Color Culture and Science
Cultura e Scienza del Colore

PEER REVIEW PROCESS

All articles submitted to the "Color Culture and Science Journal" are peer-reviewed according to the following procedure:

First review level
The Associate Editors evaluate each article in order to determine if the topic and content are of interest to the journal. Once the article passes the initial review, the Associate Editors select several reviewers from the Editorial Board based on their expertise in a particular subject area or topic.

Second review level
Each article is reviewed by two or three reviewers and submitted to a blind peer review process where the reviewers are kept anonymous. Reviewers are asked to evaluate the manuscript based on the following criteria:
− Originality
− Relevance to journal's aims and scope
− Technical merit and/or validity
− Soundness of methodology
− Completeness of the reported work
− Conclusions supported by the data
− Correct acknowledgment of the work of others through reference
− Effectiveness of the manuscript (organization and writing)
− Clarity of tables, graphs, and illustrations
− Importance to color researchers
− Relevance to color practices

If the article is accepted with major revisions, the author(s) are asked to improve the article according to the suggestions of the reviewers. The revised article will then be submitted to a further review.
After collecting the reviewers' reports, the Associate Editors make a recommendation on the acceptability of the article to the Editor-in-Chief.

TOPICS
The CCSJ accept papers on a wide range of topics on color, including and not limited to the following:

1. Color and Measurement/Instrumentation. Colorimetry, photometry and color atlas: method, theory and instrumentation; quality control and food coloring, dyes, organic and sustainable color.
2. Color and Digital. Reproduction, management, digital color correction, image processing, graphics, photography, film and video production, printmaking and 3D print, artificial vision, virtual reality, multispectral imaging, data visualization. Light field imaging. Multi-sensor fusion. Color localization, recognition, HDR imaging, ADAS systems.
3. Color and Lighting. Metamerism, color rendering, adaptation, color constancy, appearance, illusions, color memory and perception, color in extra-atmospheric environments, lighting design, lighting technologies, visual comfort.
4. Color and Physiology. Mechanisms of vision in their experimental and theoretical aspects, color vision and color appearance, deficiencies, abnormalities, clinical and biological aspects, synesthesia, health, well-being.
5. Color and Psychology. Phenomenology of colors, color harmonies, color & form, perceptive, emotional, aesthetic and diagnostic aspects.
6. Color and Production. Food and beverages, agriculture, textiles, plastic materials, ceramics, paints, gemology, color in the food industry.
7. Color and Restoration. Archaeometry, painting materials, diagnostics and techniques of conservation, restoration and enhancement of cultural heritage.
8. Color and Environment. Representation and drawing, urban planning, project of color, architecture, interior design, landscapes & horticulture, color and architectural syntax, territorial identities, biodiversity.
9. Color and Design. Furniture, CMF design, fashion, textiles, textures, cosmetics, food design, museography.
10. Color and Culture. Arts and crafts, history, philosophy, aesthetics, ethno-anthropology, graffiti, geology, sociology, lexicology, semantics, anthropology of vision, food culture and heritage, color naming.
11. Color and Education. Pedagogy, didactics of color, aesthetic education, artistic education.
12. Color and Communication/Marketing. Graphics, communication, packaging, lettering, exposure, advertising.

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Editorial

Color and pandemic

When Maurizio Rossi asked me to write the editorial of the first 2021 issue, the first thought has been about pandemic. This difficult and strange situation has deeply influenced us all. Scaring us, tickling our rebel side, but also in some cases forcing a little bit of meditation. Let me humbly share with you some concise questions and thoughts about color and pandemic. Please bear with me if they seem out of topic. They aim to be just stimuli to start hopefully broader discussions, color enthusiast is a wide community, I truly hope to see it enlarging even more.

Color after pandemic

What will remain in the field of color after this pandemic? Color share with coronavirus the fact that they both need a human to exist. But while the virus is a menace for the host, color is a powerful resource. We all know that color is in the eye of the beholder (more correctly in his/her brain), but we easily forget this fact, treating color as an objective property, external from our visual system. But it is not. Thus, let's put back human at the center of our research on color. A well-designed visual experiment worths thousand formulas.

Color for pandemic

Beside the color we sense and perceive, color has a strong effect on our body and mind. It is not just a property of what we see, it affects our mental and physical health. The many self-made theories about color need scientific research to assess them. Pandemic underlined our weakness; color can support our future strenght.

The pandemic of color

Color research has been fostered for many years by the industries of lighting first, then by the digital printing and recently by the display community. At every step the related business model changed, much faster than major part of scholar's approach. The interest about color is always present, what is changing is the way research is shared and spread and the way industries use it and depends (or not) on it.

In a global marked of research and production, standards and rules are less and less shared and maybe necessary. This can be seen as a positive fact since our knowledge about vision and color is still very limited. We are going to face new challenges about education and knowledge sharing and pandemic has been a test bed. Pandemic is a nightmare that we can't wait to consider history, but we need to keep what we have learned from it.

So what?

A journal is the overall sum of its contributors. If these points raised any comments or further questions, better if controversial, please share with us. They will be the topic of future editorials. Hopefully out of this pandemic

March, 2021
Alessandro Rizzi
Deputy Editor CCSJ
Full professor of Colorimetry and Multimedia
Università degli Studi di Milano

Color and/is narration. The narrative role of color in Wes Anderson's filmic images

Greta Attademo[1]

[1] Department of Architecture, University of Naples Federico II, Naples, Italy. greta.attademo@unina.it

Corresponding author: Greta Attademo (greta.attademo@unina.it)

ABSTRACT

American Director Wes Anderson's films are an interesting case study on the use of representation and visual language as elements capable of implementing the narrative underlying the film plot. His films, in fact, are constructed according to a logic similar to that of architectural representations. The combination of geometries, perspectives, textures and colors generates a code of signs capable of mediating between the intelligible and the sensitive, between the idea and the image. In particular, chromatic aesthetics constitutes a carefully curated component in the image sequences. The balanced and perfect color compositions, however much they may seem a decorative whim, represent a clever narrative device that, designed according to logical patterns, is able to embody symbolic and communicative values. This research, therefore, aims to investigate the language of color in Anderson's films, with the aim of analyzing its narrative potential. The color is investigated both as a narrative content of the filmic atmosphere and as a narrative container of emotions and symbols. The double register of analysis used for Anderson's films can become a trace of a general methodology of analysis, applicable not only to the works of other directors, but also to other forms of visual narration.

1. Introduction

The visual representation constitutes a communicative tool that accompanies the history of man since his birth, as clearly demonstrated by the examples of wall painting found in the *Lascaux* Caves, dating back to the Paleolithic period. The language of images, in fact, for its characteristics of conciseness, immediacy and universality, allows the observer to understand the underlying messages only through the use of sight, the sense he has most developed and experienced. As Scott McCloud also argues, the visual code has the ability to be understood by a generic individual without he has developed a specific formal education to interpret it, unlike what happens with the writing. The latter, in order to be understood, requires him to use a special vocabulary in order to decode the symbols of its language (McCloud, 1994). The role of visual narratives - already embedded in the same root "*idein*/to see" of the words "*eidos*/idea" and "*eidolon*/image" - is a topic of great interest, especially in today's society, where the concept of information culture is parallel to that of visual culture (Manovich, 2005). In recent years, in fact, visual media have experimented and investigated the narrative potential of images, whether they are static (painting and photography) or dynamic (video games and cinema). In the latter, in particular, the relationship between representation and narration is fundamental. The visual experience, in fact, is the dominant means of communication, so much so that it can acquire perfect narrative autonomy, as demonstrated by the first silent films. The story is an essential element, because each film sequence has its corresponding one that, mounted to the others, goes to configure the overall narrative. Among the formal elements of visual language used in cinema, color is certainly one of the most effective tools, because, in addition to contributing to the determination of tones, atmospheres and rhythms of the narrative, it is endowed with great psychological power, able to convey messages by leveraging emotional and perceptual factors of the audience. With the aim of analyzing the narrative potential of color in cinema, the research focuses on the films of American director Wes Anderson. In his films, in fact, the color is used both as content and as a narrative container, responding to the Kandiskyan idea according to which "color is the keyboard, the eyes are the hammers, the soul is the piano with its many chords" (Kandinsky, 1996).

2. Visual storytelling in Wes Anderson's cinema. A methodology of investigation

Wes Anderson is an American director, screenwriter and film producer, who became famous for the great attention paid, in each of his films, to the definition of a precise and structured "aesthetic guideline" (Vaughn Vreeland, 2015), able to make itself immediately recognizable to the viewer. The logic through which Anderson constructs filmic images is similar to that of architectural representations. The combination of geometries and perspectives, as well as the care and attention in the composition of patterns and colors, in fact, generate a code of signs capable of mediating between the intelligible world and the sensitive one, transforming every idea into an image and every image into a story. Although the scenes are in motion, the compositional characteristics adopted by the director instill in the viewer the feeling of being in front of a painting. The camera, in fact, placed perfectly central and perpendicular to the scene, seems to move slowly along an imaginary grid of vertical and horizontal lines, thus building the story through prolonged sequence plans. When it is necessary to take a break in the montage, the camera, while changing its position, maintains its perpendicularity to the frame, giving the observer an ideal, symmetrical and perfect point of view. In particular, Anderson's style is distinguished by the role given to chromatic composition which, carefully crafted, confers an aesthetic logic to the visual compositions of each film (Seitz, 2013). The balanced and perfect color compositions, however much they may seem a decorative whim, represent a clever narrative device. The attention to the lights, to the chromatic combinations and to the calibration of the tones becomes for the director an element of support in the determination of the overall narrative atmosphere. The colors, moreover, are used in their emotional and symbolic component, with the aim of stimulating the mind of the audience, creating specific impulses and feelings necessary for the interpretation of the contents of the story. Wassily Kandinsky, theorizing about color in "Concerning the Spiritual in Art", states that it acts simultaneously on two levels: the first is physical, based on the concrete visual sensation obtained from the observation of the chromatic phenomenon; the second is psychic, in which color, once processed by the brain, defines its role on the allegorical and perceptual level (Kandinsky,1996). Starting from these considerations, it is interesting to investigate the color of Anderson's films through this double register of analysis: on the one hand, it will be investigated as a tool to support the narrative in which it is inserted; on the other hand, we will focus on its ability to trigger a series of emotional and symbolic relationships in the viewer.

3. Color and Narrative. The construction of the filmic atmosphere

In the films of Wes Anderson, color is one of the main elements in the implementation of the narrative. As set

designer Adam Stockhausen explains, color is first studied to determine a general atmosphere, common to all his films, and then modeled on the individual narrative sequences, thus defining a specific palette for each of them (Grobar, 2015) (Vaughn Vreeland, 2015). Anderson's filmic narrative is always composed of particular, undefined and enigmatic plots. The characters do not specifically belong to the categories of protagonists/antagonists, because both dark and delicate aspects of them are shown. The film genre is never well defined, having comedies with nostalgic tones and dramas with bittersweet endings. This condition of indeterminacy is also communicated through color: the chromatic choices, the brightness and the calibration of shades, in fact, contribute to the construction of a stylized aesthetic (Zettl, 2011), aimed to communicate a narrative world explicitly fictitious and deliberately artificial (Lee, 2016). At the beginning, in fact, the color palette is reduced to a few essential colors, generally pastel tints, able to introduce the unrealistic and fairy-tale atmosphere. To the succession of scenes, then, corresponds a chromatic transformation increasingly synthetic: from pastel colors, soft and dusty, we pass to defined and saturated colors that, making each frame more artificial than the previous one, emphasize the story of a theatrical and surreal universe (Bartolomei and Ippolito, 2016). In "The Grand Budapest Hotel", for example, the ethereal tones with grey dominants of the initial scenes are transformed, as the narrative continues, into strong and distinct oranges and browns, until the insertion, in the final scenes, of shades of blue and violet (Fig.1). The sensation of a dreamlike and timeless world is also reinforced by the relationship between the chromatic choices of the filmic photography and those of the costumes and sets which, combining, generate retro atmospheres characterized simultaneously by nostalgic tenderness and jovial fun. One thinks of the yellow/blue patina that permeates skies, buildings and clothes in "Moonrise Kingdom", capable of recalling old family photographs, as well as the orange/brown lens of "The Darjeeling Limited", capable of creating oriental atmospheres inhabited by vintage characters. The synchronic composition of all the colors of the representation unifies the characters to their worlds, almost as if they could only live in that particular context. Moreover, even when darker events occur, the colors are kept bright and brilliant, ensuring that the viewer always has in mind that the one observed is a representation of a fantasy (Austerlitz, 2010). The perception of unreality is also communicated through the lighting: the light, always warm and soft, brings out the particular chromatic contrasts. The position of the light sources, often frontal to the scene, does not create strong shadows even in interiors, where the lights are diffused, determining a

further flattening of the images. The color, therefore, serves to support the director's message to the audience: by explaining the artifice, in fact, Anderson makes the viewer aware that what he is observing is not a faithful reproduction of reality, but a fictitious story that is located in a different world.

Fig. 1. The transformation of color in the narrative sequences of "The Grand Budapest Hotel".

Although the general definition of chromatic features is similar in all of Anderson's movies, the color is able to diversify each of his films. According to the director, in fact, every film needs a dominant color that, combined with a specific palette, allows to identify each story as different from the others (Fig.2). It is due to this reason that only one or a few colors are used in an overwhelming manner, thus monopolizing the "projective foreground" of the viewer (Yumibe, 2012). From the beige of "Isle of Dogs" to the yellow of "Moonrise Kingdom", from the blue of "The Life Aquatic" to the orange of "Fantastic Mr. Fox", each film presents itself as a vivid memory reduced to a single color, emblematic of the microcosm it wants to narrate. The revelation of the process of emphasizing a single color is once again revealed by Stockhausen. Talking about pink, the predominant color in "The Grand Budapest Hotel", he states that if only its tones had been used, its presence would have been cancelled in the eyes of the observer. He, becoming accustomed to the uniqueness of the chromatic stimulus, would stop seeing it (Vaughn Vreeland, 2015). For this reason, the addition of shades such as yellow and blue was necessary, so as to "cut" the dominant color, making it stand out more clearly (Grobar, 2015). Many studies show that the audience has little memory of color when reflecting on digital media (Block, 2008). Anderson, therefore, decides to increase

the intensity and saturation of the main color in relation to those of secondary colors. In this way, the viewer can create an immediate association between color and film, thus transforming the chromatic signal into a factor of differentiation of the narrations (Fig.3).
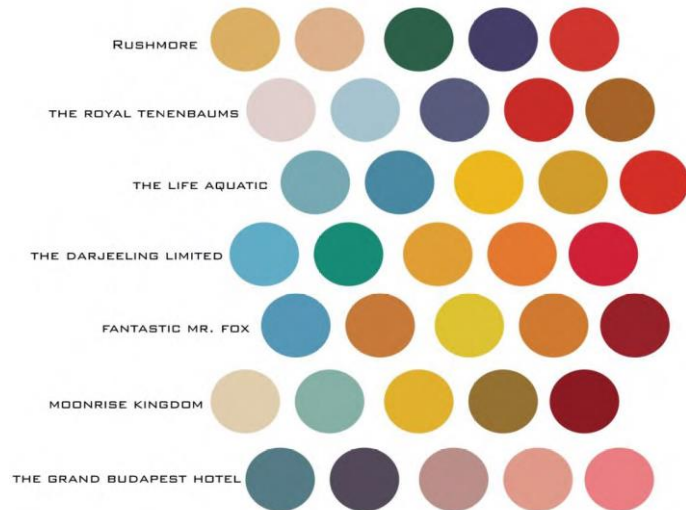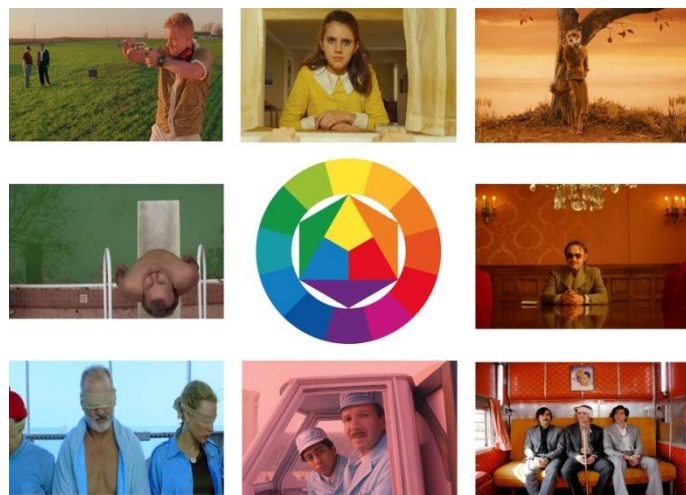

Fig. 2 Color palettes in Wes Anderson's films

Fig. 3. Dominant colors in Wes Anderson's films

4. Color is Narration. The chromatic associations between emotions and symbolism

The studies on color perception, the neurosciences and the biology all agree that color can influence certain moods or can trigger specific psychological reactions in people (Vaughn Vreeland, 2015). These perceptions that color is capable of establishing are assimilated by the human mind according to the images formed over time in the collective memory and culture. According to Yumibe, in fact, "through its sensual appeal, color can move the mind and emotions of a spectator. This understanding of

the interconnection of the senses, intellect, and emotions is also, broadly construed, synesthetic in nature" (Yumibe, 2012). Prolonged exposure to a specific color, therefore, creates reactions in the viewer, capable of connecting to specific symbols and emotions (Gegenfurtner and Sharpe, 2000). It is possible to diversify the sensations produced by combining and mixing tones (Itten, 1974). The psychological potential of color can be fundamental within film narratives, because the chromaticity of the images can itself be a story. In the works of Wes Anderson, in fact, color has become a real language through which to interpret themes and feelings of the characters and of the space they inhabit. Saturation and color mixing create different environmental perceptions and psychological impacts (Itten, 1974), while lighting and temperature establish relationships between characters and spatial contexts (Vaughn Vreeland, 2015). Anderson balances the chromatic weight in different ways with the aim of generating a sense of environmental stability or instability (Hurbis-Cherrier, 2012). In this way, he determines two types of scenes, those that are harmonious and those that are alienating. The visual result is pleasant, communicating security, calm and peace to the viewer, when the colors used in a scene are similar or close in color wheel, and the colors of the costumes and accessories of the characters blend with those of the furniture and of the architecture. On the contrary, if complementary colors are used, the contrast between the tones, becoming jarring and disturbed, causes feelings of tension and discomfort (Fig.4). The colors of the scene set in the elevator in "The Grand Budapest Hotel", for example, show a clearly caricatural situation. The saturated red of the elevator seems to incorporate the characters inside it, suggesting a feeling of tension. This feeling can be seen on the face of Madame D. who, not surprisingly, wears hat, gloves, dress and lipstick which are also of an intense red. The other characters are in contrast. The concierge and the lobby boys, in fact, wearing purple clothes, create a strident contrast with the red, emphasizing their feeling of discomfort and resignation towards the rich and impudent woman. On the contrary, the scene of the Mendl's sweet boxes is substantially monochromatic. The pastel tones of pink and light blue make the contrast less accentuated, expressing a harmonious situation of intimacy and rediscovered love, in which even the chaos of the boxes is perceived as positive and delicate. Color, moreover, becomes a symbol in Anderson's films to introduce a certain theme or emotion to the audience (Lee, 2016). The choice of specific colors and the variation of saturation scales of the tones, in fact, become emblematic in the construction of underlying meanings

Fig. 4. Comparison between contrast and chromatic harmony in "The Grand Budapest Hotel".

(Itten, 1974): the warm tones, from yellow to red-violet, symbolize humanity and life, contrasting with the cold tones, from purple to green, which are a metaphor of brutality and dehumanization. When Richie decides to commit suicide in "The Royal Tenenbaums", the director does not show the action, but he uses color to narrate the event. The thematic opposition between death and life is in fact represented by the contrast between the soft blue that occupies the entire visual scene, and the bright red of the blood that flows in the arms of the main character. In contrast, the scene is colored with warm yellows, oranges and browns when Richie himself discovers that his tormented love for Margot is reciprocated (Fig.5). The representation of color, moreover, often coincides with the emotional states of the characters, adding depth to their characterization, as happens with the pink of the young love between Zero and Agatha in "The Grand Budapest Hotel" or with the orange of the rediscovered communion between the brothers Francis, Peter and Jack in "The Darjeeling Limited". Red, for example, seems to be a color associated with male characters' desire and issues with the father figure (Vaughn Vreeland, 2015) (Fig.6). The young Max, in "Rushmore", wears a red hat in the moments in which he has the

desire to have the affection of his father Herman; Chas, in "The Royal Tenenbaums", wears a red jumpsuit since his adolescence, when he develops a conflictual relationship with his father, and his children also wear it; the vintage red car in "The Darjeeling Limited", is the only object that connects the three protagonists to the father figure, with whom they wished to have a relationship, no longer possible due to his death. Yellow, on the other hand, is often used by Anderson as a color of optimism and union (Fig.7). The sky is always tinged with yellow when the foxes are happy in "The Fantastic Mr.Fox"; the yellow submarine is the only source of joy for the protagonist of "The Life Aquatic of Steve Zissou"; the boy scouts wear yellow neckerchiefs in "Moonrise Kingdom" when they start a collective exploration.

Fig. 5. Warm tones and cool tones as symbolic and emotional expression in "The Royal Tenenbaums"

5. Conclusions

The analysis of the cinematographic images of Wes Anderson is an interesting starting point to understand how color is an integral part of filmic narration. The specific case of the films of the American director, capable of creating a symbiotic relationship between aesthetics and narrative, highlights the different communicative potential of color. Hues, saturations and tones allow to make explicit the director's intentions and ideas, differentiating the tone, rhythm and plot of each story. The different relationships between the colors, able

to generate contrasts, harmonies and different chromatic weights, stimulate instead the perceptions and feelings of the viewer in relation to the stories told. The color is investigated both as a narrative content of the filmic atmosphere and as a narrative container of emotions and symbols. The double register of analysis used for Anderson's films can become a trace of a general methodology of analysis, applicable not only to the works of other directors, but also to other forms of visual narration.

Fig. 6. The color red as an expression of the conflictual relationship with the father figure. From top to bottom: "Rushmore," "The Royal Tenenbaums"," The Darjeeling Limited"

Fig. 7. The color yellow as a metaphor for union and optimism. From top to bottom: "Fantastic Mr. Fox", "The Life Aquatic", "Moonrise Kingdom"

6. Conflict of interest declaration

The author declares that nothing affected her objectivity or independence and original work. Therefore, no conflict of interest exists.

7. Funding source declaration

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8. Short biography of the author

Greta Attademo -• Architect, Ph.D.student at the University of Naples, Department of Architecture (Diarc). Her fields of research are the relationships between the space and visual culture, and drawing in architecture and design.

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Bramante and his work of Painted Façades: Bergamo and Lombardy

Patrizia Falzone[1]

[1] Department DAD, Scuola Politecnica, Genova, Italy. pa.falzone@gmail.com

ABSTRACT

Bramante, a renowned architect of the High Renaissance, is not well known for the remarkable paintings that constitute his artistic beginning, education, and development in the wake of Piero della Francesca, of Melozzo and of Mantegna, as well as Paolo Uccello and others from the circle of Urbino. His painted architectural illusions, which create complex and articulated spaces, make him a fundamental figure in the fifteenth century in Lombardy. In fact, moving from Urbino to Milan, he brought there the renewal that was developed by the Urbino circle, which was a humanistic centre of primary importance since the mid-fifteenth century. Here "on the basis of the teachings of Piero della Francesca … and not without some knowledge of Mantegna, a school of 'perspective architects' must have been formed" – with architects, architectural designers and painters working together. In any case, the culture of Urbino and the Paduan-Mantegnesque culture are at the basis of Donato's education (Bruschi, 1985).

