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THE PERCEPTION OF THE CHROMATIC REINTEGRATION FROM THE ADJUSTMENT OF THE WORK CLOTHING. THE LAB COAT AND ITS COLOUR ALTERNATIVES

Beatriz Doménech (1)(2)
Vicente Guerola (1)(2)
María Castell (1)(2)
Antoni Colomina (1)(2)

(1) Universitat Politècnica de València; Camí de Vera s/n 46022 Valencia; beadomga@gmail.com, vguerola@crbc.upv.es, mcastell@crbc.upv.es, ancosu@upv.es
(2) Instituto de Restauración del Patrimonio; Camí de Vera, s/n 46022 Valencia

ABSTRACT

The present study is focused on the revision of the work clothes of the conservators-restorers, specifically in the lab coat, analysing its colour and the interference it can create regarding the perception of the colours, both of the artwork and of the chromatic palette used in reintegration.

In this way, the study begins with a review of the corpuscular theory of light. According to this theory, it is analysed the absorption-reflection process of the interaction of light with matter, as well as it is explained how the colour of the lab coat can hinder or favour the perception and adjustment of the colours in a chromatic reintegration.

This investigation is reinforced by a process of experimentation in which the light reflected by both white and black lab coats, is analysed through measurements using a lux meter. The measurements are made facing pictorial works characterized by chromatic palettes of dark colours or vivid colours, wearing a white lab coat and a black one. Afterwards, the results obtained are analysed and compared allowing to discover, in a more realistic way, the intensity of the light reflection according to the colour of the garment of the conservator-restorer.

In addition, the present study is complemented with the realization of an opinion survey to international Conservation-Restoration professionals. Through this survey, the aim is to find out whether professionals take this factor into consideration during colour reintegration, as well as their general opinion on this issue.

Keywords
Perception of the retouching; Lab coat; Chromatic reintegration; Corpuscular theory of light; Colour adjustment of the losses; Light control in retouching

1. INTRODUCTION

In recent years, professionals have pointed out, although not in a proven way, the interference generated by the colour of the restorer's laboratory gloves when carrying out chromatic reintegration. Some institutions, such as the Museo del Prado in Madrid, have incorporated the use of black gloves in order to reduce the interference from the white of latex gloves and the blue of nitrile gloves [1].

This event leads to the need to check the personal protective equipment (PPE) of the conservator-restorer. Thus, the study carried out in this research specifically examines the lab coat, its colour, and the interference it can cause in the perception of colours and, therefore, in the development and result of chromatic reintegration of the losses.

It is therefore necessary to first clarify that interferences in colour perception during reintegration work are not caused by the colour of the protective clothing, but by the way that light interacts with it. Consequently, it is important to examine the corpuscular theory of light in order to understand this phenomenon correctly[i].

1.1 Observations on the corpuscular theory of light

Defining light exactly is difficult, but it can be described as a set of electromagnetic radiations that propagates in wave-like movements [2][3][4] and which is essential to the perception of space, shape, and colour [5].

This type of radiant energy is part of the electromagnetic spectrum, which contains a wide range of different types of waves, such as ultraviolet, infrared, gamma rays, etc., each of which corresponds to an interval defined by wavelength (λ) or frequency (f).

Within this spectrum, light is located between 380-770 nanometres in wavelength, which is known as "visible light", since it is the only type of light radiation perceptible to the human eye [6][7].

Likewise, light causes different phenomena depending on how it interacts with matter: it can be scattered, transmitted, refracted, diffracted, reflected and absorbed [8]. As such, these forms of interaction have been extensively explored by many specialists before, which is why only the phenomena of light reflection and absorption have been examined in this study, since they are directly related to the hypothesis put forward concerning the interference of the colour of the lab coat in the processes of chromatic reintegration.

In this way, the property of reflection can be simply understood as the phenomenon that occurs when light strikes and reflects off the surface of objects [9][10][11]. Furthermore, this phenomenon, which is influenced by the characteristics of the surfaces, is determined by the directionality of the scattered light rays, and it is also possible to differentiate between regular, diffuse, and mixed reflections [12] [13].

Regarding to the absorption property, it refers to the ability of a surface to absorb the waves that make up the electromagnetic radiation of light [14].

Consequently, when light strikes an object, it undergoes a reflection-absorption process that is determined by the type of pigment on the surface of the object, which will absorb part of the light spectrum and reflect the rest. This reflection will correspond to the colour that makes up the material. In this way, black surfaces absorb all the light without reflecting any, while white surfaces do not absorb any radiation and reflect the entire light spectrum [15].

