a clear development of the columns in their entirety [5].

It does not however exclude a further hypothesis: there are comments in reference to the barely visible vertical lines, and the bases of the columns visible in part in the Louvre "*Mona Lisa*". In general, Leonardo's compositions followed strict mathematical principles and certainly the Master's ability in describing reality had already been acquired by the beginning of the sixteenth century. Logically, if he had intended to frame the Louvre "*Mona Lisa*" between two columns, he would certainly have painted them in the correct manner, by giving them a special space in the geometry of the structure. Leonardo himself points out that: "No human investigation can be a real science unless it can be demonstrated mathematically."

Hence, there is a strong feeling that, at some point in the painting's history, a restorer considered that the portrait would look better with columns, despite the fact they would not be really evident [5]. This assumption, however, has not yet been scientifically proven.

Likewise, there are several significant differences in the embroidery on the dress, in the various copies and the original. For this reason, a comparison will be made of the Isleworth "*Mona Lisa*" (the earlier "*Mona Lisa*"), the Oslo copy, the Louvre "*Mona Lisa*", and the Prado copy, with regard to the portion representing the columns (Figs. 11-13) and the embroidered dress (Figs. 14-17).



Figure 11. Comparison of the columns

As regards the left-hand column, in more detail (Figure 12):

L1. Isleworth version: in this work, the column and its base are clearly part of the original composition and not an afterthought. In addition, in accordance with Leonardo's studies on light, the shadow of the columns falls softly on the balcony ledge.

L2. Oslo copy: in this work, the details and composition of the Isleworth version have been copied: in particular, the column, the base, the shadow on the ledge and most of the landscape through the trees.

L3. Louvre version: the column, barely visible, and its base, seem to have been added later, by another artist. The base has been painted inaccurately and there is no shadow on the balcony ledge.

L4. Prado copy: the base of the column is more shapely than the one in the version of the Louvre, which they have tried to reproduce, and once more, the shadow on the balcony ledge is missing [5.7].



Figure 12. Comparison of the left column

As regards the right-hand column (Figure 13):

R1. Isleworth version: among the different versions and copies of the "*Mona Lisa*", the right-hand column and base demonstrate confidence in the design and knowledge of classical architecture. This painting is believed to be the true genesis in relation to the composition of the flanking columns and may also have been a model for some of Raphael's early works from the sixteenth century.

R2. Oslo copy: as with the left side of the painting, the copyist accurately reproduces the composition with the columns on each side, as well as Leonardo's Florentine landscape from the Isleworth version.

R3. Louvre version: on the right side too, the column is barely visible, and the base is evidence that it was painted on the landscape and was therefore probably not part of the original composition.

R4. Prado copy: in this case too, there is a great deal of evidence (including the bridge) that proves it is based on the Louvre version. However, the details on the base have a different shape to those on the left and the perspective is imprecise [5,7].

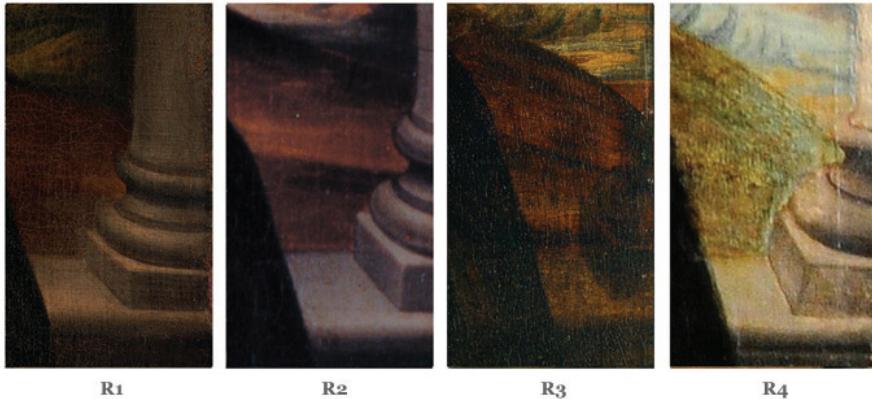


Figure 13. Comparison of the right column

In comparing the embroidery of the dress in the different versions and copies of the "*Mona Lisa*" (Figs. 14-17), it is to be noted that:

- in the Isleworth version, the embroidery is done in a loose horizontal style (Figure 14);
- in the Louvre version, the design of the embroidery has a closer oval vertical pattern, further evidence of the diversity of the two paintings (Figure 15);
- in the Oslo copy, the embroidery follows the same horizontal pattern of the Isleworth version (Figure 16);
- in the Prado copy, unlike in the others, the pattern in the embroidery is more rounded (Figure 17) [5-19].