1. Introduction

Within the decades-long field of study of painted façades of historical architecture, and of the relationship between painted façades and architecture, the specific theme of Bramante's activity as a painter of façades is here addressed. The aim is to spread this fundamental part of his work widely and to develop it as it deserves (Falzone, 2020). This part of his production, in fact, is not very well known, when compared with his great fame as an architect. Indeed, the theme of his several façade frescoes, mostly in Lombardy, is not much dealt with, nor diffused among non-experts: perhaps because this heritage is little preserved in situ, and only partially musealized.

In this paper, in particular, the chromatic values of his two most important and remarkable façades are analyzed:

1. the façade of *Palazzo del Podestà* in Bergamo, whose detached fresco portions are preserved in the *Museo delle Storie di Bergamo*, in *Palazzo della Ragione*. The theme is that of the "ancient philosophers", which are painted between the openings. Unfortunately, the preserved parts are very incomplete.

2. the frescoes on the walls of the hall of *Casa Panigarola* in Milan, in *Piazza dei Mercanti*, now detached and preserved in the *Pinacoteca di Brera.* These are particularly interesting and meaningful since in them all the figures, which represent men-at-arms, are preserved, two in their entirety and the others from the waist up.

In addition to these two most important examples, of which the chromatic characteristics are analyzed, the features of other bramantesque façades are cited and described:

3. *Casa Angelini* in Bergamo, with a polychrome fresco on its façade and painted stories in Venetian style.

4. *Casa Bottigella* in Pavia, whose façades on the court are frescoed with Renaissance grotesques.

5. The porticoed façades on the square of Vigevano, decorated with the repeated motif of the *candelabra*.

6. The façade of *Palazzo Fontana Silvestri* in Milan, *Corso Venezia*, painted with a double order decoration in Renaissance style.

Bramante's pictorial work emerges clearly in the main Renaissance treatises of the fifteenth centuries: those of L. B. Alberti (Alberti, 1436), Francesco di Giorgio Martini, Piero della Francesca and Antonio Averlino "Filarete". While, in the sixteenth century, it is visible in that of Sebastiano Serlio (Serlio, 1537), Giacomo Barozzi da Vignola, Giovanni Paolo Lomazzo, Vincenzo Scamozzi,

Andrea Palladio and others, as well as Vasari's *Vite – Vita di D. Bramante* (Vasari, 1568).

In modern times, Andrea Bruschi is the Italian scholar of Bramante that explored the most his entire production, including his work on façades, through his several publications: (Bruschi, 1971), (Bruschi 1973) and (Bruschi, 1985).

Recently, in 2018, the conference *"Bramante a Bergamo e la città a colori"* was held in Bergamo. It was aimed at rediscovering the city, that was once all painted, and Bramante's façades in Bergamo (Ferrari, 1964). Here, instead, the overall typological, compositional, and chromatic analysis of his façades production in Lombardy is developed, through what has been preserved.

Bramante was born in Monte Asdrualdo, near Urbino, in 1444. He earned his education in the artistic environment of Urbino, at the Montefeltro Court, but he carried out his production mostly in Milan and Rome. In fact, Bramante moved from Urbino to Milan, at the court of Ludovico il Moro, between 1477-1479, where he worked from about 1479 to 1499 (Malaguzzi Valeri, 1915), (Beltrami, 1901), and then moved to Rome, where he worked from 1499 to 1514 (Longhi, 1955).

Piero della Francesca and Melozzo da Forlì's influences, as well as the acquaintance of Mantegna, emerge from the frescoes that are preserved in *Palazzo del Podestà* in Bergamo, and even more from the frescoes of *Casa Panigarola* at Milan. Here, Melozzo and Mantegna's suggestions are recognized in the layout used for the monumental figures. These are painted using a view from below, with a conception of spatial illusion that is new to the fifteenth century. The recurring chromatic values are few but intense, and show "his particular sensitivity for coloristic and atmospheric values" (Bruschi, 1985). Moreover, according to Bruschi, Bramante is also sensitive to what was already being made in Lombardy by Filarete, Michelozzo, Foppa (*Cappella Portinari* in *Sant'Eustorgio*), and Amadeo (*Cappella Colleoni*).

This pictorial heritage stands out for its distinct architectural component. In fact, the frescoes - façades and building interiors - always show the strong architectural-perspective suggestions derived from his education in Urbino.

2. The main fresco façades in Bergamo

In 1477, on behalf of *Podestà* Badoer, Bramante worked on frescoing the façade of *palazzo del Podestà*, in Bergamo. Here, he painted "melozzesque" and monumental figures of "ancient philosophers" (Bruschi, 1985). This theme was recommended by Filarete in his

1460 Treatise (Averlino, 1460), as described by Michiel in 1525: *"Li phylosophi coloriti nella fazzada sopra la piazza et li altri phylosophi de chiaro et de scuro verdi nella sala furono de man de Donato Bramante..."* (i.e. "the colorful philosophers in the façade above the square and the others philosophers painted with a green *chiaroscuro* in the hall were created by Donato Bramante") (Michiel, 1525). He uses both polychromy, in the exterior, and monochromy, in green, in the interior hall. Green, within an overall analysis, is one of the colors he uses most frequently, and it refers to one of the masters of Early Renaissance, Paolo Uccello. The latter in fact, a perspective virtuoso, frescoed the equestrian monument to Giovanni Acuto in Florence Cathedral in green monochrome; the large lunette with "flood and Stories of Noah" in the *Chiostro Verde* at *Santa Maria Novella* in 1448; the "Stories of saint monks" in the Cloister of *San Miniato al Monte* using vibrant colors, with figures in green monochrome and scenes framed by pillars (Fig.1).

Fig. 1.- The frescoes by Paolo Uccello in the upper loggia of the Cloister of San Miniato al Monte. Vasari wrote**:** *"He painted in San Miniato, in a cloister, in green umber and partly colored, the life of the Holy fathers, in which he did not observe very much the solution of using a single color, as stories should be painted, since he colored in blue the backgrounds, in red the cities, and the edifices in more colors, according to his will…". Photographs by the author.*

On the façade of *Palazzo del Podestà,* in Bergamo, Bramante celebrated Venice's supremacy painting an architectural apparatus that illusionistically unifies the smooth surface, consisting of two pre-existing medieval elements, in a single front, which becomes the background of the square (Figs. 2 and 3). In this apparatus he inserted monumental figures that evoke moral, philosophical, and cultural messages. The *architectura picta*, starting from the top, consists of a painted *loggia* bounded by a balustrade; below, between the front openings, in the architectural *sfondato*, it shows square-based niches bounded by pillars, with the gigantic figures of the Seven Sages of Greek antiquity: Solon, Epimenides, Pittacus, Periander and Chilon are the ones identified to date (Figs. 3 and 4). The thirteen fragments of the preserved gigantic decoration, discovered on the façade in 1927 and then *strappati* (i.e. detached), are nowadays placed in the *Sala delle Capriate* of *Palazzo della Ragione, Museo delle Storie* (located in the same square, *Piazza Vecchia*, as *Palazzo del Podestà*). Here, the great perspective scenography was rebuilt (Fig. 2), according to the concept of "eloquence of architecture", "considering the edifice as an entity that expresses concepts, that speaks, that communicates" (Argan 1984).

Fig. 2 – The façade of Palazzo del Podestà on Piazza Vecchia, in Bergamo. Photography by Jennifer Coffani.

Fig. 3 - Conference "Bramante a Bergamo e la città a colori" (2018). Reconstruction and video mapping of Bramante's fresco strappi on the current façade of the palace. Photography of the projection by Alessandro Bettonagli.

Fig. 4 – Starting from the top: Fragments of the Loggia Balaustrade, from which a lively polychromy can be noticed. Next to it, fragment of an architecture and of the sfondato between the openings, with the bright blue of the sky. Next to it, a fragment with an inscription. Below, the philosophers Chilon and Epimenides and, on the right, the fragment of another philosopher. Again below: fragment of a figure and fragment of an architecture. Cornice with a frieze. Fragments. Photographs by Alessandro Bettonagli.

A vivid color range, made up by few recurring colors, emerges clearly from these fragments, which are unfortunately incomplete (Fig. 4). As a first reference for the analysis, we chose the comparison with the colors of the *Norma Italiana (1991) Colorimetria. Denominazione dei colori. UNI 9810*, which defines a chromatic wheel with 24 hues, 5 levels of saturation and 7 levels of brightness.

The architectural fictions, with a strong *chiaroscuro* that emphasizes depth and the *sfondati*, are in the colors: *"Giallo aranciato brunastro"* and *"Bruno giallo aranciato"* (Hue 2 p. 5 – *GIALLO ARANCIATO*, i.e. orangey yellow).

The *loggia balaustrade* alternates small columns in a marble color, in *"Grigio giallo aranciato"* shade (Hue 2. p. 5) and, one every two, in *"Rosso forte chiaro"* shade (Hue 7 p. 10 – *ROSSO*, i.e. red), perhaps in reference to the pink marble of Verona. The green handrail, in *"Giallo verdastro forte medio"* shade (Hue 24 p. 27 - *GIALLO VERDASTRO*, i.e. greenish yellow), is in stark contrast with them.

The two preserved monumental figures of Philosophers show robes with rich draperies in bright green, even if in different hues.

In the first figure, the green robe in *"Verde forte chiaro"* shade, (Hue 22 p. 25 – *VERDE*, i.e. green), is accompanied by a red mantle in *"Aranciato rossastro forte chiaro"* shade (Hue 5 p. 8 - *ARANCIONE ROSSASTRO*, i.e. reddish orange) with bright yellow edges in *"Giallo aranciato forte chiarissimo"* shade (Hue 2 p. 5 - *GIALLO ARANCIATO*, i.e. orangey yellow).

In the second figure, the large green mantle in the shade *"Verde ciano moderato scuro"* (Hue 21 p. 24 - *VERDE CIANO*, i.e. cyan green) opens onto the tunic colored in *"Arancione forte molto chiaro"* (Hue 4 p. 7 – *ARANCIONE*, i.e. orange). The lining of the mantle is purple, in the shade *"Violetto purpureo moderato medio"* (Hue 13 p. 16 - *VIOLETTO PURPUREO*, i.e. crimson purple). The latter color is present also in the other large fragment of a figure, while blue is found in the fragment with green and red.

Therefore, we find once again green and red, complementary colors, while green is found almost in all fragments, even if in a small part. The bright blue of the sky that breaks through the wall between the openings is a *"Ciano bluastro moderato molto chiaro"* (Hue 18 p. 21 - *CIANO BLUASTRO*, i.e. bluish cyan).

The drawings of architectures in perspective for the frescoes of *Casa Angelini* façade (Fig. 5), still in Bergamo, were attributed to Bramante, too, and dated between 1480-85 (Bruschi, 1985). Besides these, also the drawings for the interiors, which depict complex architectural perspectives with a typically mantegnesque character, were attributed to him (Fig. 5). On the outside, the colors appear in a rich polychromy and more reminiscent of an extremely decorative late-gothic taste, even if within classical references. Here too, we find the bright light-blue of *sfondati* and the relevant presence of very bright red and green colors.

Fig. 5 – Casa Angelini interiors, where the projects are preserved. In the basement, the complex painted Renaissance architectures with figures. On the right, design for the façade in a lively polychromy, architectural sfondati with figures and wide landscapes. Image taken from: brochure of the Conference.

3. The main fresco façades in Milan

His main activity took place in Milan, at the court of Ludovico il Moro. Here, he still was *"ingegnerius et pinctor"* (Bruschi, 1985) and continued his activity as a painter and perspective expert. His name is mentioned for the first time in a 1481 act about a drawing for the Milanese engraver Bernardo Prevedari. The drawing depicts a temple in ruins, populated with figures. This is considered a real architectural piece, the first that is clearly influenced by his education in Urbino and by Alberti. In it, the figures show the closeness to Ferrarese painting and especially to Mantegna (Bruschi, 1971). Lomazzo attributed to him the figure of the poet Ausonius and "other colored figures" in a façade in *Piazza dei Mercanti* (Lomazzo, 1584). The frescoed decoration of a hall in *Casa Panigarola* in Milan, located in the rear part of *Piazza dei Mercanti*, is attributed to him, and dated to 1480-85 (Fig. 6). It constitutes a monumental work, fortunately largely preserved at the *Pinacoteca di Brera*.

The theme is "Men-at-arms", painted within niches, which articulate the hall in an illusionistic way. This was defined as a "fundamental work of spatial modeling, obtained through the perspectival system that breaks through the walls with semicircular niches, marked by *lesenes*, in which heroic figures of men-at-arm are inserted, along with the figures of the philosophers Heraclitus and Democritus, in the entrance overdoors" (Bruschi, 1985). These materials in particular allow us to carry out a wider and more significant chromatic and perceptive analysis, thanks to almost completely preserved *strappi* (i.e. detachments), compared to the fragments of Palazzo del Podesta in Bergamo. As far as colors are concerned, here too there is a recurring range of few fundamental colors, often complementary, declined in different hues, with a good color saturation and a strong chiaroscuro. The colors are green, yellow, red; red is often combined with green, yellow with green and red, alternated in their prevalence.

Fig. 6 – From the top: Man with a mace; Man with a broadsword; Heraclitus and Democritus; Man at arms; Man with a halberd; Man at arms; A cantor. Following, details of the previous subjects with the recurrence of colors. Photographs by the author.

In detail, in the first standing figure we can find three colors: a green mantle *"Verde giallastro debole chiaro"* (Tinta 23 p. 26 - *VERDE GIALLASTRO*, i.e. yellowish green) accompanied by dark-yellow breeches and bodice in *"Giallo aranciato brunastro forte chiaro"* (Tinta 2 p. 5 - *GIALLO ARANCIATO*, i.e. orangey yellow) and a red robe in *"rosso purpureo moderato chiaro"* shade (Tinta 8 p. 11 - *ROSSO PURPUREO*, i.e. crimson red). The second standing figure presents only two colors: the faux bronze dark yellow of the partial armor, and the red of the mantle in *"Rosso aranciato forte molto chiaro"* shade (Tinta 6 p. 9 - *ROSSO ARANCIATO*, i.e. orangey red).

On the other hand, the two philosophers, who are talking to each other, show mantles and draperies in the same hues.

The first mantle is red in *"rosso purpureo moderato chiaro"* shade (Hue 8 p. 11 - *ROSSO PURPUREO*, i.e. crimson red) and the yellow robe is a *"giallo debole chiaro"* (Hue 1 p. 4 – *GIALLO*, i.e. yellow). The other figure's drapery is in bright yellow *"Giallo aranciato moderato chiarissimo"* (Hue 2 p. 5 - *GIALLO ARANCIATO*, i.e orangey yellow), and white robe.

The four partial figures, preserved up to their bust, present the following colors: the first one shows the combination of the bright yellow of the mantle in *"Giallo aranciato moderato chiarissimo"* shade (Hue 2 p. 5 - *GIALLO ARANCIATO*, i.e. orangey yellow), which is the prevailing color, with the light green of the robe, in the same color *"Verde giallastro debole chiaro"* (Hue 23 p. 26 - *VERDE GIALLASTRO*, i.e. yellowish green) of the first standing figure.

The second figure shows the same combination of a golden-yellow mantle in the shade *"Giallo aranciato moderato chiarissimo"* (Hue 2 p. 5 - *GIALLO ARANCIATO*, i.e. orangey yellow), which is the prevailing color, with the light-green color *"Verde giallastro debole chiaro"* (Hue 23 p. 26 - *VERDE GIALLASTRO*, i.e. yellowish green) of the lapels, while the sleeves are in the same red color *"rosso purpureo moderato chiaro"* (Hue 8 p. 11 - *ROSSO PURPUREO*, i.e. crimson red) of the first standing figure.

The third one still presents the same combination, but with a prevalence of green of the wide bodice in *"Verde giallastro debole chiaro"* (Hue 23 p. 26 - *VERDE GIALLASTRO*, i.e. yellowish green) with a pinkish-red decoration in *"'rosso purpureo moderato chiaro"* shade (Hue 8 p. 11 - *ROSSO PURPUREO*, i.e. crimson red), and parts of the armor in a faux bronze dark yellow color.

Lastly, in the figure of the cantor we still find the same combination of colors, with a prevalence of the green color of the mantle, and then yellow and dark red.

All the niches are in monochrome with the architectural order in faux marble color and a light brown background, with the motif of the continuous circle running above the capitals of the pilasters.

The painted façade of *Casa Fontana*, now Silvestri, in Milan in *Corso Venezia* 10 (Fig.7), is probably from this same period, if created by Bramante (Rosa and Reggiori, 1962), (Bruschi, 1971), (Lomazzo, 1590). This façade is painted in monochrome, in very light umber, using chiaroscuro. It preserves only partially the architectural structure, colored in faux marble, formed by two vertical orders, with semi-columns on the ground floor and lesenes on the upper floor, where are painted the gigantic figures standing in front of the *lesenes*, or between the *specchiature* (i.e. wall panels), and classical friezes with tritons, *putti* and *clipei.*

Fig. 7 - The façade of Casa Fontana Silvestri in Milan, Corso Venezia. Details of the preserved frescoed part. Photographs by the author.

In Pavia, the drawing for *Palazzo Carminali, Bottigella* (at least the ground floor) in *Via Cavour*, is attributed to him. Here, the elevations on the courtyard present a lively and classical pictorial decoration, with figures in false niches in the walls and grotesque friezes.

In Vigevano, between 1492 and 1494, Bramante works with Leonardo for the great design of the square, where he still uses the fresco decoration for the exteriors of the adjacent edifices of this great urban space. Perhaps, the urban plan of the square (realized between 1492 and 1494) could be attributed to him, along with a scheme used for the painted decoration (1494) on the façades bounding it. The decoration shows the insertion of false triumphal arches, placed, as Alberti suggests, where the roads give access to the *"forum"* (Bruschi, 1971). On the three sides, the porticoed façades are punctuated by the scanning of the great monochrome painted *candelabra*, on the sides of the openings of the *piano nobile* (i.e. the main floor), that give life to a scenic continuous background, that amplifies the space of the small square through repeated motives. These *candelabra* can also be found in Milan, in the church of *Santa Maria delle Grazie*

in the tribune he built, and in the pilasters of the Renaissance portal.

4. Conclusion

As a first reference for the analysis, we chose the comparison with the colors of the *Norma Italiana (1991) Colorimetria. Denominazione dei colori. UNI 9810*, which defines a chromatic wheel with 24 hues, 5 levels of saturation and 7 levels of brightness. It should be noted, however, that in the future it is planned to carry out the survey also through the comparison with the Munsell System and the Munsell Book of Color, as well as other color charts, for a wider dissemination of data at an international level (Falzone, 2014).

From the examination of the frescoes of *Palazzo del Podestà* in Bergamo, and especially of *Casa Panigarola* in Milan, the identification of the chromatic range confirms the small number of colors, which are recurring, very vivid, and almost always complementary.

In Bergamo, in the two preserved figures, GREEN and RED prevail. The range of colors, according to the color wheel, is represented in Table 1.

Hue	Shades
Hue 2 p. 5, GIALLO ARANCIATO (orangey yellow)	'*Giallo aranciato brunastro*'; '*Bruno giallo aranciato*'; '*Giallo aranciato forte chiarissimo*'; '*Grigio giallo aranciato*'
Hue 4 p.7, ARANCIONE (orange)	'*Arancione forte molto chiaro*'.
Hue 5 p. 8, ARANCIONE ROSSASTRO (reddish orange)	'*Arancione rossastro forte chiaro*'.
Hue 7 p. 10, ROSSO (red)	'*Rosso forte chiaro*'.
Hue 12 p. 15, VIOLETTO PURPUREO (crimson purple)	'*Violetto purpureo moderato medio*'.
Hue 18 p. 12, CIANO BLUASTRO (bluish cyan)	'*Ciano bluastro moderato molto chiaro*'
Hue 21 p. 24, VERDE CIANO (green cyan)	'*Verde ciano moderato scuro*'
Hue 22 p. 25, VERDE (green)	'*Verde forte chiaro*'
Hue 24 p. 27, GIALLO VERDASTRO (greenish yellow)	'*Giallo verdastro forte medio*'

Table 1.

In Milan too the figures show a prevalence of GREEN, YELLOW and RED. The niches are in monochrome, with the architectural order in faux marble color and the background in light brown. The range of colors according to the color wheel is shown in Table 2.

Therefore, in all the figures the prevailing colors are:

1. GREEN, in its different hues and tints (tints from 19 to 23 in the color wheel).

2. YELLOW (tints from 1 to 2)

3. ORANGE (tints from 3 to 5),

4. RED (tints from 6 to 8).

Hue	Shades
Hue 1 p. 4, GIALLO (yellow)	'*Giallo debole chiaro*'
Hue 2 p.5, GIALLO ARANCIATO (orangey yellow)	'*Giallo aranciato moderato chiarissimo*' (repeated three times); '*Giallo aranciato brunastro forte chiaro*' .
Hue 6 p. 9, ROSSO ARANCIATO (orangey red)	'*Rosso aranciato forte molto chiaro*'
Hue 8 p. 11, ROSSO PURPUREO (crimson red)	'*Rosso purpureo moderato chiaro*' (repeated four times)
Hue 23 p. 26, VERDE GIALLASTRO (yellowish green)	'*Verde giallastro debole chiaro*' (repeated four times).

Table 2.

Followed by PURPLE (tints from 11 to 13), LIGHTBLUE (tints 18 and 19), and BLUE (tints 16 and 17).

The similarities with the color range of works by coeval or immediately previous authors are emphasized: Paolo Uccello especially for the dark greens and reds, Melozzo for the bright greens and light-blues and the dark crimson-red that we also find in Piero della Francesca. Mantegna for the *"rosso aranciato moderato molto chiaro"* (i.e. "very light moderate orangey red"), the golden yellow, and green. All are authors who show a wide use of complementary colors.

5. Conflict of interests

The author declares that she has no conflicts of interest.

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8. Short biography of the author

Patrizia Falzone - • former Full Professor of Architectural Survey, DAD Department, *Scuola Politecnica*, University of GENOVA. She has carried out study and survey activities in the field of historical Architecture and in the field of study and survey (materials, colors, decorative elements) of exterior surfaces of built architecture, aimed at their knowledge for enhancement, conservation and redevelopment of buildings and spaces of the historic city.

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The selection of colors for fashion collections in relation to color theory: a case study from the analysis of Brazilian ready-to-wear

Gisela Costa Pinheiro Monteiro[1], Camila Assis Peres Silva[2]

[1] Universidade Federal Fluminense, Niterói, Brasil, giselamonteiro@id.uff.br

[2] Universidade Federal de Campina Grande, Campina Grande, Brasil. camiaps@gmail.com

Corresponding author: Gisela Monteiro (gisela.gisdesign@gmail.com)

ABSTRACT

This paper is a Brazilian case study that will demonstrate the relevance of the color chart in fashion management. In general, clothing creation companies usually select several specific colors to use in order to assist not only the creative process, but also to guide the purchase of inputs such as fabrics and trims for each collection. It is worth saying that the colored samples of these colors are organized on a sheet of paper and each one receives an identification. That said, the purpose of this paper is to analyze the way in which companies arrange colors on the chart in order to check if there is any relationship with the color theory in this process.