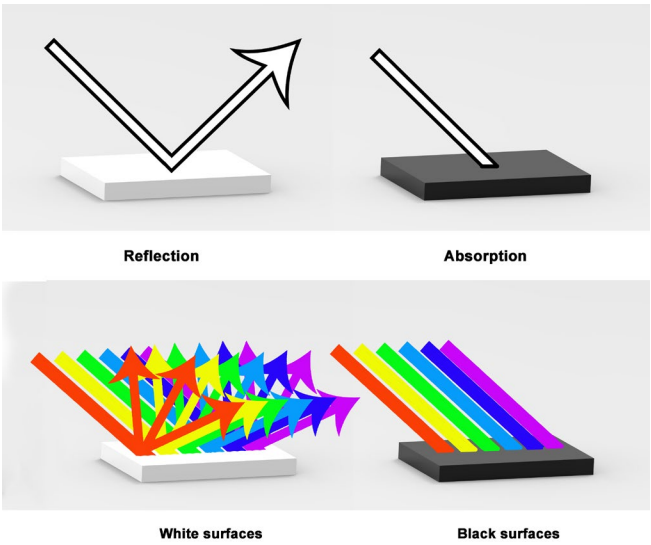


Figure 1 – Detail of the reflection-absorption process of the light on white and black surfaces respectively.

Consequently, this event explains the assumption made in this section. Depending on the pigment present in the restorer's lab coat, a greater or lesser amount of light will be reflected towards the artwork and, specifically, towards the areas with losses that need to be reintegrated, thus interfering both in the perception of the colours present in the painting itself and in those used for the chromatic reintegration. Accordingly, a white garment will reflect the entire spectrum of light and interfere more with the adjustment of the reintegration shades, while a black garment will absorb all light and reduce interference almost entirely.

2. MATERIALS AND METHODS

In order to reinforce this hypothesis, a process of experimentation was carried out in which light measurements were made of the light reflected by both a white and a black lab coat. These measurements, carried out with the PCE-222 lux meter, were taken in the easel and altarpiece painting workshop of the Instituto de Restauración del Patrimonio (IRP) of the Universitat Politècnica de València (UPV), where an average ambient illuminance of 580.6 lux was recorded. In addition, the measurements for this study were carried out on three pictorial works characterised by different colour palettes.

Figure 2 – Sequence of light measurements in front of an artwork characterized by a dark colour palette.

Figure 3 – Sequence of light measurements in front of an artwork characterized by a vivid colour palette.

Figure 4 – Sequence of light measurements in front of an artwork characterized by a chromatic palette of pastel tones.

In order to ascertain the current state of this issue, a survey of international Conservation-Restoration professionals was conducted. This survey was carried out and sent digitally using the "Google Forms®" software tool, which allows for the creation and analysis of this type of study. An anonymous questionnaire has been chosen, combining closed polytomous questions with an open-ended question that allows respondents to answer freely in order to obtain a greater wealth of detail in the answers.

The form was circulated in mid-2021 to expert groups, university professors, independent restorers, specialised forums made up exclusively of Conservation-Restoration professionals from all over the world, museums and other public and private institutions. Among the recipients contacted were specialists from the Museo del Prado in Madrid (Spain), the Museo Nacional Thyssen-Bornemisza in Madrid (Spain), the Universitat Politècnica de Valencia (Spain), the Faculty of Fine Arts of the University of Lisbon (Portugal), the Academy of Fine Arts in Zagreb (Croatia), the Academy of Art of the University of Split (Croatia), as well as the National Gallery in London (U.K.).

3. RESULTS AND DISCUSSION

In the following sections, the results obtained from both the lighting measurements carried out with the lux meter and the responses obtained from the analytical opinion survey are presented.

3.1 Lighting measurements

The development of this experimental process has begun with the recording of a total of five lighting measurements for each artwork, wearing a white and a black lab coat respectively. Subsequently, the average value of the quantities recorded was calculated:

Table 1 – Calculation of the average values of the lighting measurements

	White lab coat	Black lab coat
Painting nº1: average value	675.2 lux	514.4 lux
Painting nº2: average value	662.6 lux	534.4 lux
Painting nº3: average value	653.8 lux	579.2 lux
Total average value	**663.87 lux**	**542.67 lux**

Finally, taking as a reference the average value of ambient illuminance (580.6 lux) recorded in the easel and altarpiece painting workshop of the IRP, the calculation of the differential amount has revealed a greater amount of reflected light when using the white lab coat:

Table 2 – Calculation of the average differential values

Ambient illuminance average value	Average differential value: white lab coat	Average differential value: black lab coat
580.6 lux	**+82 lux**	**-48,2 lux**

3.2 Analytical opinion survey

The form carried out among Conservation-Restoration professionals resulted in a total of 263 responses. Before presenting the results, it should be pointed out that the recorded responses cannot be considered as absolute results, as they only represent a small percentage compared to the large number of professionals currently involved in Conservation-Restoration. For this reason, they should be interpreted as an indication of the current state of the issues raised in the questionnaire.