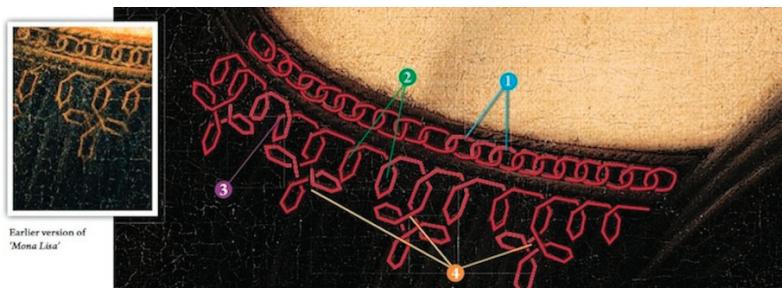


Figure 14. Embroidery on the dress of the Isleworth “Mona Lisa”



Figure 15. Embroidery on the dress of the Louvre “Mona Lisa”

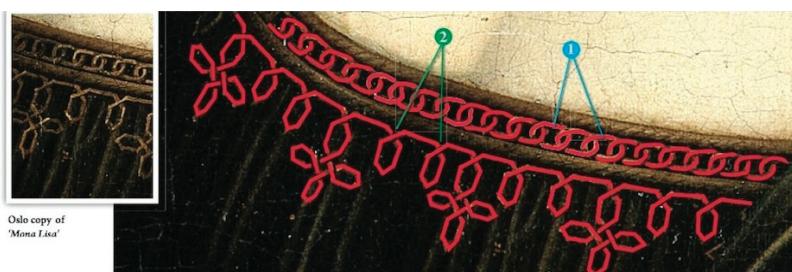


Figure 16. Embroidery on the dress of the Oslo “Mona Lisa”



Figure 17. Embroidery on the dress of the Prado “Mona Lisa”

Some further considerations can be made regarding certain details of the embroidery relating to the repetition of the “cloverleaf” pattern, the regularity in the design, the irregularities in the interwoven “cloverleaf” and the gala (trimming).

As regards the recurrence of the ‘cloverleaf’, the following differences have been noted. The Isleworth version shows continuity in the repetition of the “cloverleaf” twice on the bodice.

In the Louvre version, Leonardo went ‘out of sequence’ in the centre by using three rings among the cloverleaves. From this, it can be assumed that this painting is not only different from the Isleworth *“Mona Lisa”*, but that – the bodice at least – was probably painted at a later date. The three rings in the center are another indication of Leonardo’s intention to differentiate the paintings. The *“Mona Lisa”* in the Louvre is the only painting of this subject in which the detail of the three rings is found.

In the Oslo and Prado copies a repetitive pattern of two cycles can be seen between each cloverleaf [5].

As regards the irregularities in the interweaving of the ‘cloverleaf’, in the Isleworth version each individual group of cloverleaves has a unique pattern, identified by a slight difference in the threading of the pattern, no two are the same. This feature itself identifies the Isleworth version in a significant way, as being a unique original version. In the Louvre version and the Oslo and Prado copies, the cloverleaves have a repetitive pattern [5].

The gala, a delicate ruffle at the top of the bodice, is clearly visible only in the Prado copy. In the other works examined, however, this detail is no longer visible [5].

## 7. Final considerations

Firstly, study of the paintings has highlighted not only the presence of two versions of the *“Mona Lisa”*, but also the necessary distinction between the copies and aforementioned versions: for versions, read the Isleworth *“Mona Lisa”* and the Louvre *“Mona Lisa”*. These are to be considered, therefore, two original works, as they were both painted by Leonardo in two different periods. The subject is the same, but the paintings vary considerably, making them two works in their own right and not a copy of each other.

Consequently, it can be assumed that all subsequent copies of the *“Mona Lisa”* are in fact copies of one version or the other, or a combination of both.

The workmanship of the *“Mona Lisa”* copies is heterogeneous: there are over sixty recorded copies and probably others that have yet to be discovered. The works are often of good quality and painted by talented artists, others are of inferior quality. This is probably also due to the fact that shortly after the death of its author, the *“Mona Lisa”* became a true “icon”. This also meant that it was studied and used as a means of testing the skills of those who wanted to pursue a career in the arts and inevitably had to look to the greatest master of the Italian Renaissance – an artist who had invented a new way of doing and feeling art [18, 21].

Carlo Pedretti claims that none of the known copies reproduces the transparent veils which follow the woman’s contours in the original (such as in the left arm up to and past the elbow) [22]. Just as there is difficulty in reading the color of the dress and the folds of the clothes on the figure, it is equally difficult to reproduce the infinitely subtle gradations of the bright tones transposed in the modeling of the face and hands,

tones that Leonardo produced layer by layer, over many years, with small transparent brushstrokes [21-27].