1. Introduction

"Fashion" is a cultural phenomenon that refers to the cyclical change of society in relation to language, manners, ideas, tastes, habits, choices and affects artifacts in general, such as furniture, cars, home appliances and decorative objects (Calanca, 2008, p. 11; Lipovetsky, 1989, p. 24). Usually, fashion is applied to all social arenas and clothing is one of the cases (Simmel, 2008). Although its meaning is not limited to clothing, in this research the word "fashion" will be used about clothing. And, more specifically, the creation of clothing items, which is one of the moments when color is of fundamental importance. After all, it is a striking feature in any piece of clothing: a yellow shirt, green pants, a white dress. That is, the pregnant color in the pieces is very noticeable to the public, but few notice the color of the sewing thread, the color of the zipper, the bias, the collar, the label. The garment is accurately designed by fashion designers at the time of creation.

In addition, it is possible to see in store windows that the pieces were designed to generate a series of combinations, such as the mathematical "combinatorial analysis". Designers plan the 'mix and match' among the pieces. In these cases, the challenge is to use the same color in fabrics and materials with different lightness, textures, trim, such as jeans and cotton T-shirt. There is a margin of acceptance due to the difference in materials, but there needs to be a balance. That is why, before starting to design a clothing collection, designers select the colors they want to use and organize them in a chart called a color chart. It will serve as a source of consultation for the team from before creation to production, considering all moments of the design process.

The experience in higher education in fashion design has shown the challenge students have to deal when applying colors in their final projects. There is still a gap between theory of color teaching and the way colors are presented in fashion trend catalogs, that designers frequently use as reference. Pantone® colors are present in the daily life of this student and young professional. In an attempt to narrow the dialogue between the use of pantone colors and a theoretical basis, we began to analyze the organization and composition of the color charts of the collections, starting with four companies that we present in this paper as case of study.

2. Color and Fashion Design: how theory is used by designers

As previously mentioned, color is relevant in the fashion world and the color chart plays a fundamental role in this environment. The color chart is a showcase that gathers samples of colors used in the collection. The selected colors will guide the creation during a project and the purchase of inputs for the manufacture of garments. It is necessary to make clear the need to describe colors accurately to avoid miscommunications. Thus, each color sample, that is, one "Small solid printed square (plated), is accompanied by a technical reference provided by a paint manufacturer" [1] (Bann, 2012, p. 193). These references are codes that will allow those involved with the project to use exactly the desired colors, even without looking at the samples.

Regarding the fashion universe, these colors reference - used to create the color charts - are usually consulted in color catalogs manufactured by Pantone®. Which is an international company recognized for selling printed and bound color guides with the purpose of allowing "designers to 'colour match' specific colours when a design enters production stage - regardless of the equipment used to produce the colour" (Design Face, 2020). Thus, there is greater control on the part of creation. It can be said that Pantone® conquered the market thanks to the style consultancy offices, which from 1965 began to establish guidelines to facilitate the production flow, reducing the insecurity of industrialists in the face of the need to periodically reinvent themselves - at each cycle. After all, a collection is nothing more than a landmark of ephemerality, as it reinforces the obsolescence of the old collection, as soon as the new one comes into force (Liger, 2012, p. 19). Which means that periodically these offices have had to develop new color combinations for their new collections.

In practice, according to Françoise Vincent-Ricard - one of the pioneers at the head of the French office *Promostyl* - the work of such offices has consisted of researching and providing companies with information on trends in the form of illustrated notebooks (1989, p. 58). The information offered in those notebooks was categorized in "style" indications about colors, shapes and materials related to the textile process for the industrial fashion chain, from spinning to retail (Rech, 2006). Promostyl, as well as the French Carlin and the Brazilian Inova Moda, provides Pantone's reference when citing the colors of the season. Since 1963, Pantone®, under the command of Lawrence Herbert, has developed color matching systems for a variety of substrates, including fabric (Design Face, 2020). From this brief explanation we aim to present the close relationship between style consultancy offices and the Pantone® Color System. Not only that, we would say that colors for fashion designers has been synonymous with Pantone.

Regarding its application in the fashion market, the company presents the Pantone® Textile Color System which is separated in two sort of color charts - the colors

references in dyed cotton (TC or TCX) and the colors references printed on paper (TP or TPX). "The suffix 'TP' stands for 'Textile Paper' and the suffix 'TC' stands for 'Textile Cotton'" (Pantone, 2020a). The addition of letter X means that the colors belong to an extended range. As well as it is a code to differentiate the most recent editions. Another suffix can be found on Pantone® Textile Color System, launched in 2015, the eco-friendly formulations which are printed on paper is represented by TPG, which stands for Textile Paper Green (Pantone, 2015).

Finally, we understand that Pantone® is a reference widely used in the field of fashion design due to its presence throughout the 'design process' (Design Council, 2020). Since from the discovery phase (insight into the problem), when designers consult trend books developed by companies such as Carlin, until the deliver phase (the solution that work) once that Pantone® Color Guides are easily available both digitally and physically in the hands of the professionals of supply chain. What, therefore, enables communication between creation and a product? From this, we can infer that the relationship of designers with the theory of cuts tends to be influenced by the nomenclatures and organization of colors that this company uses.

3. Pantone textile system notation: the theory unknown or neglected by designers

Pantone textile system notation is based on a cylindrical solid and consists of a code of three pairs of digits. The first two digits of the Pantone code show the lightness (value) of the sample on a scale ranging from 10 (lightest, 90% to 100% reflectance) to 19 (darkest, 0% to 10% reflectance). The second pair of digits shows the hue of the sample and it consists of the section of the cylinder - a tone circle. This tone circle is divided into 64 sectors, starting with 01 for yellowish green, and ending in 64 for greenish yellow. The third pair shows the sample chroma on a scale from 00 for gray to 64, the maximum saturation assumed (Fig. 1). This system for color numbering, although not explicit on the company's website[2], demonstrates its relationship to the theoretical foundation considering the three attributes of color as in the Munsell System (Régula, 2004; Araújo, 1991).

In which concerns to color samples presentation in Pantone Color Guide, there is no explanation in the company website about the criteria used to organize them. So as to take the discussion to the field of theory of colors, we suggest that Pantone has been mainly organizing its colors by considering the attributes of Hue and Value.
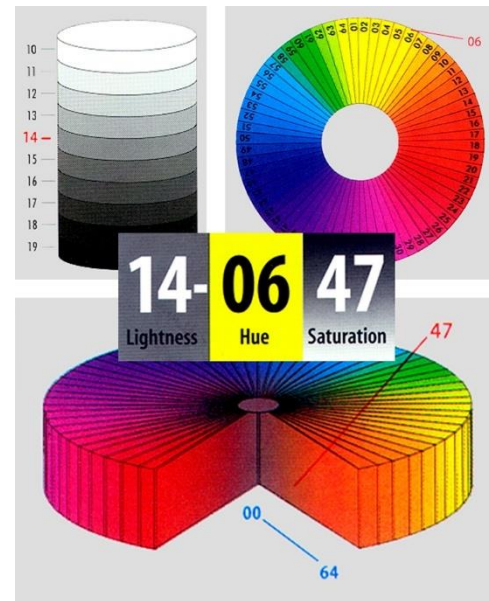

Fig. 1. Pantone textile system notation (Hirschler, 2002 apud Régula, 2004).

Differently from Munsell Book of Color, in which each sheet (page) has two axes of coordinates (vertical for value and horizontal for chroma), Pantone presents in each sheet its colors in one single vertical axis (Fig. 2). Each one of these sheets presents one Hue which varies in Value and Chroma. Despite of that, it is not easy to identify the variation of Chroma. The perception of lightness is more obvious. Even though there is no logical precision in the ordering of color attributes, Pantone Color Guide allows the user a wide view of all hues when opening the book in the form of a 'quarter circle'. As we can see in the following figures.

Fig. 2. Pantone Color Guide and The Munsell Book of Color (Pantone, 2020).

4. Design process: how fashion designers use color

The knowledge of colors has wide influence on design process. Not only the selection of color samples, but not only that, the knowledge of its attributes, its semantic aspects and the possibility of chromatic combinations are of great relevance in this process. Considering the four phases of the design process based on the double

diamond (Design Council, 2020), we can identify the role of color in each one of them.

The designer starts his process with the trend research (*1. discover*), where the color references will be analyzed especially under the meaning aspect. In the next phase (*2. define*), from the elaboration of a semantic panel to conceptualize the collection, the designer will extract the colors to assemble the charts. It is important to register the color codes and search for equivalences in the Pantone catalog that serves as a reference to facilitate communication between designers and suppliers. In the third phase (*3. develop*), the designers elaborate the collection and at that moment two questions are important. The first question is the search for color equivalence among the different materials used in garment (which evolves color applied to fabrics, metals, plastic, etc.) to maintain an acceptable harmony. The second question is how designers will organize the colors in terms of color balance (analogous and complementary, for example), contrast (hue, value and chroma) and in terms of chromatic proportion. All this care with the use of colors is due to the possibilities of interaction inherent to them, as postulated by Albers. And that will consequently affect the visual perception of the target audience. Finally, in the fourth phase (*4. delivery*), the designer must provide the solution that works. That it is, regarding the use of colors, what is feasible to make - the colors that best applies to the various items of garment. Keeping in mind the need evaluates the selection of pigments to minimize the possibilities of metamerism. As well as providing a technical sheet with

the largest possible number of equivalent references. In the case of fashion designers, it is common to specify Pantone. This reference serves as base to compare with other color catalogs of supply chain.

5. Case of study: Brazilian color charts

5.1. *Methods and materials*

To carry out a case study of the trendy color chart, we selected color charts from the same year and the same season (winter) of four similar companies were analyzed. It was done based in the fact that: 1) they are companies located in the state of Rio de Janeiro, Brazil (in which place the research were taken); 2) hire fashion designers on their staff; and 3) serve the young female audience. In order to facilitate observation and maintain the confidentiality of companies, the collected cards were redesigned, however, maintaining the same order and number of colors per line with their respective references (color name and color catalog reference), exactly as the original ones. In this paper we will refer to these companies as Brand 1 (B1), Brand 2 (B2), Brand 3 (B3) and Brand 4 (B4). We present next a miniature version of these color charts indicating the numbers of each color used by each Brand. These numbers preceded by hashtag are also used in the analysis boards present further. The aim is allowing an analysis of these color organization in each Brand's color charts. Note that B1 and B2 (Fig. 3) presents one single group of colors meanwhile B3 and B4 (Fig. 4) presents more than 1 group of combinations in which some colors are repeated.

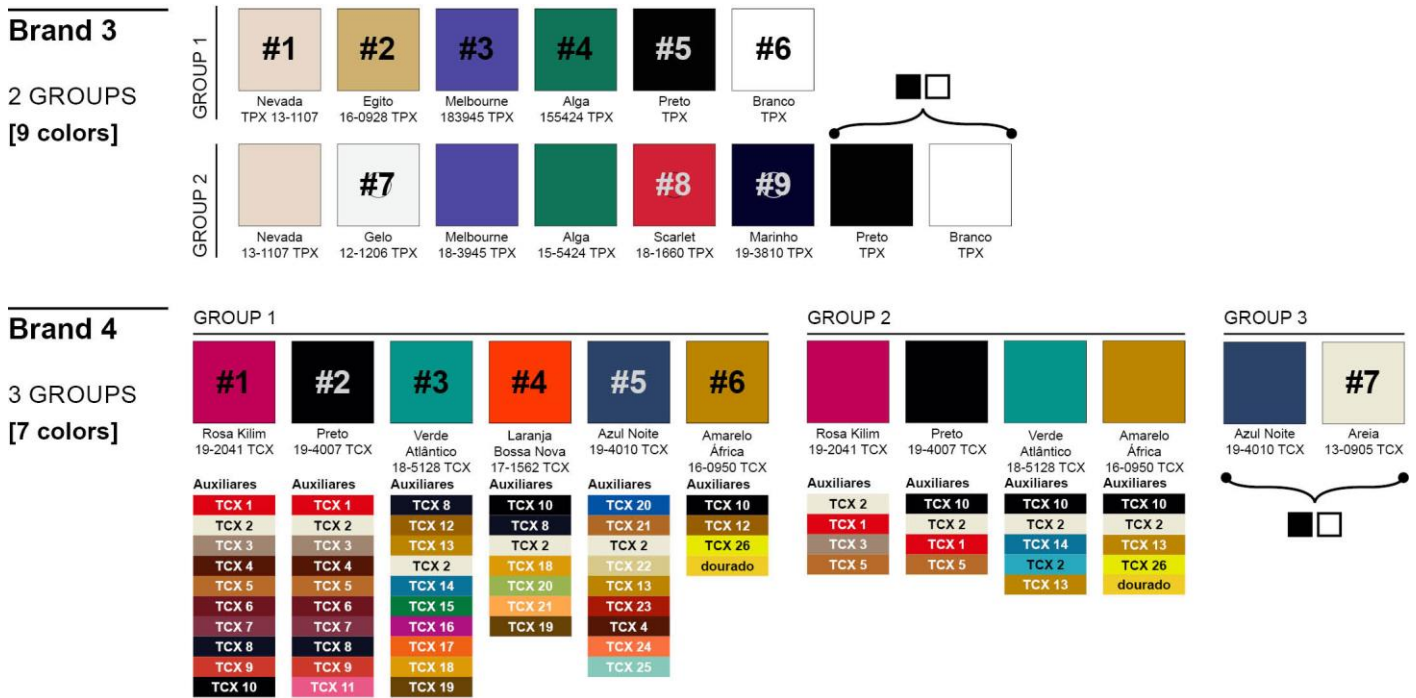*Fig. 3. Miniature version of color charts from Brand 1 and Brand 2.*

Fig. 4. Miniature version of color charts from Brand 3 and Brand 4.

It is worth mentioning that all companies use the Pantone textile reference. Brands 1, 2 and 3 use Pantone TPX on their cards and Brand 4 uses TCX. Such references were used to assist the authors in reorganizing the color charts of each one of the brands into Analysis Boards. The elaboration of such boards aims to allow an analysis of how Brands take advantages color attributes variations - hue and value. In these analysis boards, different from how companies present in their color charts, we order colors by these two attributes.

As Pantone itself does, such brands selected for this research also name their colors, as it is easier to identify than to call them by code. These names, which we will refer to here as trade names, are somehow related to the vocabulary of the target audience and to the concepts that the brand wants to communicate. We can notice three forms of nomenclature in the color charts: (1) hue name; (2) hue name + commercial name; and (3) commercial name. In this analysis we are also interested in highlighting which names are related to each of the colors. To do this we will keep the original names and translate them into English when necessary.

5.2 *Analysis and discussions*

When carefully analyzing the organization of colors in the charts developed by the brands studied in this paper, we observe a logic of visual organization by value (lightness) and/or hues in B1, B2 and B3. However, we chose to do a more detailed analysis considering that the first pair of digits correspond to Value, and the second pair of digits correspond to Hue. By checking the Analysis Board 1

(Fig. 5), we can observe that all the brands use light, mid and dark tones. Looking to the # color numbers, we can see that, excepted by B1, there is no logical sequence when considering lightness assortment. The same thing happens when we observe the Analysis Board 2 (Fig. 6), there is no logical sequence when considering hue assortment.

Concerning to color naming, we can notice that B3 and B4 have four colors with the same codes, but with different names. This is proof that each brand names its color according to its collection. There also the use of the same name (sand) for light tone colors (B1 and B4). In general, considering that the color references used by the designers of the four brands analyzed come from the same source, from the major trend companies, it is admissible that such colors are similar if not the same. In this case, the names of the colors play an important role in the conceptualization of the collection. These names bring an atmosphere that can relate to varied stories. Creating them is one of the possible storytelling techniques, a resource that the designer can use to convey the desired atmosphere (Lidwell, Holden, Butler, 2003, p. 230). For example, the colors of B4 are: Sand; Yellow Africa; Night Blue; Orange Bossa Nova; Atlantic Green; Kilim pink; and Black. We could deduce that the theme presented is Brazilian culture with the influence of Africa. Making the person feels like being in a mystery night to the sound of Bossa Nova on the sands of an Atlantic Ocean beach. This just to illustrate how colors and names can be related to contribute in the creative process and marketing strategies.

Value/Lightness (11-19)

11 - TPX (next to white) ▭▭▭ 19 -TPX (next to black)
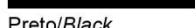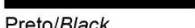
	Brand 1 [16 colors]	Brand 2 [23 colors]	Brand 3 [9 colors]	Brand 4 [7 colors]
		# 19 Branco/*White*	# 6 Branco/*White*	
11 - 13 Light tones	# 2 11-0105 TPX (Areia/*Sand*)	# 18 11-0107 TPX (Creme/*Cream*)		
	# 1 12-0915 TPX (Blush)	# 13 12-0521 TPX (Pistache)		
	# 10 13-5313 TPX (Sky)	# 12 12-0825 TPX (Amarelo/*Yellow*)		
		# 20 12-1206 TPX (Cinza/*Grey*) # 17 13-1107 TPX (Nude)	# 7 12-1206 TPX (Gelo/*Ice*) # 1 13-1107 TPX (Nevada)	# 7 13-0905TCX (Areia/*Sand*)
14 - 17 Mid-tones	# 5 14-1050 TPX (Mel/*Honey*) # 3 15-1225 TPX (Camurça/*Suede*) # 4 16-1439 TPX (Terra/*Land*) # 6 17-1461 TPX (Bourbon) # 7 17-1663 TPX (Chili) # 11 17-5034 TPX (Jade)	# 15 14-5714 TPX (Verde Piscina/*Green Pool*) # 10 15-1132 TPX (Cáqui/*Persimmon Fruit*) # 21 16-0000 TPX (Cinza Mescla/ Grey Mix) # 11 16-1364 TPX (Laranja/*Orange*) # 6 17-1656 TPX (Coral)	# 4 15-5424 TPX (Alga/*Seaweed*) # 2 16-0928 TPX (Egito/*Egypt*)	# 6 16-0950 TCX (Amarelo África/ *Yellow Africa*) # 4 17-1562 TCX (Laranja Bossa Nova/ *Orange Bossa Nova*)
18- 19 Dark tones	# 15 18-0316 TPX (Oliva/*Olive*) # 8 19-1934TPX (Wine) # 9 19-2045TPX (Berry) # 13 19-3830TPX (Eclipse) # 16 19-3900TPX (Rock) # 14 19-3919TPX (Indigo) # 12 19-3951TPX (Blues)	# 5 18-1660 TPX (Vermelho/*Red*) # 7 18-2436 TPX (Rosa/*Pink*) # 8 18-3027 TPX (Uva/*Grape*) # 2 18-3945 TPX (Azul/*Blue*) # 16 18-4728 TPX (Verde Alga/Green Seaweed) # 14 18-5425 TPX (Verde Esmeralda/ *Emerald Green*) # 22 18-5203 TPX (Grafite/*Graphite*) # 9 19-3536 TPX (Roxo/*Purple*) # 4 19-3810 TPX (Azul Noturno/ *Nocturnal Blue*) # 1 19-3952 TPX (Azul Royal/ Royal Blue) # 3 19-4507 TPX (Azul Marinho/ Marine Blue)	# 8 18-1660 TPX (Scarlet) # 3 18-3945 TPX (Melbourne) # 9 19-3810 TPX (Marinho/*Marine*)	# 3 18-5128 TCX (Verde Atlântico/ Atlantic Green) # 1 19-2041 TCX (Rosa Kilim/Pink Kilim) # 2 19-4007 TCX (Preto/*Black*) # 5 19-4010 TCX (Azul Noite/ Night Blue)
		# 23 Preto/*Black*	# 5 Preto/*Black*	

Fig. 5. Detailed analysis by Value.

Hue (1-64)   _ _ - 01 _ _ TPX (yellow greenish)   _ _ - 64 _ _ TPX (green yellowish)

	Brand 1 [16 colors]	Brand 2 [23 colors]	Brand 3 [9 colors]	Brand 4 [7 colors]
01 - 08 **Yellow greenish to** **Yellowish colors**	# 2 11-0105 TPX (Areia/*Sand*) # 15 18-0316 TPX (Oliva/*Olive*)	# 21 16-0000 TPX (Cinza Mescla/ Grey Mix) # 18 11-0107 TPX (Creme/*Cream*) # 13 12-0521 TPX (Pistache) # 12 12-0825 TPX (Amarelo/*Yellow*)		
14 - 17 **Orange colors**	# 1 12-0915 TPX (Blush) # 5 14-1050 TPX (Mel/*Honey*) # 3 15-1225 TPX (Camurça/*Suede*) # 4 16-1439 TPX (Terra/*Land*) # 6 17-1461 TPX (Bourbon)	# 17 13-1107 TPX (Nude) # 10 15-1132 TPX (Cáqui/*Persimmon Fruit*) # 20 12-1206 TPX (Cinza/*Grey*) # 11 16-1364 TPX (Laranja/*Orange*)	# 2 16-0928 TPX (Egito/*Egypt*) # 1 13-1107 TPX (Nevada) # 7 12-1206 TPX (Gelo/*Ice*)	# 7 13-0905TCX (Areia/*Sand*) # 6 16-0950 TCX (Amarelo África/ *Yellow Africa*) # 4 17-1562 TCX (Laranja Bossa Nova/ *Orange Bossa Nova*)
18- 19 **Reddish colors**	# 7 17-1663 TPX (Chili) # 8 19-1934TPX (Wine) # 9 19-2045TPX (Berry)	# 6 17-1656 TPX (Coral) # 5 18-1660 TPX (Vermelho/*Red*)	# 8 18-1660 TPX (Scarlet)	# 1 19-2041 TCX (Rosa Kilim/Pink Kilim)
24 - 43 **Pinkish to lilaceous**	# 13 19-3830TPX (Eclipse) # 16 19-3900TPX (Rock) # 14 19-3919TPX (Indigo) # 12 19-3951TPX (Blues)	# 7 18-2436 TPX (Rosa/*Pink*) # 8 18-3027 TPX (Uva/*Grape*) # 9 19-3536 TPX (Roxo/*Purple*) # 4 19-3810 TPX (Azul Noturno/ *Nocturnal Blue*) # 2 18-3945 TPX (Azul/*Blue*) # 1 19-3952 TPX (Azul Royal/ Royal Blue) # 3 19-4507 TPX (Azul Marinho/ Marine Blue)	# 9 19-3810 TPX (Marinho/*Marine*) # 3 18-3945 TPX (Melbourne)	# 2 19-4007 TCX (Preto/*Black*) # 5 19-4010 TCX (Azul Noite/ Night Blue)
44 - 57 **Bluish to greenish** **colors**	# 11 17-5034 TPX (Jade) # 10 13-5313 TPX (Sky)	# 16 18-4728 TPX (Verde Alga/Green Seaweed) # 21 18-5203 TPX (Grafite/*Graphite*) # 14 18-5425 TPX (Verde Esmeralda/ *Emerald Green*) # 15 14-5714 TPX (Verde Piscina/*Green Pool*)	# 4 15-5424 TPX (Alga/*Seaweed*)	# 3 18-5128 TCX (Verde Atlântico/ Atlantic Green)
		# 19 Branco/*White* # 23 Preto/*Black*	# 6 Branco/*White* # 5 Preto/*Black*	

Fig. 6. Detailed analysis by Hue.