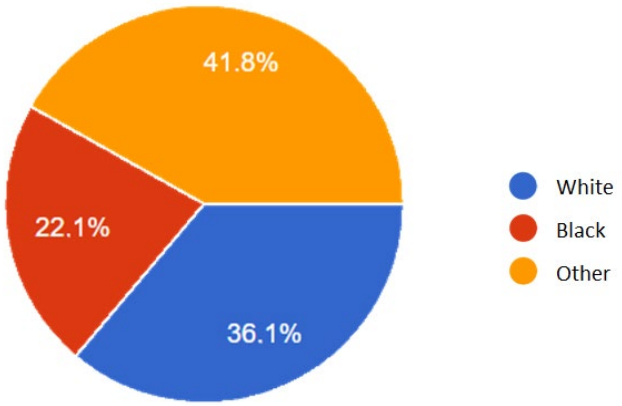
Thus, following are the questions asked in the analytical opinion survey and the corresponding results:

1) *What colour is the lab coat or clothing that you use in your work as a restorer?*

Regarding this first question of the form, the results obtained are as follows:

- 95 participants (36.1%) responded that they use a white lab coat for restoration work.
- 58 participants (22.1%) have answered that they wear a black garment in their work as a restorer
- 110 participants (41.8%) responded that they use other coloured clothing for their restoration work.

Chart 1 – Results obtained to determine the colour of the work clothes of the professionals when performing restoration tasks.



Based on the results of this consultation, it appears that black working clothes are not fully incorporated into restorers' practices. As reflected in the responses received, professionals seem to be more inclined

towards the use of the conventional white lab coat or other coloured work garments.

2) *If you marked "Other..." in the previous question, could you specify what colour? If you do not wear specific work clothing, please indicate it.*

This open-ended question allowed participants to specify the colour or type of work clothes they wear. Furthermore, along with those who answered "Other..." in the previous question, some participants who answered "white" or "black" took the opportunity to specify more extensively on the clothes they wear, as well as their opinion and other questions related to this issue. This resulted in a total of 118 open-ended responses.

Analysing all the individual replicated samples obtained, it becomes clear that a large number of professionals wear white, black, blue[ii] and grey[iii] garments. In reference to this last colour of work clothing, some respondents specifically recommended it for critical reintegration work. Added to that, there were also responses indicating that the white lab coat is only used for tasks involving the use of solvents in large quantities, for work that may be messy or for varnishing.

As well, professionals pointed out to use black and white lab coats, in some cases indistinctly and, in others, depending on the tasks to be carried out, highlighting the use of black for chromatic reintegration work. Likewise, a reply was obtained which specified the use of white lab coats when receiving the public, for reasons of "good image", while black lab coats are used for the reintegration of varnished or dark paintings, without wearing any working clothes for the rest of the restoration work.

In reference to this latter question, a large number of respondents indicated that they do not wear any specific work clothing, they simply wear their everyday clothes, which can include any kind of colour. However, some professionals have expressed that they wear everyday clothes in neutral and dark colours when they know they are going to carry out colour reintegration tasks.

Furthermore, a small number of responses indicate the use of work clothes in other less conventional colours such as light blue, natural linen, beige, olive green, dark green, brown, peach or dark red.
In addition, some of the professionals responded that they wear an apron instead of a lab coat, stating that this is more comfortable for them. In these situations, the specified colours of aprons used include black, dark grey, cream or blue denim.

On the other hand, a limited number of participants highlighted the importance of wearing black gloves, either cotton or nitrile, to reduce reflected light and its interference in the colour reintegration process. Some of them indicated that they complement them with the use of a black lab coat, while others downplay the importance of wearing specific work clothes.

Thus, some responses specified not to wear white lab coats or any light clothing during reintegration work, as they reflect light and interfere with colour adjustment, whereas others participants said that dark clothing should be worn while working with dark works as well.

