

Chromatic values in Pablo Picasso's early work: a comparison of hues in "Science and Charity" (1897) and its three oil sketches

Marcello Picollo¹, Costanza Cucci¹, Lorenzo Stefani¹, Reyes Jiménez-Garnica², Laura Fuster-López³, Anna Vila⁴

¹ "Nello Carrara" Institute of Applied Physics of the National Research Council (IFAC-CNR), Sesto Fiorentino (FI), Italy. m.picollo@ifac.cnr.it, c.cucci@ifac.cnr.it, l.stefani@ifac.cnr.it

² Museu Picasso, Barcelona, Spain. rjimenezga@bcn.cat

³ Universitat Politècnica de Valencia, Instituto Universitario de Restauración del Patrimonio, Valencia, Spain. laufuslo@crbc.upv.es

⁴ Departament d'Arts, Conservació i Restauració. Universitat de Barcelona, Barcelona, Spain. avila@ub.edu
Corresponding author: Marcello Picollo (m.picollo@ifac.cnr.it)

ABSTRACT

This paper deals with the chromatic and colorimetric analysis of one of the most representative paintings by Pablo Picasso (1881-1973) of his formative years, "Science and Charity" (*Ciencia y Caridad*, 1897), and its three oil sketches of the Museu Picasso in Barcelona. Picasso, among the modern painters, turned from a subdued chromatism to brilliantly varied palettes in the course of his career. Measured colorimetric values obtained from reflectance spectra of relevant areas are presented and the evolution of the tones and hues used by Picasso to enhance drama through the scenes represented in the four paintings selected is discussed. This study was carried out in the framework of an inter-institutional research project aimed to gain an insight into the failure mechanisms of modern and contemporary paintings.

KEYWORDS Pablo Picasso, painting *Ciencia y Caridad*, conservators' colour perception, FORS, colorimetric measurements, hyperspectral imaging

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1. Introduction

Pablo Picasso, who since the start of his career was supported by his father José Ruiz Blasco, also a painter, obtained his first success in Barcelona where his painting "Science and Charity" (*Ciencia y Caridad*, 1897, size 197.0 cm x 249.5 cm, inv. number MPB110.046) gained recognition also in a national competition. Subsequently, the painting has been acknowledged as one of the most representative works of Picasso's formative years and it is one of his significant paintings belonging to the permanent collection of Museu Picasso in Barcelona (MPB), where it has recently been restored. This oil painting on canvas depicting a bedridden woman reveals the artist's early interest in fin-de-siècle art which was drawn to such topics as physical illness, madness, and decadence. It marks his accomplishment in academic art education in turn-of-the-twentieth-century Spain. Moreover, Picasso was one of the modern painters who in the course of his career turned from a subdued chromatism to variegated palettes of brilliant hues (Gage 2006). This paper will discuss one of his most important paintings hosted at MPB, namely, the already mentioned "Science and Charity", and three smaller oil paintings on different supports (1896-97), all of which are displayed next to the big canvas and are considered to be its preparatory sketches. These sketches reveal a different organization of the scene presented in the larger version as well as differences in the hues the artist used in portraying the same characters and objects that appear in the scene.

The present study was carried out in the framework of an inter-institutional research project (ProMeSA) whose aim was to gain knowledge of the failure mechanisms of modern and contemporary paintings that produce degradation patterns in their paint layers (Fuster-Lopez et al. 2018). Within the ProMeSA project, the study of the materials and techniques used by the artist, in particular the chromatic and colorimetric analysis of Picasso's (1881-1973) paintings at the MPB, involved several different documentation and analytical methodologies. "Colour," as Gage points out at the beginning of the introduction of his book "Color in Art", "is implicated in physics, in chemistry, in physiology and psychology, as well as in language and philosophy; yet it is visual art alone that has engaged simultaneously with most or all of these branches of knowledge and experience ..." (Gage 2006). Moreover, he continues, "colour is primarily a psychological phenomenon." Indeed, although the link between various colours as a psychological phenomenon and the way artists apply their creativity to experimenting with colour has already been explored by art historians, critics, and artists themselves (Buswell 1935, Arnheim 1974, Gombrich 1968, Gage 1999), the reflections expressed in their publications often do not stem from or

take into consideration scientific data and measurements. Hence, the present study proposes a relatively new method in gaining insight into artworks by merging the visual approach employed by professionals, such as painting conservators, who have expertise in the field, with scientific measurements of colorimetric values calculated from the reflectance spectra of the specific investigated spots (Parraman 2010, Striova et al. 2018, Dooley et al. 2014).