6. Conclusion

Results shown us three important things concerning to: color naming, color organization and color harmonies. Regarding the identification of colors on the charts, in addition to the Pantone code, a commercial name is used. It usually comes preceded by the name of the color plus its characteristic, such as "pink kilim", referring to the shade of pink commonly used in Indian tapestry. Alternatively, the name used alludes to a known color, such as "Scarlet" which refers to scarlet red. In this analysis, we could observe the repetition of the same color in different cards only with the change of the commercial name. As for the organization, we identified that three of the four companies organize colors according to the hue (following the sequence of colors in the spectrum) and the fourth organize them by the color harmonies. Finally, as for the color combinations, we could find that companies would better take advantage of it if they had considered dimensions of color such as hue, value and chroma. Based on what we presented in this paper, we argue that its contribution to the field of color study is to verify how color is used in professional practice. Moreover, we aim to collaborate with the teaching of color so that designers can consciously apply color theory in their projects.

7. Conflict of interest declaration

The authors declare that there is no conflict of interest regarding the publication of this paper.

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10. Short biography of the author(s)

Gisela Costa Pinheiro Monteiro - Design Professor at Universidade Federal Fluminense. Doctor of Science (UERJ), master in Design (UERJ) and bachelor in Industrial Design (UERJ). Conducts research and teaches in the areas of design, color, visual perception, user-centered design, history and design theories.

Camila Assis Peres Silva - Design Professor at Universidade Federal de Campina Grande. Doctor of Science (USP), master in Design (UERJ) and bachelor in Industrial Design (UFRJ). Specialist in Marketing and E-learning (UFF). Conducts research and teaches in the areas of packaging design, color, visual perception, user-centered design, usability, history and design theories.

Notes

[1] Originally from portuguese: "pequeno quadrado impresso sólido (chapado), é acompanhada por uma referência técnica fornecida por um fabricante de tintas".

[2] During the conduct of this research between the years 2015 and 2018, we could find in the Pantone Help Center the explanation about the relationship between its numbering and the parameters of hue, value and chroma.

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Color in architecture among futurism, neoplasticism, rationalism (and more...)

Anna Marotta

Department of Architecture and Design, Politecnico di Torino, Torino, Italy. nannarella.marotta@gmail.com

ABSTRACT

In the first decades of the Twentieth century, the relationships between the culture of color and all forms of creativity were intense. In general - between Futurism and Rationalism - if chromatic theories, trends and "fashions" are clearly recognizable in sectors such as graphic and painting, these are less evident in the complex of architecture. The Futurists immediately appeared open to international contacts: Prampolini, in the area of French Purism; Marinetti, close to Karel Teige and the new Czechoslovakian researches; Paladini to the Russian Imaginism, while Carmelich is the trait d'union with the Yugoslav constructivist area. In all cases, the roots of Bauhaus appear central, even with the fertile role of generator for chromatic theories (Matotta, 1999), with Itten, Klee, Kandinsky, Hinnerk Sheper, Albers (fig. 1), but van Doesburg as well. On the basis of studies on the history and theories of color, this essay intends to re-establish - albeit through still largely incomplete fragments - the network of diffusion developed in Futurism, from Futurism (between theory and practice, knowledge and experience), to start possible comparisons through analogies or discrepancies, and to grasp some developments in architecture, in the contemporary debate, or in subsequent moments. From this point of view, both in coeval and in subsequent periods, the figure of Alberto Sartoris is confirmed illuminating if we take into consideration his intuitive ability and his cultural background, even in the field of color. Combining cultural or speculative aspects with experimentation in the architectural design, his national and international contacts in the field of color, by taste and in the Futurist period, later matured with Rationalism (including all the derived and/or connected "isms") are also valuable.

1. Futurist Manifestos as a cultural strategy

One of the typical traits of Futurism lies in the copious production of manifestos (fig. 1) intended as a real cultural strategy and for which reference is made to the chronology already collected by the author (Marotta, 2019).

In 1914 Antonio Sant'Elia (fig. 2) published the Manifesto of Futurist Architecture in Milan: the city is placed at the center of interest and is conceived as a symbol of dynamism and modernity. The paper does not explicitly refer to color, nor to its historical and theoretical foundations, nor to the relationship between architecture and color.

The second Technical Manifesto for Futurist painting is much more interesting (1911), where - for the chromatic aspects - it is explicit a precise reference to "style, in the belief that the new painting must be based on the decomposition of color, of Divisionist origin. The breakdown of colors (defined by them as «congenital complementarism»), not only must enhance the sensation of dynamism, but must contribute to that new spatiality where it is precisely light, together with motion, that makes objects interpenetrate one another".

2. The neoplasticism by Gerrit Thomas Rietveld and Teo van Doesburg

In those years, from Bauhaus to Constructivism, up to Neoplasticism passing through De Stijl, (and vice-versa) Mondrian, van Doesburg, van der Leck, Rietveld, Vantongerloo and Huszár expressed their individual opinions about color.

In any composition, Rietveld conceives color in an ancillary (almost supportive) term, but with an essential function in individual perception, reinforced by a captive role, of the primary colors especially. In addition, it was he whom created the Schroeder House in Utrecht (1924), an authentic architectural emblem of the movement: the decomposition of space into planes is underlined here by the use of primary colors, pure and saturated on the same surfaces (fig. 3). In a game of "pure" rectangles and colors, Rietveld creates a perfect synthesis of the theories of the movement, where the furnishing objects and the architectural structure embrace the same constructive principles. The house develops on two levels, based on four fundamental elements, comparable with the theories that began at the Bauhaus: Primary elements in white color that determine the shape and structure of the house; Flat elements in gray or white color aimed at defining the relationship between inside and outside; Linear, vertical and horizontal elements- architraves, pillars, drainpipes - in yellow, red and blue combined with white, gray and black; Functional elements - windows, doors, railings, external staircase and skylight - in black and white.

It should be noted that as early as 1921 Johannes Itten (at the Weimar school since 1919) had made a first model of color (Marotta, 1999, pp. 45, e 134-135). From the same years (1919-21) his "Fire Tower",

derived as is known from the complex and in-depth intertwining with the geometric and mathematical disciplines.

On the contrary, Huszár and van Doesburg adhered to the theories of Wilhelm Ostwald (Marotta, 2018). The latter created the Color Construction in 1922: it is a work of which Zevi writes: "The wall partitions are no longer silent, they have no weight, they can be dismembered into minor rectangles chromatically distinguished by the basic colors." (Marotta, 1999, p. 76). These are the results of the rigorous formal and functional research that van Doesburg had conducted with colleagues such as Cor van Eesteren and of which we can recall what he had written in 1923: "we examined the laws of color in space and duration, and we found that the balanced relationships of these two elements eventually lead to a new and positive plastic" (Marotta, 1999, pp. 24-25).

In 1927, according to a similar but more complex concept, Theo created (together with Hans Arp and his wife Sophie Taeuber) the Café Aubette in Strasbourg, one of the most ambitious designs of the architectural culture of the time: here his spatial vision through formal synthesis and pure colors is evident (Marotta, 2019). Again, by De Stijl, while Van der Leck considered the color essentially as a medium to achieve greater control in formal synthesis, Vantongerloo finally elaborated a chromatic theory, conceived through pseudo-mathematical formulas in order to match music to colors, and developed seven of it systematically related.

3. Chromatic and geometric matrices from Bauhaus

In 1919 because of an invitation by Hans Richter and Viking Eggeling (Siggillino, 1998) (whose filmic experiments between color and geometry are known, such as Diagonal Symphony or Orizontal/Vertical orchestra) van Doesburg went to Berlin, bringing with him the first abstract films, the collection of the De Stijl magazine and pictures of the neoplastic works (Zevi, 1974, pp.16-17). On Christmas night, in Bruno Taut's house, van Doesburg met Adolf Meyer and Walter Gropius, (as Teo remember) (van Doesburg, 1925) with

the aim of being included in the teaching staff of Bauhaus. In 1922, he also collaborated with the magazine Dada Mécano together with Schwitters, Arp and Tzara. His painting was confirmed in the combination of primary colors with elementary geometric shapes: lines, diagonals, squares, to enhance spaces and architecture. In 1925, the Bauhaus published Grundbegriffe der neue Gestaltenden Kunst in Munich, a paper about the basic principles of the plastic arts.

4. The futurist color by Nicolay Diulgheroff

The Bulgarian Nicolay Diulgheroff came to Italy, in particular in Turin (Belloli, Pinottini, 1987). He trained in Vienna in the 1920s at the Kunstgewerbeschule in Dresden (where he met Kandinsky, who was decisive for him also for the chromatic theories). He then went to the Bauhaus he spent time with Johannes Itten, whom soon became one of the best-known theorists of color. In Turin, he enrolled in the Scuola Superiore di Architettura, at the Accademia Albertina, where he left traces and documentation (the writer now investigates these, in order to better recognize the chromatic components in the design activity: the current constraining conditions have unfortunately forbidden the consultation).

Nicolay met Fillia (Luigi Colombo), close to the Constructivists: in 1931 he was significantly present in his book La Nuova Architettura [8], which cites - together with the Futurists - also authors of other tendencies: Gropius, Le Corbusier, Sartoris. This is where the premises of Futurist Mechanical Art were born, the manifesto signed by Pannaggi and Paladini in 1922, followed the one on architecture by Sant'Elia.

He signed architectural designs (Villino Montaldo, or "Il Faro") (fig. 4 d), but also interiors, as for exhibitions, as well as graphic and pictorial activities. In Albissola Marina one of his significant works: Casa Mazzotti, (fig. 4 a, b, c) for Tullio Mazzotti (called Tullio d'Albissola by Marinetti) as his home and ceramic laboratory, with an adjoining shop to display and sale. It is one of the rare examples of futurist housing still intact, designed and built under the direction of the architect without undergoing changes or additions over time. It currently houses the Ceramiche Mazzotti company.

The formal and structural language connotes the "dynamic" futurist style: the projecting roofs at the entrance to the shop and on the facade of the residence, the large windows of the house and the ones curves of the stair space, the numerous metal railings, the harmonious play of lights and shadows, the curved parts of the staircase and the shop, the protusions that frame the openings and the rounded corners. On the other hand, the proportion of the volumes and their division according to the functions for which the villa was built is rationalist: house, ceramic laboratory and adjoining shop to display and sale. In 1930, he wrote to his friend his testament about his own theory of architecture: "Architecture is beautiful and superior to the other arts, because it creates living and harmonious organisms in everything... The design of the new Mazzotti factory is of a modern and futurist style, but of a futurism of which we should not be very frightened because "we are very, very far from Prampolini's futurism". In our design there is only "simplicity, logic, proportion, economy", the rest is harmony and good taste" (Belloli, Pinottini, 1987, pp.7-14).

The colors suggested by Tullio (artist and ceramist of great cultural allegiance) stand out unusual on the Ligurian promenade even nowadays: they were inspired to Nicolay by the beach and the marine location for the choice of colors, but also by the ceramics by Albissola. On July 26th, 1932: "I chose three tones: straw yellow (almost white) for the front of the shop that stands out well in the plastic complex of the house that is in blue gray color instead, on which the tower of the staircase is painted all in earthy yellow or vice versa, and fits in the central block" (Belloli, Pinottini, 1987). The book by Fillia in 1932 (Colombo, 1931, pp. 68, 73, 75) reports the name Diulgheroff several times.

5. Color by Alberto Sartoris, futurist, rationalist and functionalist architect

Alberto Sartoris (Turin, 1901-1998) rationalist architect, then functionalist architect, has a profile with strong traits linked to the Futurism. He trained in Switzerland, at the École des Beaux Arts in Geneva, he made his artistic debut as a painter, continuing his studies in Paris. In 1920 he met Marinetti in Geneva, became his friend as well as his Futurist disciple [10]. Together with Terragni, Figini, Rava, Pollini, Frette and Larco (il "Gruppo dei Sette"), he signed the official Manifesto of Italian Rationalism, which later became the Italian Movement for Rational Architecture (MIAR).

He adhered to Futurism according to a free, independent relationship, with numerous architectural designs and to the editorial staff of the periodical "La Città Futurista". He took part to represent Italy at the International Congress of Modern Architecture in Switzerland in 1928 (a conference directly influenced by Le Corbusier), and in the same year he participated at the 1st Exhibition of Futurist Architecture in Turin. He was friend with Le Corbusier and Alvar Aalto and Gropius (with whom he developed the study of a new architectural language

based on geometric form as an absolute and structuring value).

He published in 1930 a monograph about Antonio Sant'Elia. In the1941 he joined the "Gruppo primordiali futuristi Sant'Elia" proposed by the philosopher Ciliberti, and conceived as intellectual coordination in the field of "modern" art.

He punctually takes up the fundamental themes of the way of thinking and chromatic project, ranging from theoretical aspects to project practice, even in the architectural interior, as a lucid critical filter in his volume dated 1990: Tempo dell'Architettura (Sartoris, 1990) (to be compared, moreover, with his founding Encyclopèdie de l'Architecture Nouvelle dated 1948) (Sartoris, 1948). These are the topics dedicated to the theme: Polychrome dynamism, Mystical measurement, Science and measurement of color, Polidimensional exaltation, Fourth dimension. In the first case, the "Mystical measurement" (referring to places of worship), it requires psychological colors in his opinion. "The functional windows - he says - will therefore be formed by special superimposed glass, engraved, doubled, screwed, frosted, silvered, gilded, with new mixtures, and realized with the tones of the most audacious polychrome theories" (in this regard, note the very important and conclusive experiments by the Hungarian painter Ladislas Moholy-Nagy and those by the German painter Josef Albers, with the implied theoretical implications)". In the chapter on Science and Values of color, he agrees with Ugo Maraldi (Maraldi, 1943), who examines colors and shapes of sounds studying the prodromes of a new art for a future man, according to «images created by the alchemy of words and visible harmonies of musical chords» (Marotta, 2019).

In Sartoris' way of thinking and project, in his systematic and complex vision of color, a strong character component is the relationship between his futurist training and the Neoplasticism. The in-depth knowledge of the elementary architecture and of the neoplasticist pictorial field, offered to Sartoris the starting point for a thorough investigation of the relationship between architecture and color. In the unique issue of Circle. International Survey of Constructive Art (Sartoris, 1937) published in London in 1937 by J. L. Martin, Ben Nicholson and Naum Gabo, Sartoris published a piece entitled Color in interior architecture, not sufficiently considered by critics yet. The focus is on the need to reintegrate color in the interiors of the new architecture, putting an end to the reaction against the Nineteenth-century abuses, which determined the monochrome of modern architecture in its first phase (Sartoris, 1937, pp.212-214).

Sartoris also talked about it in its application forms: "my other experiences concern a different method: the neoplasticist procedure. It treats the same wall with various colors (always joined together by grays, whites and blacks), while preserving the specific character and destination of the environment, accentuating it or transmuting its correlationships if the architecture requires it. In this case, I prefer to use pure, fundamental colors, such as yellow, light and dark turquoise and red, when the dynamic method uses all the known ranges of colors and those that the invention preconize" (Sartoris, 1937 and Sommella Grossi, 1993).

From the chapters on Polydimensional Exaltation and the Fourth Dimension, Sartoris confirms some concepts: "in the neoplastic compositions, which pursue, for example, the aim of constituting the joyful atmosphere of a specific environment, with the use of pure fundamental colors, together with whites, blacks and grays, the functions to be represented plastically are very different. The very function of the local no longer requires complete, absolute unity, but the dismembered, fragmented, diaphragmatic faction. It is for this reason that the composition made with turquoises, yellows and reds (which can also be represented by plastic materials or with artificial light effects) combined in relatively small dimensions, but in numerous quantities, has been treated by categorically breaking the bare walls, while not destroying the volume". Here too, the reference (among other things) to Rietveld, van Doesburg and Mondrian is evident.

However, Sartoris' interest in Neoplasticism (with the desire to confront with van Doesburg in particular) is also reflected on a speculative level regarding the influence of Futurism on Rationalism (concerning Italy). The complexity of the relationships between the various spheres of the international avant-gardes is based on constant confrontation and intellectual speculation. In this regard is exemplary the much debated question of the Futurist contribution to Italian Rationalism, in the light - in particular - of the essay by Sartoris, sent to van Doesburg, Le Rationalisme italien (1929), whose manuscript is kept at the van Doesburg Archive (L'Aja) (Pianzola, 1990 and Sommella Grossi, 1988).

6. Critical and comparative synthesis: similarities and differences

In the awareness of the different positions, in the developments of the various movements over time, we can summarize some possible general terms (if not real parameters) for a first comparative synthesis: chromatic

theories, "chromoplastics", pure color (also called "spatial color" by van Doesburg), "chromatic axonometries".

In a first hypothesis of comparison - towards possible analogies and discrepancies - it is possible to confirm the relationship with colour theories as a basic parameter: Itten (especially for Diulgheroff, (Marotta, 1999, pp. 31, 76), and in the "anticipatory experiences" of Rietveld); Ostwald (at which van Doesburg adheres to); Goethe and Albers (favored by Sartoris).

Furthermore, for van Doesburg and Sartoris, a substantial convergence is confirmed in the deepening of contemporary studies and research in the optical field and in the psychology of visual perception [16]. Also in relation to the aforementioned approach, (here obviously in an ex-post reading) the renewed relationship between form, color and structure (also visual) is strengthened in the dimension of the space thought, designed, represented, acted, perceived.

In this sense, a coherent contribution can be found by van Doesburg, in the comparison and application of the concept of "pure" (or "spatial") color, conceived according to a" chromoplastic "vision: Teo also hypothesizes "a new way of designing,engaging deeply through color in the relationship of two-dimensional signs with volumetric and spatial reality, against the usual system of tracing the plans, then the sections and finally the perspective facades" (Zevi, 1974) and again affirms: "a balance cannot be found between space and time if not in chromoplastics, that is, in the pictorial composition of three-dimensional space" (van Doesburg, 1925 and Bassegoda Nonell, 1982).

But the same "pure colors" (as understood above) are enriched with wider and deeper values: "Without color, architecture is without expression, it is blind […] obviously architecture does not become art through the use of color [...] but it is as indispensable to man as light" (van Doesburg, 1925). And van Doesburg concludes that "in modern architecture the surfaces ask to be animated, that is, to be composed with the help of pure color, the color of space" (van Doesburg, 1925). A consequent phase (as a subsequent development) can be identified by the representation of spatial colors in the axonometric dimension, taken not only as a mere graphic tool, but as a laboratory of intellectual speculation for the project. In these applications, similarities and convergences can be found in the visual and chromatic results (shared between Diulgheroff, Rietveld, van Doesburg, and Sartoris) through the intersections (if not real programmatic choices) with the Ittenian contrasts, above all - in the first instance - in the confirmation of pure or "spatial" colors, just mentioned. This is confirmed even more clearly for Alberto Sartoris (fig. 5): whether it is

"chromatic axonometries" (Versari, 1997) or axonometry "as a project" (Reichlin, 1979), or "integrated", according to Besset's thought (Besset, 1992) the color - in the architectural space and in its representation - it lives "no longer on the superficial level of collaboration between disciplines, but on the fundamental level of the fusion of the elements of any creation" (Beguin, Felley, 1992). The documented request for a meeting with van Doesburg (Pianzola, 1990 and Sommella Grossi, 1988) is proof of the extent to which the Turin architect was consensual with Teo's guidelines.

For Sartoris, the integration of all the arts and the various forms of knowledge is valid, but - above all - color "is the fourth dimension of architecture" (Sartoris, 1990, pp. 100-102) which he divides into three approaches: "the first coming from Dutch Neoplasticism and French Purism - mainly used by painters such as Mondrian and Ozenfant - characterized by the exclusive use of primary colors only, combined with white, black and different shades of gray" (Sartoris, 1937).This is the method he applied in the first "polychrome axonometries" from the 1920 (Pianzola, 1990, p.71).

The second "dynamic" method - which can be linked to Le Corbusier's theories and only partially to French Purism - contemplates the possibility of using a wider chromatic range (take for example the Hermitage Circle at Epesses in Switzerland). In this sense, the use of color once again highlights Sartoris's desire to build a "true artwork" through drawing and color, as evidenced by the documentation preserved in the same Club.

Finally, the "functional" method allows the use of the entire chromatic range: the colors must be chosen according to specific psychological criteria (and here the reference to his interest in this type of study - which we have already mentioned is fundamental - also shared by van Doesburg), to generate (also in physiological and perceptive ways) an atmosphere programmatically aimed at inducing targeted sensations according to the intended use in individual environments. As an example, we recall the Morandi-Pasteur house in Switzerland (1935). A long process that is a confirmation of the concept of color as a "fourth dimension", capable of triggering the dynamism and interactivity of the environment, reinforced by the success of his furniture ensembles, to which he had dedicated himself since 1928.

7. Conclusions

In the period we have considered, in a continuous exchange between art, architecture and theories (significant, for example, Itten's experiences are confirmed), color is one of the approaches to better build,

control and communicate (through visual language) structures and harmonies in three-dimensional relationships and in their respective balances in space-time. But that's not enough: it itself becomes a system and mental model structuring the design process in its complexity. From this perspective, architecture becomes an effective and complete expression of all experiences in perfect coherence with the objectives identified by the various authors. Thus, each of them "draws", represents and shares its own "chromatic thought" making it (as Berenson would observe) tactfully palpable, in a "multi-sensory" way, in a new dimension that is no longer limited to "anti-decorative", but almost a "special effect" of

that period: a new, "manifesto ideal", all projected towards the future, from which new questions will arise, for new research, and therefore still relevant. Because, as Zevi observes about Rietveld's chromatic culture, "When a 'linguistic' system is adopted outside the circle of the movement that produced it, by architects of very different sensibilities, it means that it is not a fashion, but a permanent parameter of a figurative culture" (Zevi, 1958).