Part of the "*Mona Lisa's*" charm is in the difficulty of reproducing it. All copies and prints have given rise to discussions regarding their date of execution and the sources used. The way in which the figure is given substance and depth through the transparent veils, the scarf and the folds of the clothes, escapes the copyists, just as the complexity of the landscape does, with its aerial perspective, gradually receding into the distant mountains that gently merge into the sky.

The brushstrokes in the copies are generally not full-bodied, unlike the original, in which the landscape is characterized by the typical thickness of the colors, often obtained by spreading them with the fingertips.

It is almost impossible to find the same depth, the luministic vibrations, the same play of *chiaroscuro*, the suffused glow, typical of Leonardo's masterpiece.

Copyists were probably unnerved by the bold way in which the columns had simply been suggested in the original, and so enlarged them to create a more conventional frame [5].

Nowadays, works that have been generally attributed to Leonardo, and exhibited in major museums and galleries, are not always universally recognized as originals. Experts' opinions are likely to change, often on the basis of new evidence, further reflection, studies, or simply a change of mind, but it is the thorough examination of a painting which can often reveal important features that are not evident in the accompanying documentation. Art-historical judgements are not a "definitive" science, but the art world still relies heavily on the opinions of experts.

The fame of the "*Mona Lisa*" also derives from the cult of its author, Leonardo, and the acclaim the painting has received from the time it was painted to the present day [6].

All the above points highlight the distinctive artistic features of this universal art work. It is for this fundamental motivation, but not the only one that, in continuing the historical, artistic and diagnostic-analytical study of the painting "*Mona Lisa with columns*" [1], it was considered appropriate to compare results with:

- investigations carried out on the "*Mona Lisa*" at the Louvre in 2004 by the "Center for Research and Restoration of the Museums of France," collected in the compendium, "*Au coeur de la Joconde-Leonard de Vinci décodé*" [2];
- historical and technical study of other works by Leonardo, carried out by the National Gallery [3];
- historical and technical studies of several copies of the "*Mona Lisa*", such as the Prado and Reynolds copies, as well as the version, known as the "*younger Mona Lisa*", the Isleworth painting [5].

As regards the study of other copies, it can be said that:

- the Prado copy was painted in Leonardo's workshop in parallel with the original [7];
- the Reynolds "*Mona Lisa*" is one of the copies that provides the most clues about what the original has lost over time, but also succeeds in demonstrating the "magic" of Leonardo's work. However, the Reynolds "*Mona Lisa*", though well executed, is unable to recreate the infinitely subtle shades of light and shadow, especially in the modelling of the face and hands [6];
- the Mona Lisa Foundation as well as many experts are inclined towards confirming the Isleworth "*Mona Lisa*" as authentic and probably executed before the version in the Louvre [5].

To conclude, the following statement by Kemp, a leading Leonardo scholar and curator of the exhibition of Leonardo's drawings at the Victoria and Albert Museum in London [6], sums up the exclusive and shared characteristics of Leonardo's genius:

*"There is something intangible and unique when you are in front of a work by Leonardo, it cannot therefore be compared, much less, replicated".*

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### Biographical notes

**Salvatore Lorusso**, former full Professor in “Chemistry of the Environment and Cultural Heritage” in the Department of Cultural Heritage at the University of Bologna (Ravenna Campus), continues his academic activities in various fields. His scientific activity continues as a member of the Scientific Committee of the project “Joint Research Laboratory for Cultural Heritage Diagnosis and Conservation”, within the Agreement of Cooperation between the University of Bologna, Italy, and Zhejiang University, China. He is the founder and Director of two book series: the first “*I beni culturali e l’ambiente*” consisting of 11 volumes (Pitagora Editrice, Bologna), and the second “*La formazione e la ricerca nel settore dei beni culturali e ambientali*” of two volumes (Mimesis Edizioni, Milano-Udine). He is also Editor-in-Chief of the historical-technical Journal “*Conservation Science in Cultural Heritage*” (Mimesis Edizioni, Milano-Udine).

He is the author of more than 400 publications in national and international scientific journals and congress proceedings, and of 22 volumes covering subjects such as commodity science and the system: artifact-environment-biota. He is a Foreign Member of the Russian Academy of Natural Sciences; the former Vice-president, he is now a Councilor of the Presidency of the *Società Italiana per il Progresso delle Scienze (SIPS* – founded in 1839); Director General of the Academy of Food and Wine Culture; member of the Scientific Committee of the network “Gardens of Babylon – Green Hub”; Emeritus Professor and Visiting Professor of the Cultural Heritage Institute of Zhejiang University (China); President of the Academic Committee of National Cultural Heritage Preservation (Cultural Relics Bureau of Zhejiang Province). His biography appears in the 2016 Marquis Edition of “Who’s Who in the World”.

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