This study started with a visual investigation of the various colours the young Picasso used in the four paintings to stylistically structure them; subsequently, ten spots (areas with a diameter of 3 mm) were selected on the same zones of each painting to be measured by using a spectrophotometer (Figs. 1-4). The aim was to discover if there were any associations in the painted scenes – in the painting and the three oil sketches—between the measured colorimetric values, the chromatic painting balance, and the colour perception of MPB conservators so as to gain an enhanced understanding of the conditions of these artworks.



Fig. 1. Painting "Science and Charity" (MPB 110046) with the investigated spots.

2. "Science and Charity" painting and its sketches

At the end of 1896 and beginning of 1897, Picasso worked on the painting "Science and Charity" (Fig. 1). It was the most ambitious early work by the young artist (Gual and Jiménez 2010, Jiménez 2018). The choice of the topic was not unintentional; the human condition and illness had intrigued him since the death of his sister Conchita (who passed away in January 1895), but he was also fascinated by real life and social issues that he foregrounded in the scene. Indeed, with this painting, Picasso connected with

the Social Realism movement, whose popularity at the time was at its peak in all of Europe. The origin of the so-called 'hospital theme' addressed in the painting can in Spanish art be traced to 1889 when Luis Jiménez Aranda won the gold medal at the Spanish Pavilion at the Universal exhibition in Paris with his painting "The Doctor's Visit"; it was one among other artworks that depicted similar subjects.

In May 1897, this large oil painting on canvas was exhibited at the 16th Fine Arts General Exhibition in Madrid, where it was also awarded. Some months later, it was sent to Málaga to the Provincial Exposition. The painting then remained in Málaga at the house of Picasso's uncle, Salvador Ruiz. It was kept there until the uncle's death in 1918, after which it was brought back to Barcelona. Since then, this impressive canvas was hanging in the Picasso family house located in Barcelona. It was only in May 1970 that the artist decided to donate it to the MPB so that it could be integrated into its permanent collection. During the same year, the painting was treated in the conservation studio of the Museu de Barcelona at the Museu Nacional d'Art de Catalunya (MNAC) in Barcelona. The conservation work included relining the fabric and mounting it on a new stretcher, retouching the paint losses, and varnishing the painting. Since then, it has been displayed in the museum galleries. It was loaned out only in 1980, to participate in a Picasso exhibition organized at the Museum of Modern Art (MOMA) in New York.

In addition to the early conservation work, scientific analyses were performed on "Science and Charity" for the first time in 2008. These included X-ray radiography, which assessed the condition of the original fabric and contributed to the study of the artist's technique. In addition, several micro-samples were taken in order to determine the cross-section of the painting materials. The results of these scientific analysis were presented within the context of an exhibition entitled *Ciencia y caridad al descubierto* and were subsequently published in the exhibition catalogue (Gual and Jiménez 2010, Jiménez 2018). These were the first scientific studies that contributed to the understanding of the pictorial technique, while also enabling an enhanced documentation of Picasso's working process. For instance, the X-ray radiography revealed that the artist had worked in multiple sessions during which he made several modifications to the composition. In some areas of the painting, for example in the blanket covering the ailing woman, as many as seven successive colour applications were observed and, moreover, it was discovered that in most cases the subsequent paint layers had been applied only after the previous layer had completely dried.