Fig. 1. Chromatic matrices between Futurist and Bauhaus, theories and practice.
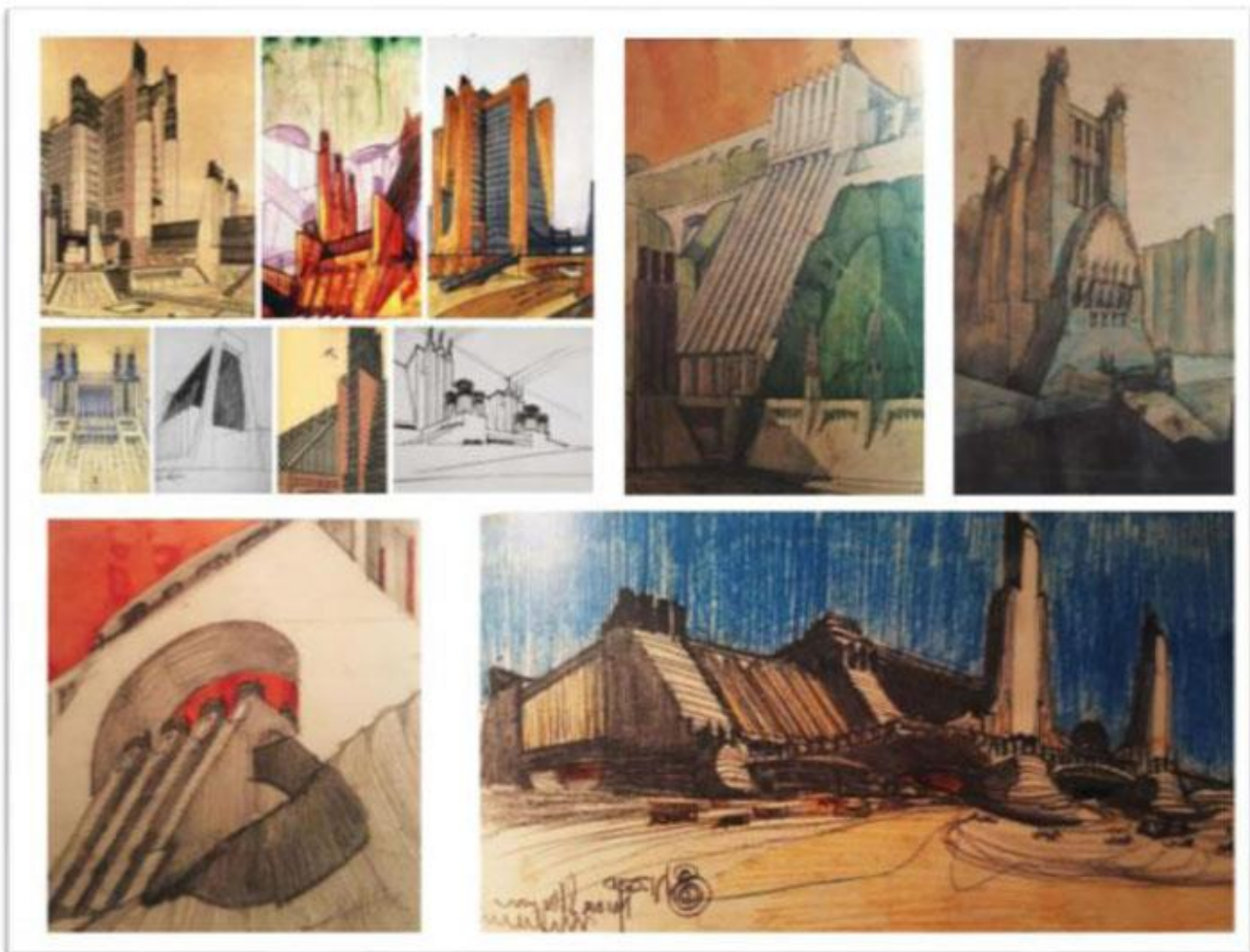
Fig. 2. A Futurist vision: City designs by Antonio Sant'Elia. His Futurist Architect Manifesto (1914) sets forth the principles of this new tendency: the city is placed at the center of interest and conceived as a symbol of dynamism and modernity. Despite the wide and generous use adopted in the representation of his designs, the paper does not explicity refer to color, nor to its historical and theoretical foundations, nor to the relationship between architecture and color.
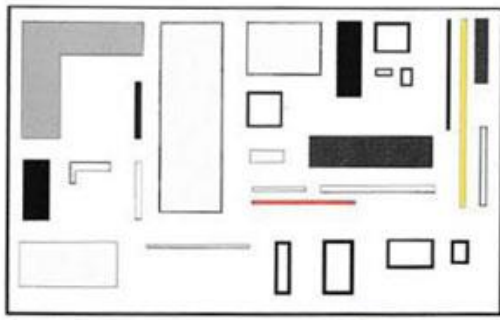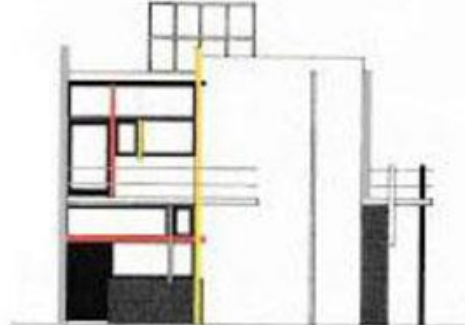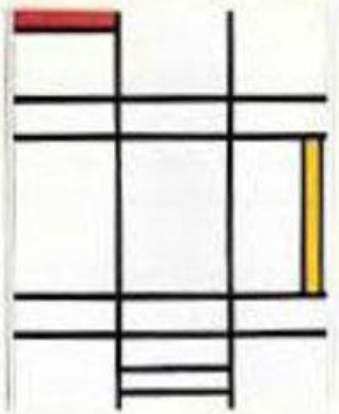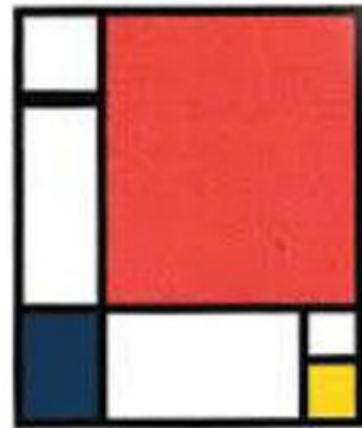
Fig. 3. The neoplasticism of Gerrit Thomas Rietveld in Schroeder House (1924).

a.- Symmetry and repetition. "Instead of symmetry, in the example the architecture proposes the balanced relationship of unequal parts, (by position, measure proportion, etc.) balanced by their functional character. The conformity of these parts is given by the overall balance and not by the equality". (Zevi, 1937, p. 280);

b.-The chromatic system in the building structure. It is often cited as the culmination of neo-plasticism, as a Mondrian painting made in three dimensions: especially from the Prins Hendriklaan side, it reveals many relationships with Mondrian's paintings. But this does not necessarily imply that the building is a translation of a Mondrian in architecture, or that the structural typology and the architectural form depend on uncritical automatisms;

c-d-e-f. Exchanges between art, architecture and theories. Rietveld met Mondrian by chance; but in 1918 in the red-blue chair Rietveld had combined lines, primary colors and planes in advance of Mondrian's works of that period. Analyzing the works of Rietveld and Mondrian, we realize that the situation is more of confrontation than of influence; (e) Mondrian, composition with white, red and yellow 1936; (f) Mondrian, Composition with red, yellow and blue, 1926.
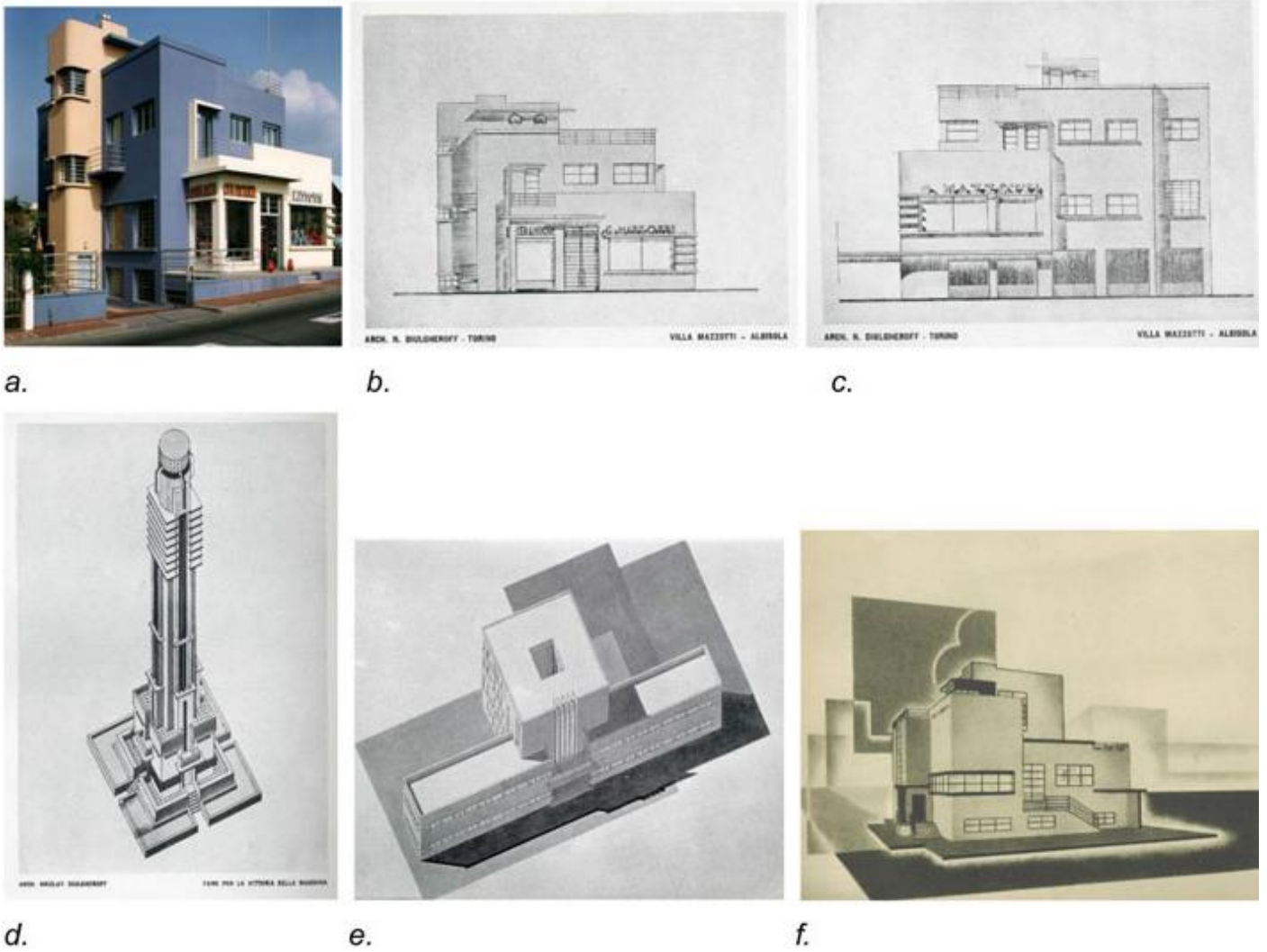
Fig. 4. Color by Nicolay Diulgheroff's futurism (by Fillia, 1931; by Marotta, 2019).
a. - Villa Mazzotti - Albissola - photographic view and façade (Marotta, 2019);
b. c. - Villa Mazzotti - perspective drawings;
d. - "Lighthouse for the Victory of the Machine" - axonometric projection;
e. - Design for a High School, axonometric projection;
f. - Villa Cittadina - perspective drawing.

The colors suggested by Tullio Mazzotti (artist and ceramist of great cultural allegiance) stand out unusual on the Ligurian seafront still nowadays: they were inspired to Nicolay by the beach and the marine location for the choice of colors, but also by Albissola's ceramics. "I chose three tones: straw yellow (almost white) for the front of the shop that stands out well in the plastic complex of the house, in a blue gray color instead, on which the staircase tower is painted all in earthy yellow or vice versa and fits into the central block". July 26th, 1932. (Belloli, Pinottini, 1987).
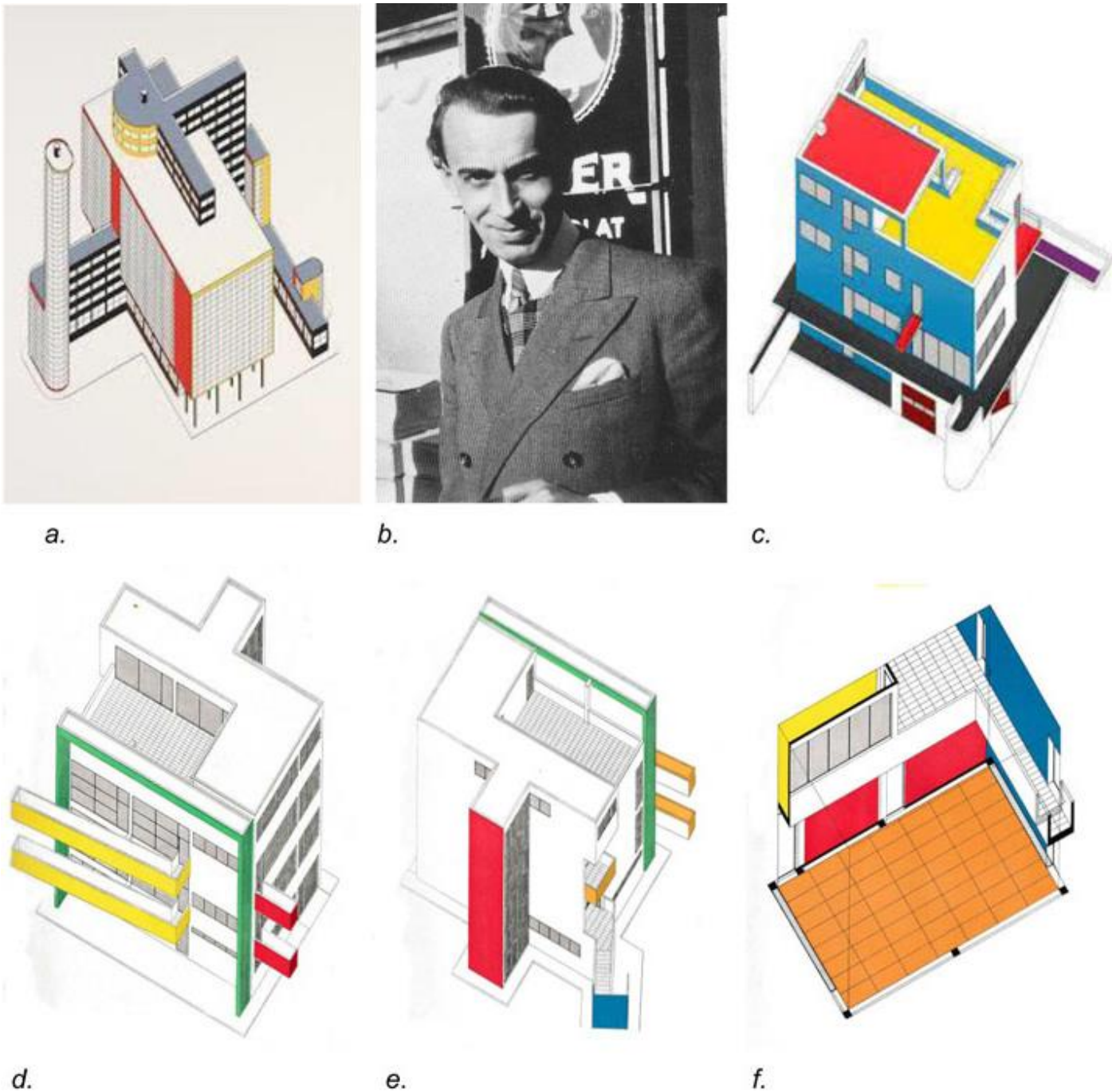
Fig. 5. Color by Alberto Sartoris, futurist, rationalist and functionalist architect.
a. - Cathedral Notre-Dame du Phare, Fribourg, Switzerland, 1931
b. - Picture of Alberto Sartoris;
c. - Villa for Romain Brun, Lausanne, Switzerland, 1934 (by Cristiano);
d. - Residence d'un architecte, side South East East, Florence, Italy, 1942 (in Sartoris, 1948).
e. - Residence d'un architecte, side North-West, 1942
f. - Residence d'un architecte, Interior details of the atelier, 1942.
For Sartoris - above all - color "is the fourth dimension of architecture", which he divides into three approaches:"the first coming from Dutch Neoplasticism and French Purism; second "dynamic" method (linked to Le Corbusier's thinking); finally, the "functional"(based on specific psychological criteria) allows the use of the entire chromatic range.

8. Funding source declaration

9. Conflict of interest

The author declares that nothing has affected her objectivity or independence in the production of this work. There are no actual or potential conflicts of interest, including financial, personal or other relationships with other people or organizations.

10. Short biography of the author

Anna Marotta Architect, Full Professor of Representation at the Department of Architecture and Design (DAD) of Politecnico di Torino. Ph.D in Conservation of Monuments. For years she has dedicated his interests to surveying, reading and communication (in a cultured and specialized sense as the result of the culture of vision) of architecture, cities and landscapes, even in the most up-to-date events, including those relating to color treated according to the "comparative theories". She is the author of many publications on the topics of his research, many of which are recognized in Research Projects of National Interest. She teaches - even internationally - disciplines related to drawing and representation fields, including Visual Communication, Laboratory of Drawing and Architectural Survey, Atelier of Representation and Project, Drawing from the True and the Imaginary. Since 2012, she is a member of the Scientific Committee of the Gruppo del Colore and she is a member of the Presidential Committee of the Associazione Nazionale Colore.

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Lighting and color design in the live music show between new technologies and practice

Andrea Siniscalco

Dipartimento di Design, Politecnico di Milano, andrea.siniscalco@polimi.it

ABSTRACT

The choice of light and color to complete the performance of a singer or performer in a live music show is an important and critical issue that can contribute to the success of the event. As part of the show, whether it's a concert, a musical, or a fashion show, the lighting designer's design choices can make an event unforgettable or sink its quality invalidating the efforts of all the production. In this paper we introduce the evolution of this sector from a technological, methodological and research point of view, comparing it with today's reality of the professional practice of the stage lighting designer.

KEYWORDS: live show, lighting, color, performance, LED.

1. Introduction

There are many factors that affect the choice of color for each single song of a show; for example, the personal interpretation given by the sensibility of the designer who can "feel" a specific color and its shades, more appropriate for the staging of the song. You can also make choices related to the different stages of the show, in order to create a sort of "color narration", bringing dominant colors to the stage for more consecutive songs, giving the perception of "monochromatic" periods within a more vast scheme of interpretation, which will evolve later, recalling an imaginary and transmitting different sensations to the viewer so as to accompany him emotionally through the path of the show.

Fig. 1. Albert Sperr Lighting at Zeppelinfeld stadium in Nuremberg 1934. Courtesy German Federal Archive.

The use of artificial lighting as a stage tool began to spread in the 20s of the last century when cinema, from the first experiences of theatrical shooting in plen-air, started production in indoor film studios. The masters of photography discovered the importance of scenographic light as a communication tool. A turning point in this area was Fritz Lang's 1927 film Metropolis. In this film, the luminous coding assumes a semiotic value, in the management of light and shadow, in the dynamic projections, in the use of electric discharges and luminous objects, as scenographic communication tools, able to amplify the effect of the scenes on human emotions (Roth, 1978). Lang drew his inspirations from Art Deco, Bauahus and Futurism (Rutsky, 1993; Wolfe, 2020) applying them to light, which from a scientific and technological subject became a communicative, scenographic and design tool (Pooky, 2016).

In the following years it was not only cinema that drew inspiration from the scenographic and communicative use

of light. In 1933 Albert Speer, the Nazi architect, aware that he would not have had time to build the Zeppelinfeld stadium in time for the 1934 annual party meeting, decided to use light as a building material. He used 152 anti-aircraft floodlights loaned by the Luftwaffe to delineate the boundaries of the stadium in a space in Nuremberg that could hold up to 340,000 people. The British ambassador Henderson, described it as "sacred and beautiful cathedral of ice", while the French ambassador Francois-Poncet defined it as "a mystical ecstasy, an holy illusion" (Speer, 1970). The communicative effect was such that even in the following years the same set-up was used. In the documetary the Triumph of the Will (by Leni Riefenstahl), about the 1934 Nuremberg Party Rally, music was also used: as part of the soundtrack she used Wagner's Die Meistersinger (Moller, 1980). The aim was to emotionally involve the viewer through a synaesthetic interweaving of the two senses, sight and hearing, which are the basis of remote communication.

Light, music and, with the end of the era of black and white, color arrived on the stage. As evidenced by (Applebee, 1950), the introduction of color through lighting was already beginning in post-war British theaters. Even decades before the advent of LEDs (Strange and Hewitt, 1956) cite the example of the theatrical experience as a possible model of experimentation to determine the quantity and chromaticity of general lighting to try to make it more pleasant for users.

The issue of color also affects television stages, posing serious problems with regards to color rendering as a function of different lighting setups. One of the first television stages was created at the BBC with the possibility of remotely controlling up to 100 different intensity configurations of the installed system. It arose also the problem of obtaining the first color filters capable of withstanding high temperatures for a long time (Ackerman, 1969).

The relationship of light with the subject of the representation was defined by (Reid, 1970) as the art and science of the stage lighting. In his description, this is an activity that must manage three fundamental variables of light: intensity, color and direction, which are the syntactic elements on which to design selective, atmospheric and dimensional lighting that should be suitable for the context of the representation.

After the color, a further innovation took place in the 1980s by Vari-Lite with the introduction on the market of moving lights. These light projectors are able to rotate the emission of the light beam on two axes and to control the color thanks to the use of dichroic filters. From those

years onwards, stage lighting has become dynamic in live music shows, theater and television stages. A turning point in the live music show came with Pink Floyd's The Wall concerts, whose lighting design marked a difference from previous live music shows (Williams, 1988). And from those years, even in theatrical (Taylor, 1989) and television stages, dynamic lighting began to become a new expressive variable, used to amplify the communicative power of light in representation, which was also celebrated in the Showlight'89 conference, made in collaboration with the CIE (Ackerman, 1990).

In the following years, the professional approach to the design of the live music show events was the subject of further researches at the marketing level where light and color always played a role of primary importance (Minor *et al.*, 2004; Moody and Dexter, 2009). Since this is a business, mathematical models have been defined to evaluate the level of satisfaction of the participants in live music shows (Hausman, 2011). Some scientific and applied research has also been done on the relationship between color and music (Pridmore, 1992; Caivano, 1994; Lindborg and Friberg, 2015; Whiteford *et al.*, 2018),and this is a research topic still open worldwide.

Some preliminary research has recently been developed aimed at investigating the psychological response of users to the variation of the luminous patterns of a concert (Lo and Steemers, 2020) and the environmental colors of the concert halls (Chen and Cabrera, 2021). This area of research on stage lighting and color is anyway in an initial phase and, in order to be developed in the future, the degrees of freedom of the variables that come into play must be determined, which in the context of the live music show must be clearly determined.

Taste, interpretation and the experience of the lighting designer are always dominant in the dynamics of lights and chromatic choices, however, there are many factors that are inevitable and can affect the choices of the designers. As an example, an element certainly important is the will of the artist himself, who could have a clear chromatic vision of his songs and, consequently, pass it on to the lighting designer.

The live stage field allows considerable freedom of intervention; greater than in other fields, such as fashion and television, where there are many more constraints. In live shows, there is no univocal approach regulated by standards. In this paper starting from world research in this sector and moving along the line of technological innovation, we have analyzed the experiential aspect of a famous Italian lighting designer: Giovanni Pinna, active since 1986, who has worked with some of the major Italian and international artists such as Fabrizio De Andre, Pino Daniele, Adriano Celentano, Eros

Ramazzotti, Luciano Ligabue, Vasco Rossi, James Taylor, Ryuichi Sakamoto, and many others.

Fig. 2, 3 - Two different moments of the building of the stage of the concert of Vasco Rossi in Modena (2017). Courtesy Giovanni Pinna.

2. Project variables

The design of lighting for a live stage show is not a simple task. Thinking of it as a series of operations that lead to a result, it could be possible to compare it to an artistic or architectural activity. Despite the freedom granted to the designer, there are numerous factors that make the preparation of the lights for a live show, a real

race against time; many steps and checks in a very short amount of time.

First, the show venues are available just few days before the show itself, so it is not possible to "play ahead" (not much at least). This is also due to the high rental costs of the structures. The productions concentrate the dates of employment near the shows and of course, the lighting is only a part of the things to be done. Designers are therefore faced with the need to carry out preparation and testing in just a few days, some more if the production is a major international event.

Working experience certainly helps in these cases; beyond the ability to find optimal solutions to possible unforeseen events, the knowledge of the various structures in which the shows are usually held (strengths and problems) for the artists with whom you work, is a very useful know-how for the lighting designer.

In recent years, some software has also been developed that make it possible to prefigure the luminous and chromatic set-up of the live show, also considering the music and the dynamic temporal dimension of the lighting. Software tools such as Wysiwyg (CAST, 2020), Depence[2] (Syncronorm, 2020), L8-Software (L8, 2019), Spotlight (Vectorworks, 2020), and others that can help, simulating an installation; but as regards their use, there are different points of view on the part of professionals. Some completely avoid these systems, others use them for a very early phase, while others use them more widely.

It is mostly software that allow the professional to virtually rebuild the stage, even starting from the CAD drawings of the set designers, and to go and install actual moving light projectors, simulating the control consoles. It is also possible to export files that allow a certain level of automatisms during the real show. The algorithms used by these digital tools, however, are not always very refined and the show simulated often does not have enough visual correspondence with the result, to the point that some designers do so easily without them.