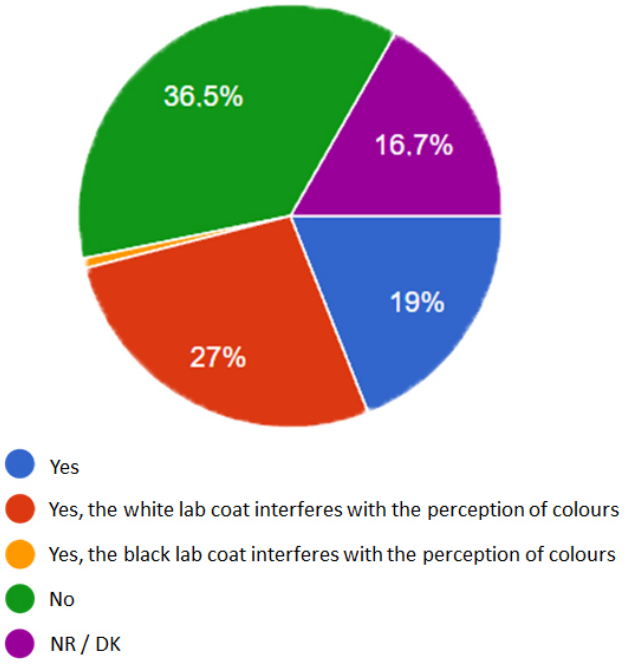
Finally, it is worth mentioning some comments obtained in which respondents specified that they do not wear any particular work clothes, but that they nevertheless think that the colour of the clothes may have an impact on the development of chromatic reintegration. Similarly, a couple of people considered lighting to be a more important issue to take into consideration.

3) *Do you think that the use of a white or black lab coat interferes the results of a chromatic reintegration?*

Based on the responses to this question, the following data was obtained:

- 50 participants (19%) believe that they do interfere.
- 71 participants (27%) think that it is the white lab coat that interferes with colour perception.
- 2 participants (0.2%) think that it is the black lab coat that interferes with colour perception.
- 96 participants (36.5%) believe that the colour of the garment does not interfere.
- 44 participants (16.7%) do not know.

Chart 2 – Results obtained to ascertain the opinion of the professionals.



Thus, the opinion of respondents is divided. The percentage of professionals who believe that the colour of the lab coat can interfere with the result of a chromatic reintegration is almost the same as those who believe the opposite. In the first case, the vast majority believe that it is the white garment that interferes and not the black one. Similarly, a large number of professionals do not know anything about this issue.

4. CONCLUSIONS

The results obtained from the lighting measurements carried out with a lux meter made it possible to demonstrate, using real data, the intensity of light reflected according to the colour of the lab coat worn by the conservator-restorer. In this way, it is shown that a white lab coat reflects a greater amount of light that encompasses the entire light spectrum, interfering with the perception of colours and, consequently, both the development and the quality of the final result of the chromatic reintegration. For this reason, the use of a black lab coat is recommended when carrying out the processes of pictorial restitution, as it reflects less light, thus reducing the possibility of receiving light interferences that could alter the quality of the final result of the chromatic reintegration.

According to the survey carried out, it has been shown that the use of the black lab coat is hardly widespread in the practice of conservator-restorers, especially in the development of reintegration tasks. White lab coats and other shades such as blue or grey seem to be more common. The white lab coat is most popular not only because it is the most commonly used by scientists in laboratories and therefore the easiest to acquire, but also because it gives an appearance of professionalism and a good image that is recognised by the general public. The survey also revealed that work aprons were frequently used as a matter of comfort. However, the use of this clothing might interfere with the development of chromatic reintegration, as the daily clothes not covered by the apron can reflect light to a greater or lesser extent.

Furthermore, the responses obtained show a clear division in the general opinion of professionals. Although the predominant criterion considers that the colour of the lab coat, either white or black, can interfere with the result of the chromatic reintegration, a high percentage of the participants think otherwise. Similarly, the large number of professionals who do not know about this subject (16.7%) stands out, showing the lack of relative studies on personal protective equipment and its interference in the results of pictorial reintegration.

In conclusion, the analytical opinion survey conducted produced very disparate results, demonstrating the lack of knowledge on this topic among professionals. Therefore, despite this first approach to the interference that the colour of the restorer's lab coat can cause in the chromatic reintegration processes, it is clear that there is a need for further studies that analyse this topic in depth, through the development of practical tests which can provide enlightening and conclusive data.

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[i] This theory refers to the way in which light interacts with matter.
[ii] Different shades of blue have been specified such as dark blue, navy blue or dark denim blue.
[iii] Different shades of grey have been specified as neutral light grey, neutral grey, medium grey, grey and dark grey.