Another significant discovery concerned the correspondences that now could be demonstrated between "Science and Charity" and other works of smaller format: six from MPB and other three belonging to other collectors. These small paintings, which until 2008 were thought to be preparatory sketches, were instead revealed to be key-documents that played an important role in the artist's creative process during the execution of "Science and Charity". They allowed not only the preparation of a chronological sequence (table 1), but also helped illustrate in a visual way the different phases of the painting process of "Science and Charity" since each of them represents a transition to the subsequent stage until the completion of the final version. Thus, together the paintings form an invaluable documentary set.

When compared to the final version, the noteworthy alterations in the smaller paintings, together with compositional changes and modifications concerning light and colour demonstrate the young artist's efforts in ameliorating the narrative realism and pictorial composition of the painting.

Artwork	Technique	Place and date	Size (cm)
MPB 110387	Charcoal on paper	Barcelona, 1896	10.5 x 27.7
MPB 70802R	Charcoal and Conté pencil on paper	Barcelona, 1896-97	28.0 x 47.5
MP 409(r) Zervós XXI, sheet 46 [10]	Brown ink, watercolor enhancements and violet ink on paper	Barcelona, 1896	16.5 x 22.2
MPB 110099	Oil on canvas	Barcelona, 1897	23.8 x 26.0
MPB 110089	Watercolor on paper	Barcelona, 1897	22.5 x 28.6
MPB 110229	Oil on panel	Barcelona, 1897, dated on the reverse March 1897	19.5 x 27.2
Zervós, VI, sheet 46 [10]	Watercolor, ink and pencil on paper	Barcelona, 1896-97	37.0 x 25.5
MPB 110214	Oil on panel	Barcelona, 1897	13.6 x 22.4
MPB 110046	Oil on canvas	Barcelona, 1897	197.0 x 249.5
Zervós, I sheet 10 [10]	Oil on canvas	Barcelona, 1897	38.0 x 48.0

Tab. 1 - Artworks in the MPB collection related to the genesis of "Science and Charity" listed chronologically (in bold the work of arts investigated in the present study).

3. Considerations about the investigated sketches

The four oil paintings belonging to MPB (MPB 110046, 099, 214, and 229, see table 1) were studied within the ProMeSA project so as to establish their different physicochemical correlations that would help to gain a

better understanding of the condition of the painting. In 2018, these four paintings were analysed by using the following spectroscopic techniques: visible (Vis) and near infrared (NIR) fibre optic reflectance spectroscopy (FORS), in the 350-2200 nm range, on different spots on the painting surfaces; reflectance hyperspectral imaging (HSI) in the 400-900 nm (VNIR) and 950-1650 nm (SWIR) ranges (HSI on the painting *Science and Charity*, MPB 110046, was acquired only in the SWIR region). Furthermore, measurements focused on the colorimetric data on 10 selected spots were also recorded by using a Konica-Minolta CM700d spectrophotometer (Konica Minolta 2008). In addition, in 2010 a set of micro-samples taken only from the painting "Science and Charity" (MPB 110046) had already been analysed by using scanning electron microscope (SEM) and Fourier transform infrared (FT-IR) techniques. In this paper, however, it was decided to report the colorimetric data only.



Fig. 2. Painting MPB 110099 with the investigated spots.

The first small painting analysed was the MPB 110099 (Fig. 2), which is a rapidly made sketch on a piece of cloth revealing certain clumsiness, which makes it probable that Picasso abandoned it, also because it does not have any resemblance to the final version.

The second preparatory oil painting MPB 110229 (Fig. 3), which the artist dated on the verso of the panel (March 1897), presents a structure that appears more similar to the final version. Here the nun, in the centre of the scene right next to the main characters, is standing close to the bed holding a cup in her right hand and a child on her left arm. In this version, the child is naked and looks younger than in the final painting. In addition, the sick woman here is not looking toward the doctor, and her right arm is placed on the bed, while the doctor is depicted holding her hand.

The main character of the composition, the doctor, is here not seen in profile but portrayed in a three-quarter view like in the final big canvas painting. However, there is still a big difference between this and the final version: here, like in the first sketches, including the watercolour (MPB 110089), the doctor's hair is white. In addition, the window is positioned on the right section of the scene.