Everything is then decided in the last days, and the lighting designer's artistic sensibility remains the essential tool; knowing how to read the various nuisance of the show and visually transpose them, improving their emotional charge.

In addition to the timing and the geometrical characteristics of the venue, there are other external variables to be taken into consideration. When you are outdoors the concert usually begins while the sun has not yet completely set. The luminous envelope therefore evolves over the course of the show and it is necessary to adjust to adapt to the change. These changes in the color of the natural light atmosphere depend on numerous factors; place, season, time, weather conditions and these are almost always variables that can be evaluated only at the last moment, due to their very nature.

Another element that can significantly influence the color choices of the Lighting Designer is the presence of light deriving from other new technical equipment. The now constant presence of elements such as LED-walls, which put in scene digital content which is not produced directly by the lighting designer.

In addition to external factors and production variables, typical elements of the actual Production of the show must also be taken into consideration. Even just the type of engagement of the lighting designer, a contract with the Production or directly with the artist, can affect the freedom of choice of the professional. Then there are the other figures in the show; the most important is certainly the artist himself, who can have a personal vision of the show by making requests to the designer. As an example: Vasco Rossi, on the last tour asked for white and blue key colors for the song "Gli Angeli". These requests are not very frequent, but they can happen; in this case the designer must be able to mediate them with his own vision of the show.

Another very important actor is the Set Sesigner. The physical construction of space involving, geometries, materials and choice of surface colors, is extremely important for the choices of lighting and the maximum synergy between the two teams is desirable.

3. Design degrees of freedom

The project starts to form in the mind of the designer early, trying to build a "painting without colors", giving more importance to those that are the compartments of the scene, the orientation of the spot beams, of the wash-type fillings, and so on. In this phase the color is only a vague anticipation; you can get an idea of what color could be used, but the information available is still not enough and the risk is to waste your work. It is at the time of staging, when everything goes into production, that it is possible to really give a color to the songs; work upwards, observing the "substance" of the light beams. Very often the initial ideas had during the programming phase are rejected because they do not fit the rest of the scenic machine. The choice of colors is almost always the result of a personal interpretation. Beyond the sporadic performer requests that might happen, it is the designer who chooses, through his musicality. The lighting designer can almost be considered an added musician who participates using time, measurements and

musical writing as a track to work on. It is essential to know perfectly the programmed repertoire to build its chromaticity, passing from framework to framework.

Fig. 4, 5, 6: White is the unifying color in the songs - performer: Vasco Rossi. Courtesy Giovanni Pinna.

The freedom to be able to do all this then depends on the factors seen before, but also on the products available and on the designer's knowledge of them, which is mostly acquired through experience. Entering into the heart of

the choice of colors, in the specific case of Giovanni Pinna, color combinations are very contained. You can play on warm tones on warm, cold on cold, complementary colors and (but only rarely) in contrast unless it is necessary for a change of narrative.

Fig. 7, 8, 9. Shift colors along the concert - performer: Vasco Rossi. Courtesy Giovanni Pinna.

The chromatic shift marks the passage from one module of the show to another. Often authors like to create narrative compartments composed of multiple songs and

a good choice is to keep the same colors within these segments, introducing different colors to move to the next compartment.

The presence of natural light in the initial moments of the concert can be an issue, partly because of its intensity and partly because of the variability of its appearance. A possible approach to this condition is the use of neutral white light, adjuvated by a good quantity of artificial smoke, which gives an impression of diffuse glow, "naturally" luminous. This can be done while waiting for the sun to set completely and then to introduce the first color. This creates a very clear perceptive detachment with respect to the initial part of the concert which allows the public to immerse themselves even more in the programmed narrative contexts.

4. New technologies

In addition to natural light, as already mentioned there are digital contents that are usually presented through LED-walls or projections. The amount of light emitted by these devices is by no means negligible and their presence is now a must in major productions.
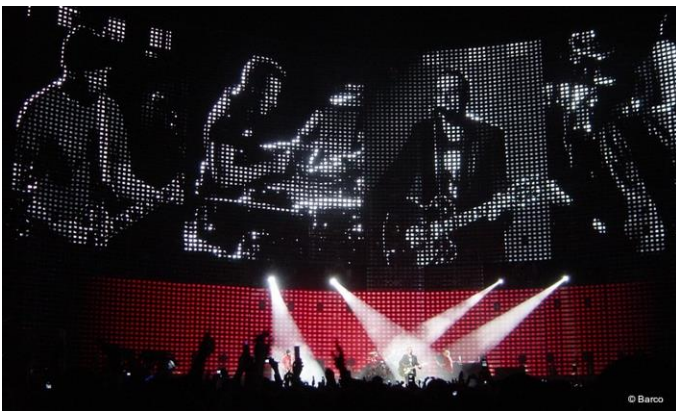

Fig. 10. LED wall A created with BARCO Creative LEDs (MiSPHERE) - performers: U2.

Spanning from simple vertical elements able to change the perception of depth on the set, to actual modules scattered all over the stage; the amount of light and its coloring must be absolutely kept in consideration when designing light. It's a good thing in fact that the lighting designer coordinate his work with the designer of digital content to create synergy and manageable choices. This can be greatly improved using media servers, which allow the integration of video content in the control consoles operated by the lighting staff, ensuring a good level of integration. Usually, however, it is the lighting designer who, when he cannot make suggestions about

the colors of the videos, must adapt to digital content in order to make harmonious light choices.

Fig. 11. A projection that overlaps the stage created with Backtraxx and Acronn screens - performer: Fedez.

Technology continues to improve in years, providing more possibilities every day: higher powers, more control and bright full saturated LED colors. However, the flip side of these innovations is that as the possibilities increase, so does complexity. If we think of the shows of just some decades ago, everything was about using fixed beacons, colored gel filter; flexibility was less, but the preparation time was consequently very low compared to today.

Moving lights allow a very wide range of colors to be obtained, gobos to be implemented, light to be profiled, and multiplied with prisms, as each luminaire is potentially able to carry out the work of many. And then video projections, sets in transparency, special materials, platforms. A flexibility that was unthinkable until not long ago, but kind of overwhelming for the designer. The possibility of obtaining unlimited colors does not necessarily mean that this should be done. At times, using a fixed spotlight with a colored gel filter is still the most effective and economical choice, even if less elegant. The available budget is always the primary constraint of each project. This does not mean that technology should be avoided, on the contrary, today more than ever it is essential that professionals are prepared for the possibilities that products and systems have to offer, always keeping up to date in order to evaluate the best choices.

Regarding color, LED light sources can produce more saturated colors with greater efficiency than using filters; obviously, we are not talking about the rendition of illuminated colors, but about the appearance of the light beam projected into the environment where artificial

smoke is dispersed. In terms of entertainment, the white remains a weak point of LEDs, making it less brilliant than the one created with metal halide lamps. Some LED sources are offered in RGBW format (Red, Green, Blue and White) in order to give greater chromatic flexibility, but the result, from a white chromatic point of view, is still not comparable with that of discharge lamps. The same is true for sources that must provide a portion of UV for fluorescence, such as Congo-blue, for which traditional lamps are still more appropriate. Obviously, the digital sources are more flexible from a control point of view, but as mentioned above, too much flexibility, can extend the preparation time of the show.

power implied has led manufacturers to develop many devices that mount this type of lamps. From a chromatic point of view, however, the LED sources still encounters resistances; some purists of gas discharge light sources prefer to avoid LEDs, opting for classic lamps, assisted by dichroic or gel filters. In the approach of Giovanni Pinna, the LED sources find a wide space, mainly in the "wash" type headlights, the wide and adjustable beam with soft and indefinite contours that increase the brightness diffused in the space, while for the "spot" headlights, the beams with well-defined contours that are easily identifiable and create hard clear lines in the atmospheres of the show, still prefer discharge sources.

Fig. 14, 15: ARC lamp moving lights with Spot type projection - Clay Paky Supersharpy

Fig. 12, 13. LED lamp moving lights with Wash type projection - Clay Paky A.leda B-EYE K20

5. Conclusions

To conclude a last consideration regarding the LED light sources. Even in the entertainment industry now, solid-state lighting sources have conquered their position. Although their dominance is not as established as in the architectural lighting field, the possibility to contain the

The future evolution of this sector will be influenced by technological innovation, but also by the methodological and marketing aspects presented in the introduction. At the end of the innovation, in a research (Hsiao, Chen and Lee, 2017) (Hsiao, Chen and Lee, 2017) proposed an automatic lighting control method, based on emotions due to music, through algorithms based on neural networks, whose application in the practice of lighting design is however very complex and far from the pretext of the lighting designer. To date and for many years the creative activity of the designer in the live music show

cannot be replaced by mathematical models or computer algorithms. Years of experience are needed to be able to grasp every nuance of a performance and be able to act accordingly, making the best choice would it be technical or stylistic that is able to emphasize, dull down or even correct what is happening on stage.

6. Conflict of interest declaration

The author wish to state that no financial or personal interests have affected the objectivity of this study, and that no conflicts of interest exist.

7. Funding source declaration

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9. Short biography of the author(s)

Andrea Siniscalco - MSc in Design in 2002 and PhD in 2007 in the field of lighting fixture design. Since 2003, he has been collaborating with the Lab Luce - Dip. Design - Politecnico di Milano. Since 2008, he has been teaching lighting (design theory and CAD methods) as adjunct professor at the School of Design - Politecnico di Milano. Deputy Director of the Master's in Lighting Design & Technology. Vice President of the GdC-Associazione Italiana Colore.

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Does gender have an impact on the color preferences in fashion products?

Ítalo José de Medeiros Dantas[1], Aline Gabriel Freire[2], Lívia Juliana Silva Solino[2], Mariana Nunes do Nascimento[2] and Heloisa Mirelly Ferreira Alves[2]

[1] Department of Design, Federal University of Campina Grande, Campina Grande, Brazil. italodantasdesign@hotmail.com

[2] Department of Textile and Fashion, Federal Institute of Education, Science and Technology of Rio Grande do Norte, Caicó, Brazil. aline.freire@ifrn.edu.br, livia.solino@ifrn.edu.br, mariana.n.n@hotmail.com, heloisamirelly57@gmail.com

Corresponding author: Ítalo José de Medeiros Dantas (italodantasdesign@hotmail.com)

ABSTRACT

This paper is part of a project that aims to identify consumers' color preferences in fashion products. The results presented in this work are part of a survey developed in 2019. In fashion products, colors are responsible for adding value through emotional and aesthetic aspects, these preferences being essential points to build a marketable and attractive product. However, through history and cultures, it was noticed that certain colors, when applied to clothes, were positively seen in a society when worn only by men and others only by women. Thus, this paper aims to identify how color preferences in fashion products change as the differences between genders are observed. The survey was conducted with 252 volunteers, 176 of whom were female, and 76 were male respondents; the results were analyzed using the IBM SPSS. As a result, a greater focus on the female gender in pinks and lilaceous hue was understood, while a lower preference for greenish hues. As for the male gender, the preferred hues were bluish, while the least preferred were pinks and lilaceous. It was concluded that genders play a certain role in color preferences in fashion products, identifying socially constructed characteristics through the history of colors as being responsible for those tendencies. It was possible to corroborate the social notion of the female gender preferring pinks hues and the masculine gender presenting tendencies of preferences to the bluish ones and a high refusal to the pinks and lilaceous – seen as women colors.

1. Introduction

Colors are found in everything around us, from the artifacts to the clothes to the skin of the people (Farina, 2006). Therefore, an element of fundamental importance for the development of any product (Baxter, 2011). The colors are presented as the first factor of perception in a visual stimulus (Pina, 2009). In fashion, the color becomes even more indispensable, being used to develop garments, accessories and shoes (Treptow, 2013).

Pina (2009) argues that color is an edifying element that can transmit sensations. Therefore, the color is used as a basis for fashion collections development. In this way, the fashion collections are designed to attract the customer, and, in several cases, "the power of attraction does not depend only on color and light, but also on psychological effects" (Farina, 2006:137).

The human being ends up preferring a certain color over another because of empathy. In fashion collections, colors are used as a trend and as a way to demonstrate emotions, color semantics (Pina, 2009). The relationship between the subject and color been positive or negative is directly linked to the environment in which they live and other factors such as age, education, and the individual's gender categorization (Farina, 2006).

Gender becomes the focus of this paper when it is understood that it has evidence of strong levels of difference in color preferences (Ellis and Ficek, 2001). It is based on this that we emphasize the need to enter into these discussions bringing out as an object of study so pertinent for use and practical application of colors: fashion (Jones, 2005; Altıntaş and Ağaç, 2008).

Regarding color preferences in fashion/clothing products, Zhang (2013: 476) found black to be the most accepted color in the Chinese environment, "The survey of style and color shows that black if fit for all styles and accepted by 90 % of the male and female". In studies focused on children aged 6 to 8 years, it was determined that the colors preferred most by the girls for all garment types were magenta, red-violet, red, and red-orange, and the colors preferred by the boys for all garment types were black, blue, cyan, and yellow (Kilinç, 2011).

This work is based on the need to pay attention to the subjective preferences of products' aesthetic-symbolic content to future fashion users (Löbach, 2001). This information allows us to create products that have a greater affective connection with consumers, avoiding product waste at the time of sale. Also, it allows us to create a starting point to identify the core of tendency to color preferences in our society. Color preferences in design products have been identified in other works as

one of the main means of influencing consumers' purchasing decisions, realizing their relevance (Yu et al., 2017; Yu et al., 2018; Luo et al., 2019).

Based on previously evidences that shows there are gender differences in color preferences (Yu et al., 2020), it is understood that the social role that each gender has played for years in the chain of a society configures important delimitations in the ways they live, behave and consume products (Silverman et al., 2007). Furthermore, this study is necessary to verify whether there are signs of the reflex of socio-cultural categorization of gender in human cognition of molding subjective preferences in colors when in a scenario of selecting fashion products.

1.1. *A brief background on color theory and color preferences*

Relevant to color theories and to better understand the treaties proposed in this research, it is important to note that colors are composed of three essential attributes that configure their existence: hue, chroma, and lightness (Holtzschue, 2011). Thus, a) hue is configured as another word to describe what each color is, as well as being able to characterize a set of similar colors; b) chroma refers to the level of gray that exists in its composition; c) lightness refers to the level of the brightness of the color (Zhang et al., 2019).

These relationships shape people's daily lives and exchanges of values and information with artifacts, serving as a strong element of pre-judgment and instant connection (Holtzschue, 2011).

Entering the field of color psychology, we discuss the effect of colors on individuals' cognition. Sherin (2012:77) says that "A person's response to color and tone can help determine how information is understood and can affect whether a consumer buys a product or uses a client's services". This information is extremely important for the product development area since it deals with consumers' needs and desires (Rathee and Rajain, 2019).

Based on this, we bring up research on color preferences as a valid starting point for identifying patterns of aesthetic-symbolic preferences in consumers' cognition (Singh, 2006; Kilinç, 2011). These researches started in the studies of J. Cohn when the researcher argued that color preferences came from a subjective value that was already born with individuals (Taylor et al., 2013).

At present, the theory with the greatest number of evidences is the ecological valence theory, which seeks to explain color preferences through the positive or negative relationship of human with the artifacts and objects that permeate our daily life, from elements of nature to industrial products (Palmer and Schloss, 2010).

1.2. *Gender differences in color preferences*

One of the first studies developed, in the 40s, determined that men and women tended to prefer colors in the same way, identifying traces of differences only to the orange colors, most preferred by men, and also on the yellow color, most preferred by women (Eysenck, 1941).

However, over time and with the expansion of studies in color preferences, several other studies have emerged to realize the existence of differences in color preferences, formalizing theories (He et al., 2011; Zhang et al., 2019). Later on, it was possible to identify those female children tended to prefer pink more, as women preferred reddish hues; male children and adult men preferred more light-tinted blue (Burkitt et al., 2003; Ling et al., 2006).

One of the main theories that seek to explain the core of color preferences is called Hunter-Gatherer Theory (Regan et al., 2001; Hurlbert and Ling, 2007). Thus, it discusses an existing relationship between the social roles that occupy the feminine gender and the masculine gender within a social organization, focusing on their survival adaptation, ending how this is reflected in color preferences (He et al., 2011). In this sense, this theory identifies the preference of women for warmer colors according to the tasks they tend to perform in a domestic context, such as identifying the quality of fruit based on its red or purple color) (He et al., 2011; Zhang et al., 2019). Meanwhile, the same scenario would tend to apply to the male gender, which, being considered in a context of nature, outside a domestic zone, tends to demonstrate preferences for colors such as blue and green (He et al., 2011; Zhang et al., 2019).

The authors mentioned above still presented a second theory, called Social Structural Theory. In this, color preferences would be related to a search for equality of gender roles in society (He et al., 2011). Based on this theory, Zhang et al. (2019:969) explain that "Men would prefer some stimulating colors such as yellow to increase their sociability, while women would prefer some energetic and disturbing colors such as orange to increase their aggression-hostility". In science, there is evidence that both confirms and refutes the theories.

2. Objectives

This research's main objective is to identify whether there are differences in color preferences in fashion products across binary genres. From this, three research hypotheses were defined to be tested:

> *H1a. People's gender has a direct impact on how they prefer color in fashion.*

> *H1b. People's gender has a direct impact on how they prefer groups of hues in fashion.*

> *H1c. People's gender has a direct impact on how they prefer color lightness in fashion.*

3. Methodology

In terms of its nature, the research is classified as applied, whose main characteristic is the application and use of knowledge in the fashion industry. Classify as exploratory-descriptive research. As for its approach, it is classified as quantitative research (Gil, 2008). Concerning its methodological procedures, it is classified as a survey, "the purpose of a survey is to provide statistical estimates of the characteristics of a target population, some set of people" (Fowler, 2014:8). Thus, we sought to discover the preference profiles in colors for fashion products. "To do that we designate a subset of that population, a sample, from whom we try to collect information (Fowler, 2014:8).

3.1. *Participants*

The research sought to understand the color preferences for fashion products among people considering the unique colors, the group of hues, and color lightness. In this way, it was also possible to perceive and discuss the color preferences between men and women. The survey's application was conducted with 252 people participated, 176 of them female and 76 men, aged between 7 and 64 years (Table 1).

Category	*N* = 252
Gender	69,84% = Female
	30,16% = Male
Age	54,76% = 7-20 years old
	35,71% = 21-40 years old
	8,73% = 41-60 years old
	0,79% = 61-64 years old

Table 1. *Profile of survey respondents*

3.2. *Sample of colors*

Based on the color chart developed by Silva (2017; 2020) in her works, the survey's questionnaire had a total of 39 colors presented to the respondents. It was devised into 12 pure colors, 12 colors darkened with 50% black, 12

colors lightened at 50% opacity, and three achromatic colors, arranged and divided into four groups of 5 hues and three lightness, and 1 group of 3 hues and three lightness (Fig. 1).

were subjected to the same visualization conditions of the colors and at the same time optimize the time of application of the questionnaires.

Fig. 1. Colors listed presented to the participants, together with the questionnaire (Silva, 2017; 2020).
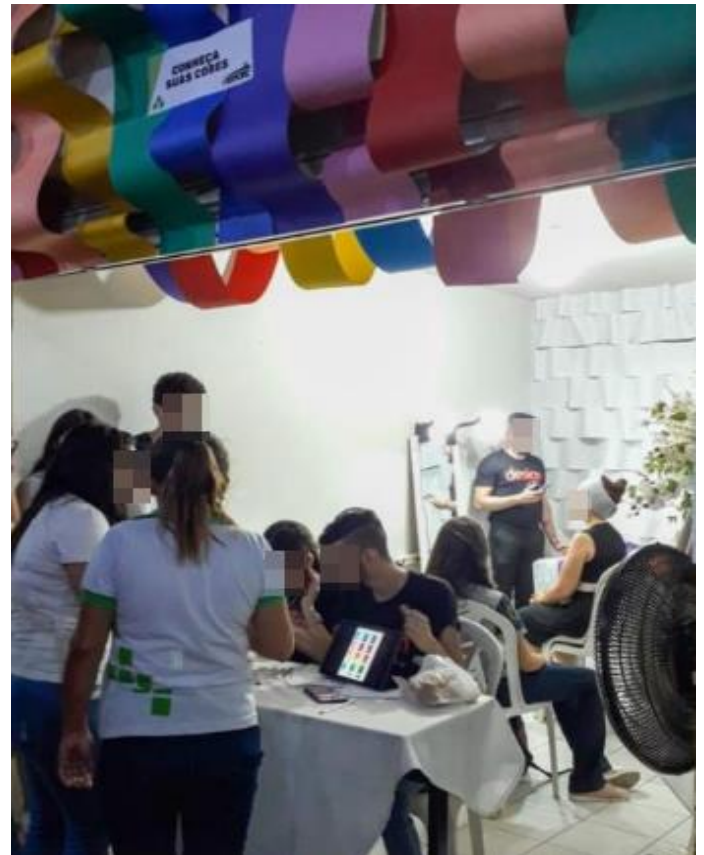
Fig. 2. The thematic room where the questionnaire was applied.

3.3. *Survey process*

The survey was conducted in late 2019 during a scientific and technological exhibition held annually by the Federal Institute of Education, Science, and Technology of Rio Grande do Norte, in Brazil. It was decided to create a thematic room on colors at a science fair where the questionnaire was applied to attract a greater number of respondents to the questionnaire. The room was called *"Know Your Colors"* and was designed to analyze the color temperature and contrast of people's skin and relate these variables to the use of colors in clothes and, in return, these people answered our questionnaire (Fig. 2).

The questionnaire's composition first sought demographic data, and in the second stage was selecting 5 of the colors that the respondents liked most when it comes to fashion products. Two new iPads (6th generation) with a 10.2-inch retina screen and a resolution of 2160 x 1620 pixels at 264 dpi were used for the application. It was a guarantee that both have the same lighting settings, thus ensuring that respondents

The data obtained were analyzed using basic descriptive statistics and ANOVA, focusing on identifying the levels of significance through the statistical analysis software IBM SPSS Statistic 20. The results were compared among themselves, considering divergences and convergences as the central focus in perceptions between genders. This paper consists of an initial and exploratory discussion on color preferences since there are so few works focusing on fashion products, and this research in Brazil is in the early stages.

4. Results: what color do men and women prefer in fashion?

This topic will be organized through the following three subtopics: unique colors, hue and color lightness.

4.1. *Color preferences within unique color*

At first, it is noticed that the color black (159 general choices) and white (75 available choices) has a common

consensus of preference between genders; both colors presented a higher level of preference in general and through genders (Fig 3).

Then, concerning the perspectives of individual genders and going beyond the colors already mentioned, women tended to prefer a shade of dark red (47 choices) and magenta (42 choices), with this set being the four most prominent colors among the female gender. In contrast, four colors derived from green were also identified as the least preferred among the female gender.

Regarding male preferences, trends were identified for preferring the color gray (20 choices) and the color red (20 choices). Unlike the female gender, the colors least preferred by men varied significantly, ranging from dark cyan (3 choices) to dark magenta (2 choices), violet (2 choices), and dark yellow (1 choice).