Fig. 3. Painting MPB 110229 with the investigated spots.

This work maintains the luminosity of the previous version evident in the great brightness and palette that abounds in white, grey and ochre. The only dark colours, which persist throughout the execution process, are the black of the doctor's frock coat and dark blue of the nun's dress. In this particular oil sketch, as discovered in an image extracted at 1300 nm (IR reflectography) from the SWIR HSI data, Picasso made an attempt to seat the doctor in a rocking chair, whose skates he subsequently covered with light paint, turning the seat into a chair. This detail does not lead to Picasso's final version either because the final painting shows a rectilinear structure of the legs of the chair.

In the painting MPB 110214 (Fig. 4) the artist decided on a radical change that brought him closer to the final painting. He dressed the child in a red suit and rectified his position by placing him higher within the composition. In this way, the child is slightly separated from the mother and physically closer to the nun, who has also turned to a three-quarter position. The figure of the doctor is already resembling the physiognomy of Picasso's father, Don José. The figures in this sketch all have a certain disproportion to the general format of the board support, which seems to indicate that it is a sketch quickly prepared with the purpose of studying the chromatic and tonal effect without altering the basic composition. In this sketch, and by extension in this phase of the creative process, the palette changes completely. It seems that Picasso gradually darkened the composition, throwing shadows over the scene: he seems to have decided to cover the white sheet with a rough ochre blanket, to apply a dark

brown coat on the light grey background around the doctor, and literally to close the window by masking the white appearing in the preparatory versions with a very thin brown coat.

It seems that from this moment, the painting has obtained its final version, with the exception of the frame in the centre of the wall, which, however, appeared in the Zervos version. This fact suggests that Zervos is the last sketch Picasso worked on before completing his final version of "Science and Charity" (Zervos 2013).

4. Colorimetric data

The analytical results reveal that despite the dissimilarities in the structure and composition of the four oil paintings (including furniture, position of characters, etc.), the artist used similar painting materials (i.e. pigments) in all four versions. This knowledge facilitated the selection of ten spots on each artwork; these were the most representative hues and details apparent in the final painting. After careful consideration, it was decided to analyse the following

spots (Figs.1-4): 1) on the wall in the background in the centre of the scene; 2) the brownish window curtain/shutter; 3) the sick woman's face; 4) the doctor's face; 5) the nun's face; 6) the white bed sheet; 7) the right sleeve of the doctor's jacket; 8) the blanket or the sheet at the end of the bed; 9) the nun's dress; 10) the child's dress.

Since the child was missing from the scene of the first sketch (MPB 110099), spot n.10 was not included.

Measurements of the chromatic parameters were carried out with the spectrophotometer Konica-Minolta CM-700d model (Fig. 5). This instrument measures reflectance spectra with an acquisition step of 10 nm in the 360-740 nm range. Measurements were acquired using the geometry of diffuse lighting, angle of view of 8° with respect to the normal and exclusion of the specular component, using the 3 mm in diameter probe-head (Konica Minolta 2008). The colorimetric data reported in this work were calculated in the CIEL*a*b* 1976 colour space for the 10-Supplementary Standard Observer (1964) and daylight D65 illuminant (table 2) (Wyszecki and Stiles 1982, CIE 1982, ISO/CIE 10526 and 10527 1991).



Fig. 4. Painting MPB 110214 with the investigated spots.

	MPB 110099			MPB 110229			MPB 110214			MPB 110046		
	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
1	40.5	1.0	1.2	39.4	-0.5	11.0	42.6	-0.4	4.3	39.6	-1.6	1.7
2	51.5	3.9	14.1	53.3	4.3	24.2	32.2	4.1	3.7	29.4	5.9	5.8
3	47.6	5.0	14.6	33.3	4.1	11.2	35.6	4.3	9.8	49.8	6.2	18.5
4	51.9	5.4	9.8	30.8	1.3	10.6	29.8	1.1	2.9	39.3	7.6	10.0
5	54.1	4.1	7.6	38.7	12.0	14.6	38.5	4.2	9.5	47.7	6.5	16.0
6	51.1	0.7	9.0	37.4	7.4	18.5	36.2	4.5	7.3	57.1	2.6	11.3
7	41.2	0.1	2.0	26.0	0.6	3.2	25.1	-0.4	-0.5	26.8	-0.3	-1.4
8	48.8	0.0	4.1	45.5	1.4	10.8	42.4	5.0	15.1	40.4	4.5	14.5
9	32.8	0.2	0.3	34.5	-2.9	0.5	27.0	0.0	0.0	25.6	-0.1	-1.2
10				33.2	12.1	12.2	34.6	11.2	10.3	46.5	3.6	9.1

Tab. 2 - L*a*b* (10°/D65) colour values of the investigated areas for the four oil paintings.

	MPB 110229				MPB 110229				MPB 110214			
	L*	a*	b*	ΔC^*	ΔL^*	Δa^*	Δb^*	ΔC^*	ΔL^*	Δa^*	Δb^*	ΔC^*
1	0.9	2.6	-0.5	-0.8	-0.2	1.1	9.3	8.9	3	1.2	2.6	2.0
2	22.1	-2	8.3	6.4	23.9	-1.6	18.4	16.4	2.8	-1.8	-2.1	-2.7
3	-2.2	-1.2	-3.9	-4.1	-16.5	-2.1	-7.3	-7.7	-14.2	-1.9	-8.7	-8.8
4	12.6	-2.2	-0.2	-1.4	-8.5	-6.3	0.6	-1.9	-9.5	-6.5	-7.1	-9.5
5	6.4	-2.4	-8.4	-8.6	-9	5.5	-1.4	1.6	-9.2	-2.3	-6.5	-6.9
6	-6	-1.9	-2.3	-2.5	-19.7	4.8	7.2	8.3	-20.9	1.9	-4	-3.1
7	14.4	0.4	3.4	0.6	-0.8	0.9	4.6	1.8	-1.7	-0.1	0.9	-0.8
8	8.4	-4.5	-10.4	-11.1	5.1	-3.1	-3.7	-4.3	2	0.5	0.6	0.7
9	7.2	0.3	1.5	-0.8	8.9	-2.8	1.7	1.8	1.4	0.1	1.2	-1.1
10					-13.3	8.5	3.1	7.4	-11.9	7.6	1.2	5.5

Tab. 3 – $L^*a^*b^*$ and C^* ($10^\circ/D65$) differences of the three sketches considering the final painting (MPB 110046) as reference.

The 'atmosphere' of the scene is most strongly conveyed through the hue used to paint the walls of the room. The data obtained from the four paintings showed no noticeable discrepancies: an inhomogeneous medium-light grey hue on the main wall that is more neutral (achromatic) for the first sketch and the final paintings than the other two intermediate sketches, which instead present a bluish predominance.



Fig. 5. Acquisition of colour measurements on the Science and Charity painting, final version.

The second spot, instead, shows a strong variation in hue passing from one sketch to the others and it turns into a saturated, dark brown in the final version. It is important to note, however, that the resulted colour is more neutral in the last two paintings, with a slight red and yellow presence, than in the first two sketches where the yellow tint is more dominant (Fig. 6).

The complexion in the faces of the three adult figures varies not only between the paintings but also within each painting. This seems to confirm the hypothesis that the first three paintings were preparatory sketches in which the artist found no necessity to refine the faces. Moreover, Picasso used the colour of each character's complexion to indicate their healthy or sickly condition.

The measurements confirmed that the sheet on the bed was whitish with some chromatic dominant turned into yellow. Only in the third sketch the white results more neutral with almost the same values of both yellow and red contributions.