For the hypothesis outlined in H1a, it was found that there is no significant difference in preferences for individual colors in fashion (p-value = 0.383 > 0.05) [1]. The hypothesis is rejected.
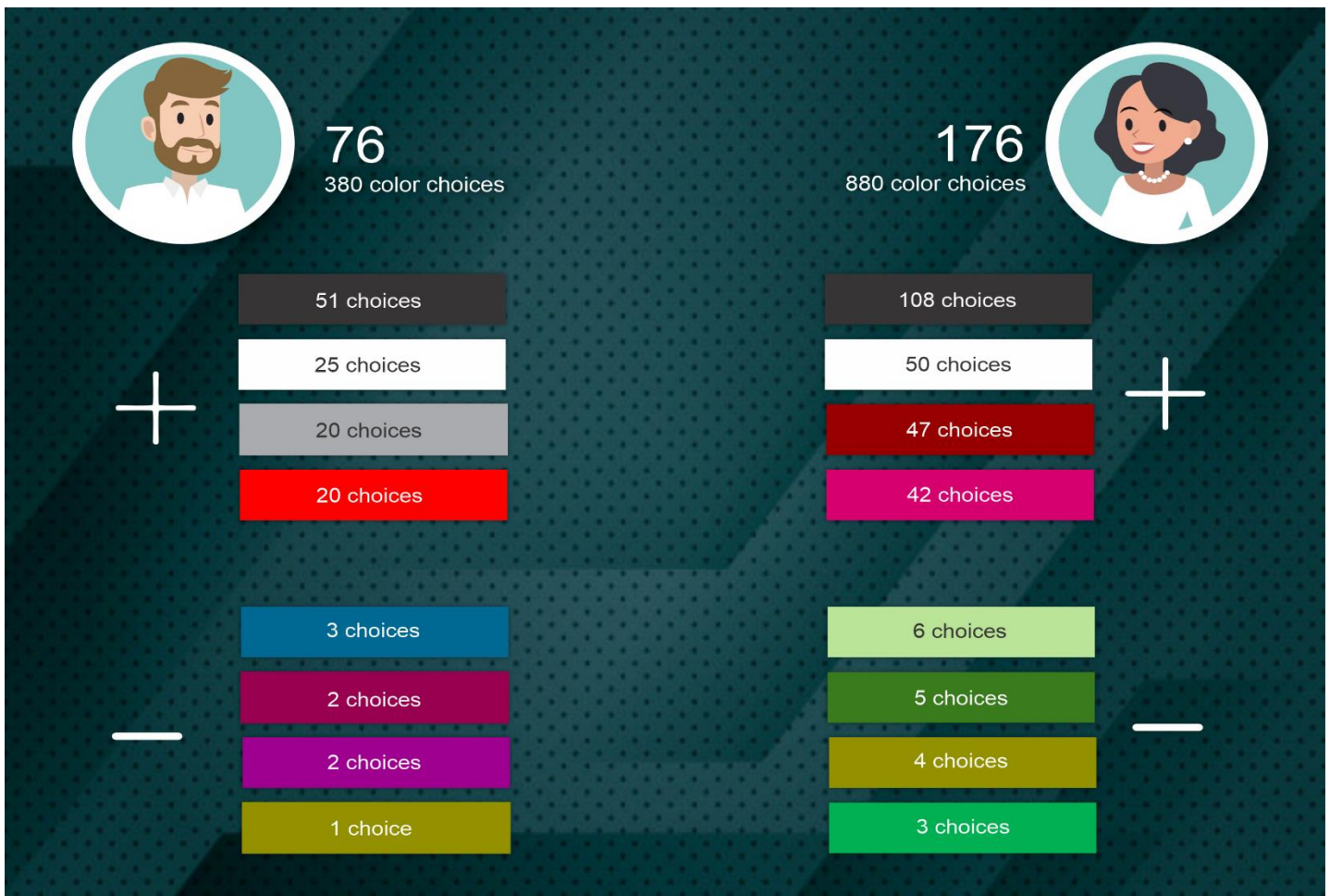
Fig. 3. Main gender color preferences for fashion products [2].

4.2. *Color preferences through the group of hues*

The second analysis of the results was divided between five hues: achromatic (black, white, and gray), greenish, bluish, yellow/orange and reddish, and pinks and lilaceous (see Fig. 1). It was possible to observe that the most preferred hues for the research's general results are pink and violet, with 291 mentions, and greenish hues were the least preferred with only 170 mentions. However, those results are mainly influenced by the level of feminine representation in the research.

Regarding the differences in preferences between genders, it was found that there were 104 mentions of bluish hues among male people, and for pink and lilaceous hues, there were only 50 mentions, characterized as the last in the list. Regarding the female gender, there were 241 mentions of pink and lilaceous hues, the largest number of choices, and 112 mentions of greenish hues, the least preferred group of colors (Fig. 4).

Thus, it is possible to understand that women have a greater preference for pink and lilaceous hues and men for bluish hues, which, in the study by Heller (2013), presents the color blue as preferred among 46% of men, also being consonant with the found by Ellis and Fieck (2001), about colors in general.

Statically, it was found that there is no difference between the groups of hue in color preferences in fashion products for the male gender compared to the female gender (*p-value* = 0,145 > 0,05) [1]. So, regarding the

hypothesis stated in H1b, the evidence indicates that it was not an accepted hypothesis.

4.3. *Color preferences through the color lightness*

In general, dark tones appear as the preferred type of color lightness, with 476 mentions, followed by light tones with 405 mentions and medium tones with 378 mentions (Fig. 5). Therefore, according to the general results, dark tones are the preferred lightness due to the greater preference for the color black in both genders.
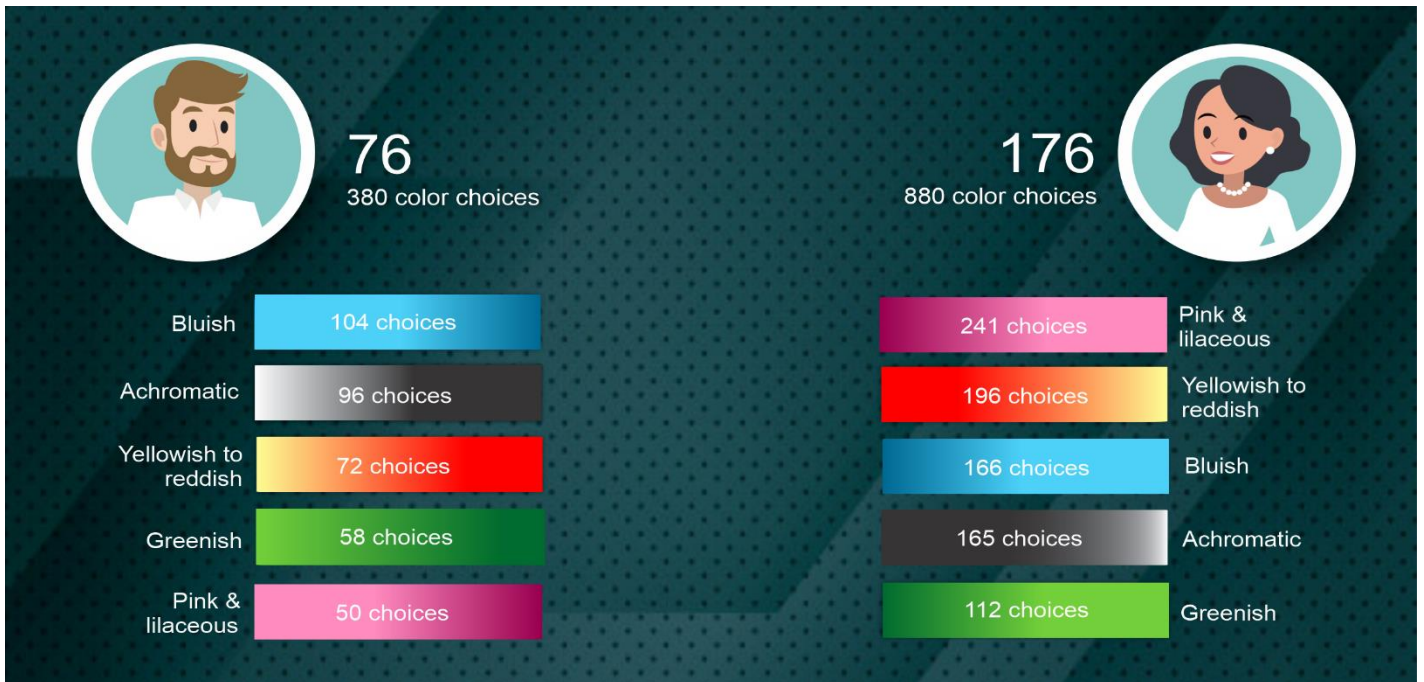

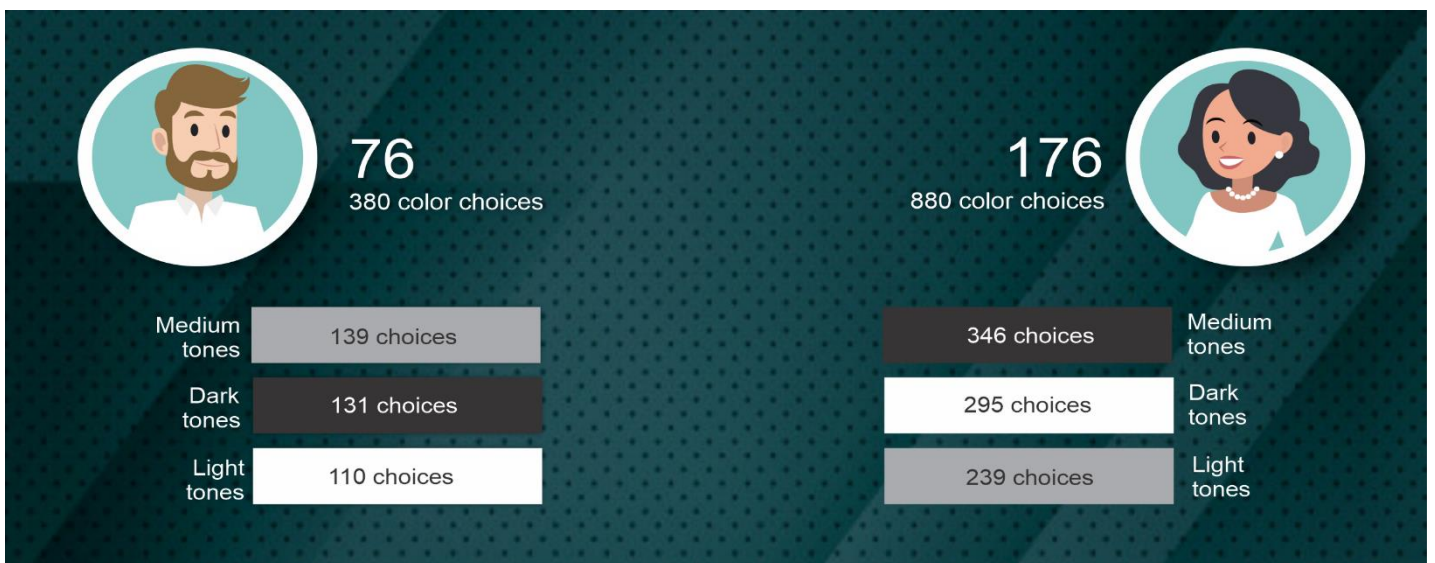*Fig. 4. Color preferences for fashion product through a range of colors [2].*

Fig. 5. Color preferences for fashion product through the color lightness [2].

There is a greater preference for medium tones among males with 139 mentions, followed by 131 mentions for dark tones and 110 for light tones; in general, black is the preferred shade among the men.

Thus, among the female gender, there is a predominance of preference for dark tones with 233 mentions, followed by 198 mentions of light tones and 154 mentions of medium tones; the black tone was preferred among women. What exactly differs from the research by Fortamann-Roe (2011), since the researcher identified a much greater male preference for dark tones and medium tones.

Regarding the hypothesis placed in H1c, it was not possible to identify any significant difference in color preferences across genders in fashion products for color lightness (p-value = 0.919 > 0.05) [1]. Based on this, the hypothesis is indicated as rejected.

5. Discussion: the reflex of gender social construction on color preferences in fashion products

Even though the results statistically suggest no difference in color preferences related to fashion products between genders, we can observe a much greater tendency for women to prefer pink and violet hues and men to higher reject it, preferring bluish hues instead (See Fig. 4). These results were in line with other studies previously developed regarding color preferences in general, without sticking to any product type (Fortamann-Roe, 2011; Heller, 2013; Bonnardel et al., 2018).

These data then suggest a more in-depth approach than would be the social dynamics of sexism rooted in a socio-cultural context, this being Brazil. This sexist thinking is very much in line with the global influences that the country has suffered and still suffers historically, mainly from the mass media. LoBue and DeLocache (2011: 663) bring that "if pink is what helps define a girl, it is not surprising that boys would have the opposite reaction".

Thus, the thought of clothing is rooted in society as a daily communication vehicle attached to one's body, actively participating in a society's interpersonal relationships, becoming part of itself, and reflecting visual messages (Jones, 2005). It is based on the thinking of fashion as a means of permeating a message that the male gender tends to create a departure from the use of clothing that brings the color pink as central since it automatically brings him closer to features that resemble the female gender (Ben-Zeev and Dennehy, 2014; Ishii et al., 2018). In Brazilian society, among cisgender men of heterosexual orientation, this approach to femininity that

the use of pink automatically brings, ends up being seen as something negative, as a denial of its masculinity (Schwinn and Funck, 2019).

The idea of *'pink for girls and blue for boys'* is a socio-cultural concept established since the individual is a child (Kilinç, 2011). The artifacts in the marketed for these age groups, such as toys, are limited and categorized through targeting the male gender, appropriating blue and green, and to the feminine, delimiting the colors pink and lilac. LoBue and Delocache (2011:665) go on to explain that "while girls are developing a preference for pink with age, boys are developing an avoidance of pink at the same time". These reinforced influences since childhood grow with our social preconceptions and become part of the judgments that we develop daily, guiding our purchase intensities sometimes only in the colors that certain artifacts carry and how they impact our social image, where men tend to refuse to wear a certain set of clothes because they are pink, lilac or red (Heller, 2013; Ben-Zeev and Dennehy, 2014; Ishii et al., 2018).

6. Final considerations

The research demonstrated the need further to investigate color preferences with a focus on fashion products. The results suggest that the preferences identified in this work are not derived either specifically from what is proposed in Hunter-Gatherer Theory or Social Structural Theory. As discussed earlier, the core of this color preference has been the pink and blue semantics' socio-cultural construction when related to genres. The results reveal this categorization of sexism projected in color as being more present in male fashion choices.

This work starts developing research in Brazil in an area not explored before. Creating a basis for what to be formalized and validated in future research as a theory about the potentializing and appearance of color preferences in fashion products and their socio-cultural and semantics perception. Besides, designers can find an opening of possibilities to explore the dimension and the psychological relationship between color-product-consumer.

Some previous studies suggest that the female preference for the color pink is directly linked to the age of the people studied, occurring mainly in children or young people. However, relationships between age and color preferences were not analyzed in this research and can be explored in other future studies.

7. Conflict of interest declaration

8. Funding source declaration

9. Acknowledgment

10. Short biography of the authors

Ítalo José de Medeiros Dantas - Master's Student in Design at the UFCG/UAD (Brazil) and Fashion Designer at the IFRN (Brazil). Research member of the Pro-Cor do Brasil Association and the Language of Color and Environment Color Design study groups from the AIC. Conducts research in the field of visual and semantic color messages, color psychology applied to fashion, and color preferences in clothing products.

Aline Gabriel Freire – Textile Engineer at the UFRN (Brazil), Master in Textile Engineering at the UFRN (Brazil) and fashion stylist at the SENAI (Brazil). Professor in the areas of textiles, clothing and fashion at the IFRN (Brazil). Researcher and extensionist in the areas of colors applied to the creative process, innovation in textile materials, modeling and circular economy.

Lívia Juliana Silva Solino – Professor and Coordinator of the Fashion Design Undergraduate course at IFRN (Brazil). Undergraduate in Fashion Design at UFC (Brazil) and Master in Production Engineering at UFRN (Brazil). She works in the areas of Slow Fashion, Innovation in Fashion Products, Processes and Color

Psychology. In addition to actively participating in university extension, promoting the circular economy.

Mariana Nunes do Nascimento - Technician in Clothing Production and Undergraduate in Fashion Design by the Federal Institute of Rio Grande do Norte (Brazil). She worked as a research student at the Textile and Clothing Research Center (IFRN). Conducts research in the area of product development to elderly, shoe ergonomics, color psychology applied to fashion and color preferences in clothing products.

Heloisa Mirelly Ferreira Alves - Undergraduate in Fashion Design by the Federal Institute of Rio Grande do Norte (Brazil). She worked as a research student at the Textile and Clothing Research Center (IFRN). Conducts research in the area of product development to elderly, shoe ergonomics, color psychology applied to fashion and color preferences in clothing products.

Notes

[1] When the p-value is higher than 0,05, we reject the hypothesis stated.

[2] Male and female graphic figure used in the image was created by *Pikisuperstar*. Available at https://br.freepik.com/pikisuperstar.

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Non-invasive identification of dyed textiles by using Vis-NIR FORS and hyperspectral imaging techniques

Greta Peruzzi[1], Costanza Cucci[1], Marcello Picollo[1], Franco Quercioli[2], Lorenzo Stefani[1]

[1] *Istituto di Fisica Applicata "Nello Carrara" del Consiglio Nazionale delle Ricerche (IFAC-CNR), via Madonna del Piano 10, 50019 Sesto Fiorentino (FI)*

[2] *Istituto Nazionale di Ottica (INO-CNR), via Madonna del Piano 10, 50019 Sesto Fiorentino (FI)*

Corresponding author: Greta Peruzzi (gretaperuzzi@icloud.com)

ABSTRACT

Natural dyes have been utilized since ancient times to produce colorful garments and, at the same time, each culture has developped its own traditional designs and techniques during the centuries. Hence, in order to accomplish a proper conservation program of these artefacts, it is fundamental the importance of studying the used dyes on historic textiles. Traditionally, the identification is carried out through invasive or micro-invasive techniques such as HPLC or Raman-SERS. However, a first screening using non-invasive approaches, that could tentatively identify some of the dyes in a contactless mode, is strongly reccommended. The present study focuses on the application of non-invasive spectroscopic techniques, namely FORS and hyperspectral imaging in the visible and near infrared range, for the identification of dyes on textiles. Twelve natural dyestuffs (twelve from plant, two insect dyes and a lichen) and three mordants ($KAl(SO_4)_2$, $CuSO_4 \cdot 5H_2O$, $FeSO_4 \cdot 7H_2O$) were selected and combined to create a set of wool samples whose reflectance spectra, acquired using FORS technique, were the basis for a spectral database. The same set was used to test the Specim IQ hyperspectral camera, with positive results for a non-invasive investigation on wider areas. The application of Spectral Angle Mapping (SAM) gave the possibility to map directly on the image pixel with similar spectral features. Finally, colorimetric data were acquired with a spectrocolorimeter to obtain chromaticity coordinates.

KEYWORDS Natural dyes, wool fiber, FORS, hyperspectral imaging, textiles, non-invasive

1. Introduction

Natural dyestuffs have been used since ancient times to dye fabrics and yarns to obtain colorful clothes. Every culture has its own traditions, which include materials and processes of manufacturing. For this reason, in order to accomplish a complete investigation on ancient textiles it is fundamental to be able to recognize which dye has been used to understand those techniques and materials, both to pursue a proper conservation program and to discover more about the manufacturer who made the object.

Natural dyes can be classified according to two criteria: color or dyeing method (Hofenk de Graaff, Roelofs and Bommel, 2004; Cardon, 2007). The classification based on the dyeing methods includes direct-, mordant-, and vat-dyes. Direct dyes are chemical compounds, soluble in water, whose structures are full of polar groups that can bind directly to the fibers without using any other compound. Mordant dyes, on the other hand, need a medium, the mordant, which is a metal salt with a chelating structure that binds the color to the fiber. Some typical mordants are alum, sulphates (mainly iron or copper), stannous chloride and potassium chromate, but also tannins were used (Cardon, 2007). Vat dyes are chemical compounds that are not soluble in water; therefore, they must undergo a redox reaction to give the thread a color. First, the dye is dissolved in an alkaline bath where the fibers are impregnated with the soluble form of the dye and then exposed to air to oxidize and reach the final color.

Traditionally the possibility to make an accurate identification of dyes on archaeological and historical clothes and textiles is accomplished through invasive or micro-invasive methods. In this sense, the most used technique is High Pressure Liquid Chromatography (HPLC) (Ferreira et al., 2000; Rosenberg, 2008) which involves the extraction of the dye from the fiber. A more recent application to the identification of dyes is Raman-SERS (Leona, 2004), that involves the use of metal colloids to enhance the Raman signal and avoid fluorescence, but that is still micro-invasive (Leona, Stenger and Ferloni, 2006; Zaffino et al., 2014; Bernardino, de Faria and Negrón, 2015; Ricci et al., 2016). Nonetheless, the use of non-invasive methodologies is fundamental when working with object of artistic and cultural importance. That is the reason why a spectroscopic approach could be useful as a first screening to try to identify some of the dyes without direct contact with the analyzed object.

Dyeing molecules contain functional groups (chromophores) that cause color and other groups, called auxochromes, which – although not directly responsible

of color – can influence the absorption of radiation and consequently make the molecule colored (McMurry, 2012). The possibility of acquiring reflectance spectra in the ultraviolet (UV), visible (Vis) and near infrared (NIR), in some cases, can lead to the identification of the main spectroscopic features of each dye and to distinguish the dyes, or at least their nature (flavonoids, anthraquinones, etc.), despite all the boundary conditions that can affect the spectrum (McMurry, 2012). In particular, fiber optics reflectance spectroscopy (FORS) in the UV-Vis-NIR range, which has been used for the investigation of works of art since the 1990s and has become an established technique for the study of artists' materials (Bacci, 2000), represent a valid option because of its portability and ability to perform non-invasive fast in situ analysis. Moreover it is reported in many recent studies, as for example (Angelini et al., 2010; Gulmini et al., 2013; Maynez-Rojas, Casanova-González and Ruvalcaba-Sil, 2017; de Ferri et al., 2018; Aceto et al., 2020) that this technique has shown positive results for a preliminary identification of dyes on textiles.

The present study is focused to create a UV-Vis-NIR spectroscopic database on colored wool fibers, whose aim is to help conservation scientists and conservators – albeit in the preliminary stages of their investigation – to recognize dyes in a non-invasive way. Therefore, twelve natural dyestuffs, selected among those sources of color historically used to dye textiles, and three mordants were employed to tint raw wool according to ancient recipes. Data were collected in the 350-1000 nm range using FORS technique. Also colorimetric data were acquired using a spectrocolorimeter to calculate for each sample its chromaticity coordinates.

Furthermore, the application of the emerging imaging spectroscopic technique (Casini et al., 2005; Delaney et al., 2010; Vitorino et al., 2015; Cucci, Delaney and Picollo, 2016; Blanch-Perez-del-Notario, Saeys and Lambrechts, 2019; Striova, Dal Fovo and Fontana, 2020) which combines the potentiality of spot spectroscopic with imaging techniques, made it possible to extend the FORS analysis to larger areas. This was the reason for testing the Specim IQ (Cucci et al., 2017, 2018; Picollo et al., 2020) hyperspectral camera (Specim, Spectral Imaging Ltd, Oulu, Finland) which is compact and portable, to the same samples used to create the spectroscopic database.

2. Method

2.1. *Preparation of samples*

In the present work, twelve dyes and three mordants were selected within those historically used in dyeing.