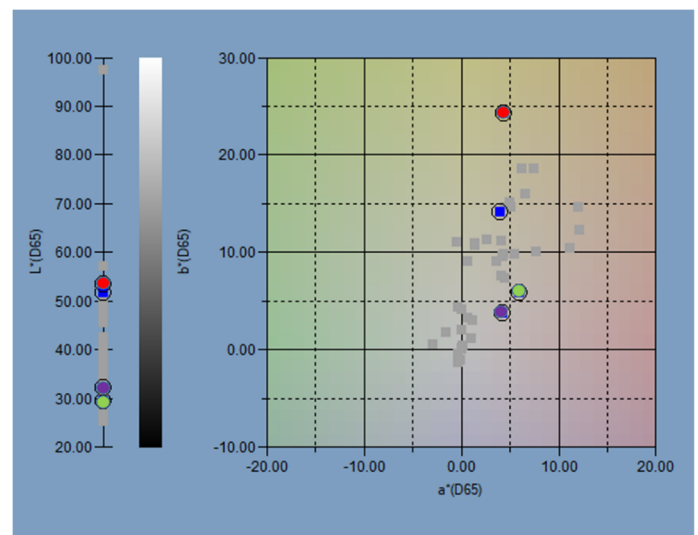


Fig. 6. $L^*a^*b^*$ ($10^\circ/D65$) colour graph of the investigated 2nd spot for the four paintings: MPB 110046 (green), MPB 110099 (blue), MPB 110214 (red), and MPB 110229 (purple).

The blanket on the bed is included in the scene only starting from the last sketch. However, the colorimetric values do not reveal any significant differences moving from the sketch to the last version, the final painting. In the first two works, the blanket blends in with the sheet, of a creamy hue, which, in the later versions, is not so different from the yellowish-brown final hue (Fig. 7).

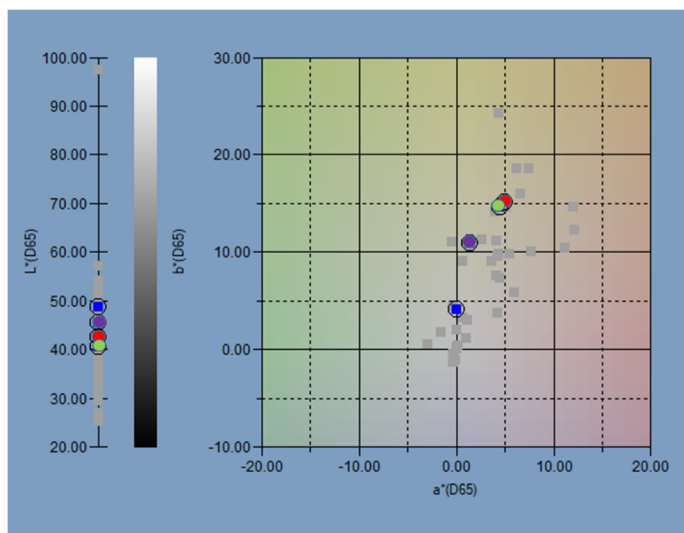


Fig. 7. $L^*a^*b^*$ ($10^\circ/D65$) colour graph of the investigated 8th spot for the four paintings: MPB 110046 (green), MPB 110099 (blue), MPB 110214 (red), and MPB 110229 (purple).

The hue of the doctor's bluish dark jacket remains more or less constant throughout the genesis of this artwork.

The nun's dress is almost black in all versions except in the second one in which it is depicted as a bluish dark tone.

The final spot, the child, appears in three different situations: the naked child, a child with orange-red cloth, and finally a child wearing a reddish-lily shirt. However, the colorimetric parameters for the first two variations of the naked and clothed child are almost identical, which is due to the similar tones of the child's complexion and his clothing. In the last version, the child's dress presents diverse colorimetric values than the first two, as expected also simply by looking at the painting.

5. Some final considerations and conclusions

The results of this research demonstrate that although the differences in colour in the four different versions of the same scene could be perceived by naked eye, the spectrophotometric colour measurements provided clear and objective information about the early palette Picasso used in introducing the emotional effects into the analysed paintings. Hence, the colorimetric values obtained from reflectance spectra of relevant areas contribute to the understanding of the evolution in the tones and hues Picasso employed to enhance the dramatic impact of the scene represented in the four paintings. From a psychological and artistic viewpoint, the natural scale of the characters in the final version of "Science and Charity" conveys a sense of veracity and transmits stronger emotional charge. However, it is through the evolution of

the chromatic elaboration that Picasso truly managed to accentuate the drama. For instance, the interplay between the clear and sombre architecture and the areas that remain in shade highlight the dramatic nature of the scene in which also the healthy characters are contrasted with the sick woman. Every small detail and larger organisation of the elements, for example the doctor's prominent presence in front of the patient's emaciated face, contribute to the pathos and imminent fate. The pallor of the patient is accentuated plastically through the comparison with the white of the sheet but also by the skilful choice of pigments. Although the artist tended to use lead whites (both pure and in the mixtures), here he decided to add zinc white to accentuate the sickness, now evident in the woman's mortuary complexion. These two different white pigments were identified by means of FORS and HSI techniques (Bacci et al. 2007).

The healthy-looking child, on the other hand, offers a positive view of the continuation of life. In one of the first versions his vulnerability is emphasised through his nakedness and the direction of his arms, as he reaches towards the sickly mother, but in the subsequent versions the drama has decreased: in the sketch MPB 110214 he is clothed, and in the final painting he not only wears a nice dress but also gathers his arms, thus remaining connected to the scene under the protection of the nun.

Throughout the painting process, the doctor is depicted as a figure of dignity; he wears a sober black frock coat that forms a contrast to the shining white collar and sleeves. In this way, Picasso had completely transformed the initial intention of presenting a certain luminosity by placing the characters in a chiaroscuro framework that accentuates the drama of the event.

This big canvas painting is remarkable in many ways; first of all, it was executed by a 15-year old artist during the formative years of his brilliant career. Moreover, although some elements in the scene do not exactly correspond to reality (i.e. the technically well-executed cornucopia decorating the wall, which is a discordant element), the greatness of the artist's achievement comes across through the painting's pictorial quality and the powerful message it conveys to its observers.

6. Conflict of interest declaration

The authors state that no actual or potential conflicts of interest exist including financial, personal or other relationships with other people or organizations within three years of beginning the submitted work that could inappropriately influence, or be perceived to influence, their work.

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9. Short biography of the author(s)

Marcello Picollo - Ph.D., is a researcher at IFAC-CNR. His interests include color measurement, Vis-NIR Hyperspectral Imaging, and spot size UV-Vis-IR spectroscopic investigations of 2D polychrome objects.

Costanza Cucci - got her Physics "Laurea" and Ph.D. in Conservation Science at the Florence University. Currently she is a researcher at IFAC-CNR. Her research focus is on spectroscopic techniques and data-processing algorithms applied to the fields of cultural heritage, environmental monitoring, and safety food controls.

Lorenzo Stefani - is a technician in telecommunications at IFAC-CNR. He is in charge of the development of hardware and software for computer-controlled instrumentation for the non-invasive and in situ study of artworks.

Reyes Jiménez-Garnica - got her degree on Conservation & Restoration at the *Universidad Complutense de Madrid, Escuela oficial de Conservación y Restauración de Bienes Culturales*. From 2002 she has been the head of the *Departamento de Conservación*

Preventiva y Restauración del Museu Picasso de Barcelona.

Laura Fuster-López - PhD in Conservation from *Univeritat Politècnica de València* (UPV). Currently she is an associate professor at UPV and research focuses on the mechanical properties of cultural materials and the environmental effects on their stability and preservation.

Anna Vila - was formed as a conservator and she has a Ph.D. in analytical chemistry. Vila has worked in the field of conservation science at The Art Institute of Chicago, the *Centre de Recherche et Restauration des Musées de France*, the Metropolitan Museum of Art and at the Center for Art Technological Studies in Conservation in Denmark. At present, she works as a conservation technician at the University of Barcelona.

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