Among the selected dyes, nine are from plants (*Alkanna Tinctoria, Anthemis Tinctoria, Indigofera Tinctoria, Haematoxylum Campechianum, Rubia Tinctorum, Carthamus Tinctorius, Curcuma Longa, Juglans Regia, Reseda Luteola*), two are insect dyes (*Dactylopius Coccus Cacti* and *Kerria Lacca*) and one is a lichen (*Roccella Tinctoria*). The preparation of samples was made by a specialist in the field following historical recipes on a set of skeins of raw wool, each of 20 g, that was prepared with three selected mordants (KAl(SO4)2, CuSO4 · 5H2O, FeSO4 · 7H2O) to enrich the color palette.

The cochineal dyed wool was etched with both alum and a mixture of alum and iron sulfate. The indigo and orchil dyes were employed with a vat procedure. The quantity of material used (% weight/weight is referred to dry material) is reported in table 1.

Table 1:Percentage of the amount of dyeing material used referred to dry weight.

		%w/w
Alkanet	*Alkanna Tinctoria*	100%
Chamomile	*Anthemis Tinctoria*	100%
Cochineal	*Dactylopius Coccus Cacti*	12%
Indigo	*Indigofera Tinctoria*	5-6%
Lac	*Kerria Lacca*	8%
Logwood	*Haematoxylum Campechianum*	30%
Madder	*Rubia Tinctoria*	100%
Orchil	*Roccella Tinctoria*	unknown amount of lichen macerated for a month in water and ammonia solution
Safflower	*Carthamus Tinctorius*	100%
Turmeric	*Curcuma Longa*	100%
Walnut	*Juglans Regia*	100%
Weld	*Reseda Luteola*	100%

The extraction of the dyes was carried out by soaking most of the plants and cochineal in water for twelve hours and then boiling the mixture for at least one hour. The alkanet dye was extracted in alcohol and the *Kerria Lacca* insect was left in a solution of water and citric acid. Subsequently, the whole was filtered to obtain the bath-color in which the skeins were soaked. Some skeins were mordanted before the dyeing process using alum 25% by weight, while iron and copper sulfate (both 10%) were used simultaneously with dyes in the bath-color.

The vat dyeing process was carried out for indigo and orchil. The indigo was left to ferment in a solution with 5% indigo, 5% sodium hydrosulfite, 10% soda Solvay to obtain the water-soluble compound. The yarn was then soaked in the bath for twenty minutes at 55°C and subsequently exposed to air to oxidize and reach the final color. Orchil dye was instead extracted by leaving the lichens in a solution of water and ammonia for one month. Therefore, the dyeing process was similar to the indigo vat process.
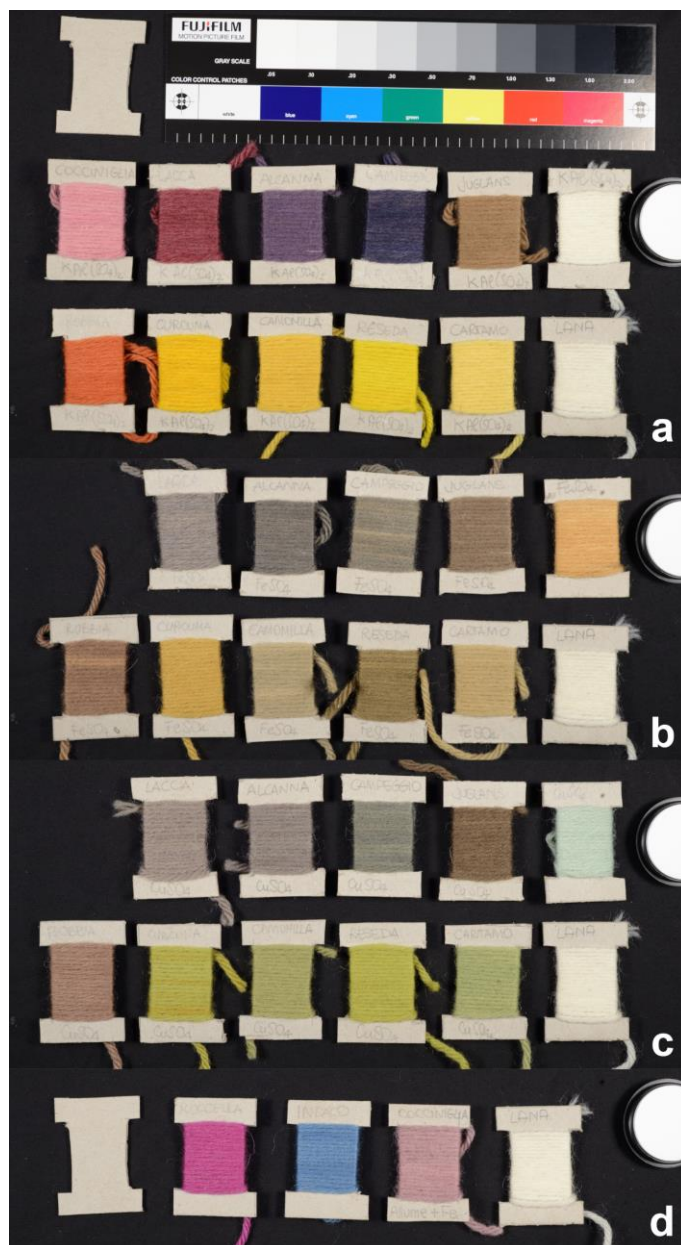

Figure 1: Overall of the set analyzed. Samples etched with alum (a), iron sulfate (b) and copper sulfate (c), without mordant (d).

2.2. Experimental

Colorimetric analysis were carried out using a Konica Minolta CM-700d spectrocolorimeter, operating in the 360-740 nm range with a 10 nm wavelength pitch. The instrument features a diffraction grating, a silicon photodiode

double array and a pulsed xenon lamp with UV cut filter. The measurement setup was: 8mm ø illumination area, d/8° geometry with both specular component included (SCI) and excluded (SCE). The colorimetric calculation was done for CIE 10° standard observer and D65 illuminant.

The FORS data were acquired using a compact module, which is portable and features in a unique chassis two spectroanalysers equipped with fiber optics. Here, it was decided to use only the Zeiss MCS601 UV-NIR spectroanalyser, which is equipped with a multi-channel spectrometer (MCS) polychromator with 1024 diodes, 0.8 nm spectral pixel pitch and 2.4 nm spectral resolution. The reflectance spectra were acquired in the 350-1000 nm range with 298.5 ms integration time, continuous dark current mode, and each spectrum was the average of three acquisitions to improve the s/n ratio. Silica fiber optic bundles were used to send and to collect the radiation to and from the samples with a 2x45°/0° geometrical configuration to avoid the reflected specular radiation (Bacci, 2000). All samples were previously analyzed using a Perkin Elmer Lambda 1050 UV-Vis-NIR spectrophotometer in the 200-2500 nm range to obtain full information over the UV-Vis-NIR range and to understand were to focus the FORS measurements. The 1000-2200 nm region was excluded from the FORS measurements as it is practically covered by the wool spectral features.

Hyperspectral data were acquired using a Specim IQ hyperspectral camera, compact and portable, with an user-friendly interface, reduced weight and dimensions compared to those instruments conventionally used in hyperspectral imaging. The IQ camera operates in the 400-1000 nm range with a 7 nm spectral resolution. It features a CMOS linear sensor with a sampling pitch of 3.5 nm for 204 spectral bands. Images resolution is 512x512 pixel and data (file-cube) are almost 300MB (Cucci *et al.*, 2017, 2018). The experimental setup chosen consists of an illumination system with a fiber optic bundle and two light diffusers to send the radiation from the source (150W halogen lamp equipped with a IR cut filter) to the sampling zone, with a 2x45°/0° geometry. Integration time was fixed for all measurements at 55ms, for an overall of 50s acquisition time. The 'custom' modality was selected to collect data, and the reference was taken using a 99% reflectance Spectralon® Labsphere. Calibration of wavelengths was done using a reference of orange plexiglass. Furthermore, a luxmeter was employed during the data acquisition to record the amount of radiation sent over the sample, which was approximately 2000 lux, 45 mW/m^2 (almost 22.5 µW/lm of UVa radiation). It is important to underline that these parameters are within the recommended values of UVa radiation dose for objects that are sensitive of UV-Vis radiation, such as dyes and textiles.

3. Results

3.1. *Colorimetry*

Measurements were carried out on all samples, including those with raw wool and cardboard only. Three spectra were recorded for each sample to assure repeatability and to evaluate the error for each set of measurements. In table 2 arithmetic averages are shown for both SCI and SCE L*a*b* (CIE1976) values and their color difference, ∆E, was obtained using the CIEDE2000 formula. Colorimetric data show that SCI and SCE values are not dissimilar and that ∆E is below the threshold of human difference color perception.

3.2. *Fiber Optics Reflectance Spectroscopy (FORS)*

For each sample, three FORS measurements were acquired, positioning the bundles parallel, orthogonal and oblique to the yarn's fibers. The three reflectance spectra compared did not show differences despite the reflectance intensity. Hence, it was decide to choose the orthogonal configuration to build up the spectral database, since it showed the highest reflectance values.

The comparison between spectra of wool with the three mordants highlights the influence of the metallic salts on the spectral features. In particular, wool samples etched with iron and copper sulfate show important absorptions in the UV-Vis region that can affect the spectral features of dyes, making it possible to distinguish dyes not only depending on their chemical nature but also on the mordant used.

Through the identification of dyes of the same color emerged the impossibility to distinguish yellows (chamomile, safflower, turmeric, weld) etched with iron and copper sulfate (Angelini *et al.*, 2010). Instead, it is possible to partially discern yellow dyes etched with alum (Fig.2) since all samples show a wide absorption band in the 300-450 nm region, but safflower and chamomile absorb at lower wavelengths compared to turmeric and weld. Moreover, weld and chamomile show a smooth shoulder at 660-670 nm. Regardless, to accomplish a deep discrimination of yellow dyes it would be useful to apply statistical and multivariate procedure, such as PCA (Cazenobe *et al.*, 2002).

Red dyes can be divided into animal and vegetal according to the n→π* absorption of the anthraquinones' carbonyl group, which occurs at 500 nm and 540 nm for madder and at 524 nm and 560 nm for cochineal and lac (Gulmini *et al.*, 2013; Vitorino *et al.*, 2015; de Ferri *et al.*, 2018). Though, it is not possible to distinguish the two insect dyes except by studying their first derivative as reported in (Fonseca *et al.*, 2019) and shown in Fig. 3. The identification of animal and vegetal red, instead, it is not possible with samples etched with iron and copper sulfate.

Table 2: CIEL*a*b*1976 values and color difference (ΔE$_{00}$) between SCI and SCE measurements obtained with CIEDE2000 formula for each sample

| SAMPLE	SCI			SCE			ΔE$_{00}$
	L*	a*	b*	L*	a*	b*	
Alk_Cu	45.71 ± 0.22	1.69 ± 0.24	6.56 ± 0.19	45.69 ± 0.25	1.70 ± 0.24	6.58 ± 0.19	0.03
Alk_Fe	39.95 ± 0.36	1.36 ± 0.05	5.39 ± 0.16	39.88 ± 0.38	1.38 ± 0.05	5.41 ± 0.16	0.06
Alk_Al	33.91 ± 0.15	7.24 ± 0.15	-5.06 ± 0.18	33.84 ± 0.12	7.26 ± 0.16	-5.04 ± 0.18	0.07
Card_	70.52 ± 0.01	1.25 ± 0.01	7.96 ± 0.01	70.36 ± 0.01	1.26 ± 0.01	7.99 ± 0.01	0.13
Cha_Cu	52.99 ± 1.06	-3.65 ± 0.28	26.11 ± 0.27	52.93 ± 1.10	-3.64 ± 0.28	26.12 ± 0.29	0.06
Cha_Fe	53.10 ± 0.38	2.80 ± 0.04	17.74 ± 0.15	53.01 ± 0.25	2.79 ± 0.05	17.76 ± 0.16	0.09
Cha_Al	62.39 ± 0.07	12.59 ± 0.05	49.83 ± 0.04	62.34 ± 0.09	12.60 ± 0.05	49.83 ± 0.04	0.04
Coc_Al	56.43 ± 0.04	25.88 ± 0.02	3.59 ± 0.01	56.40 ± 0.05	25.87 ± 0.03	3.62 ± 0.03	0.03
Coc_AlFe	53.13 ± 0.01	14.94 ± 0.01	2.57 ± 0.01	53.02 ± 0.01	14.95 ± 0.02	2.60 ± 0.01	0.08
Ind_	46.27 ± 0.03	-6.16 ± 0.01	-13.87±0.01	46.22 ± 0.02	-6.18 ± 0.01	-13.84 ± 0.02	0.05
Lac_Cu	48.46 ± 0.02	2.76 ± 0.01	7.76 ± 0.01	48.44 ± 0.01	2.77 ± 0.001	7.79 ± 0.01	0.03
Lac_Fe	48.26 ± 0.02	3.08 ± 0.01	5.39 ± 0.01	48.15 ± 0.01	3.09 ± 0.01	5.42 ± 0.01	0.12
Lac_Al	32.14 ± 0.01	25.36 ± 0.02	2.34 ± 0.01	32.03 ± 0.02	25.38 ± 0.01	2.38 ± 0.02	0.09
Log_Cu	42.60 ± 0.18	-1.96 ± 0.03	8.44 ± 0.15	42.59 ± 0.18	-1.95 ± 0.03	8.46 ± 0.16	0.03
Log_Fe	46.48 ± 1.06	1.34 ± 0.06	10.34 ± 0.24	46.39 ± 1.06	1.35 ± 0.06	10.36 ± 0.23	0.09
Log_Al	25.26 ± 0.13	1.67 ± 0.01	-5.91 ± 0.03	25.21 ± 0.13	1.66 ± 0.01	-5.88 ± 0.03	0.05
Mad_Cu	46.62 ± 0.01	10.27 ± 0.01	10.38 ± 0.01	46.58 ± 0.01	10.28 ± 0.01	10.40 ± 0.01	0.04
Mad_Fe	43.17 ± 0.02	10.03 ± 0.01	11.67 ± 0.01	43.05 ± 0.01	10.04 ± 0.01	11.69 ± 0.01	0.11
Mad_Al	43.09 ± 0.01	37.73 ± 0.01	26.06 ± 0.01	43.05 ± 0.01	37.75 ± 0.01	26.10 ± 0.01	0.05
Orc_	39.97 ± 0.01	32.16 ± 0.01	-6.85 ± 0.01	39.95 ± 0.01	32.23 ± 0.01	-6.80 ± 0.01	0.05
Saf_Cu	55.68 ± 0.02	-7.27 ± 0.04	25.66 ± 0.16	55.62 ± 0.25	-7.25 ± 0.03	25.69 ± 0.18	0.07
Saf_Fe	55.85 ± 0.13	5.28 ± 0.02	24.28 ± 0.07	55.79 ± 0.09	5.28 ± 0.02	24.31 ± 0.06	0.07
Saf_Al	71.56 ± 0.04	5.43 ± 0.02	47.35 ± 0.01	71.56 ± 0.04	5.45 ± 0.02	47.45 ± 0.02	0.03
Tur_Cu	55.74 ± 0.10	-2.06 ± 0.05	37.56 ± 0.19	55.68 ± 0.06	-2.04 ± 0.06	37.58 ± 0.19	0.04
Tur_Fe	55.75 ± 0.42	11.35 ± 0.09	34.69 ± 0.09	55.78 ± 0.34	11.34 ± 0.06	34.69 ± 0.01	0.11
Tur_Al	63.78 ± 0.04	17.84 ± 0.04	74.99 ± 0.02	63.72 ± 0.03	17.96 ± 0.04	75.14 ± 0.04	0.06
Wal_Cu	34.70 ± 0.03	4.53 ± 0.02	11.83 ± 0.02	34.67 ± 0.03	4.55 ± 0.03	11.84 ± 0.02	0.03
Wal_Fe	42.10 ± 0.02	5.67 ± 0.01	11.60 ± 0.01	41.98 ± 0.01	5.69 ± 0.01	11.62 ± 0.01	0.11
Wal_Al	42.20 ± 0.03	8.90 ± 0.01	16.03 ± 0.02	42.07 ± 0.02	8.94 ± 0.02	16.07 ± 0.01	0.12
Wel_Cu	56.30 ± 0.06	-3.34 ± 0.01	42.10 ± 0.05	56.19 ± 0.07	-3.33 ± 0.01	42.11 ± 0.04	0.11
Wel_Fe	42.04 ± 0.03	3.86 ± 0.01	18.55 ± 0.01	42.02 ± 0.02	3.87 ± 0.01	18.59 ± 0.01	0.03
Wel_Al	68.46 ± 0.01	6.36 ± 0.01	77.51 ±0.01	68.41 ± 0.03	6.37 ± 0.01	77.55 ± 0.02	0.04
Woo_Cu	69.93 ± 0.01	-9.59 ± 0.01	12.43 ± 0.01	69.87 ± 0.02	-9.57 ± 0.01	12.47 ± 0.02	0.06
Woo_Fe	58.48 ± 0.26	14.26 ± 0.03	30.42 ± 0.16	58.47 ± 0.25	14.27 ± 0.03	30.43 ± 0.16	0.02
Woo_Al	85.67 ± 0.01	-0.54 ± 0.01	15.75 ± 0.01	85.64 ± 0.03	-0.58 ± 0.01	15.82 ± 0.01	0.06
Woo_raw	84.16 ± 0.03	-0.20 ± 0.01	14.97 ± 0.01	84.12± 0.03	-0.22 ± 0.01	15.02 ± 0.01	0.04
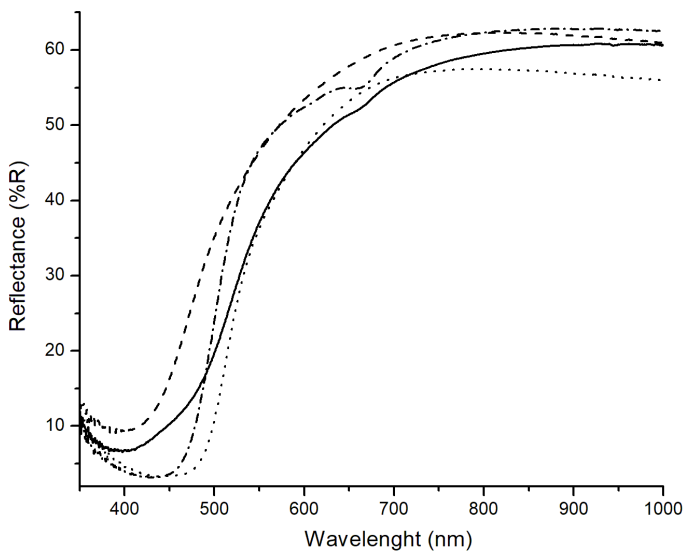
Figure 2: Reflectance spectra of yellow dyes etched with alum: chamomile (solid line), safflower (dash line), turmeric (dot line), weld (dash dot line).
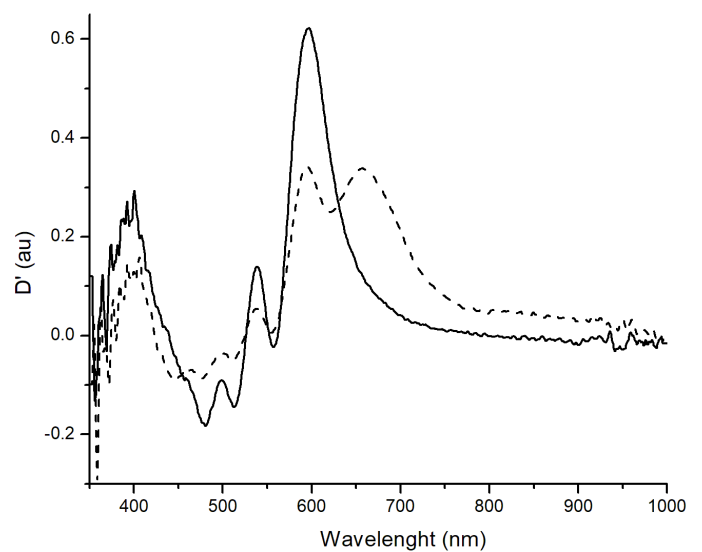

Figure 3: First derivative spectra of animal red dyes: cochineal (solid line) and lac (dash line), both etched with alum.

Purple-bluish samples (alkanet, logwood, orchil and indigo) show reflectance spectra that make their identification possible according to values reported in literature (Fig. 4). In particular it is possible to observe two bands at 424 nm and 588 nm (Gulmini *et al.*, 2013) for logwood with alum mordant and two bands at 545 nm and 580 nm (Aceto *et al.*, 2015) for the orchil dyed sample. Instead the indigo dyed sample shows the typical $\pi \rightarrow \pi^*$ absorption of the indigo molecule around 660 nm

and another week band at 550 nm (Monahan and Kuder, 1972) and a shoulder at 345 nm (Gulmini *et al.*, 2013).

The only dark dye present in the investigated set of samples (walnut) did not show any characteristic absorption. However, its spectral features in the three spectra corresponding to different mordants makes walnut dye easily distinguishable from the others in the set.
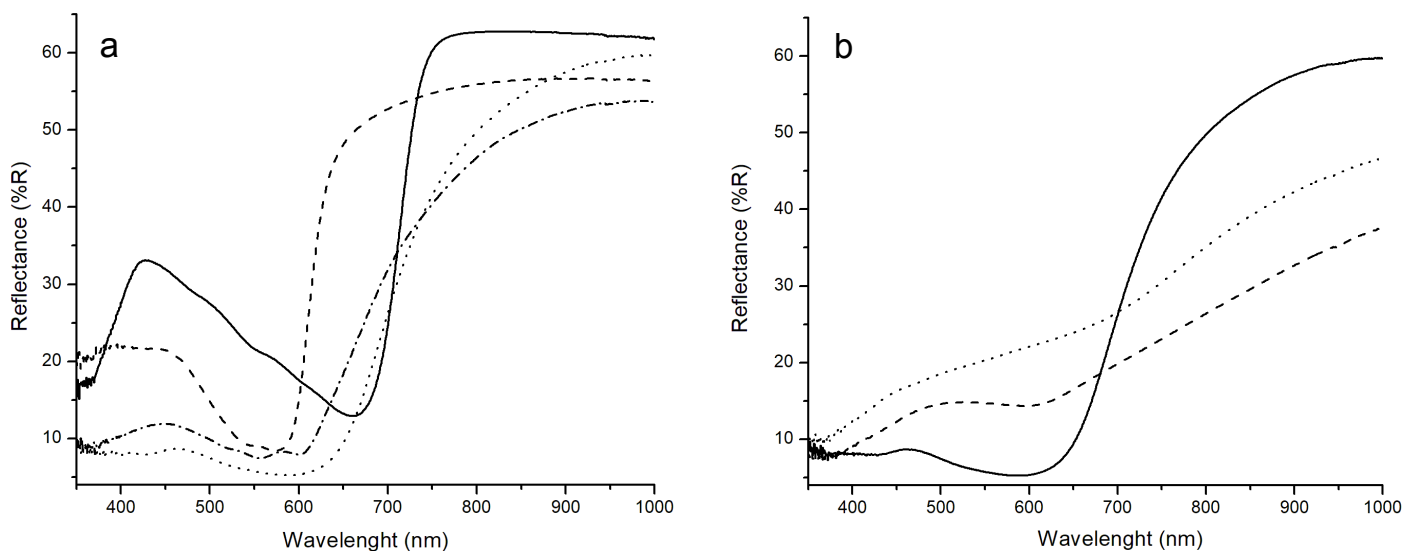

Figure 4: a) Reflectance spectra of indigo (solid line), orchil (dash line), logwood (dot line) and alkanet (dot dash line) both etched with alum. b) Reflectance spectra of logwood etched with alum (solid line), copper sulfate (dash line), iron sulfate (dot line).
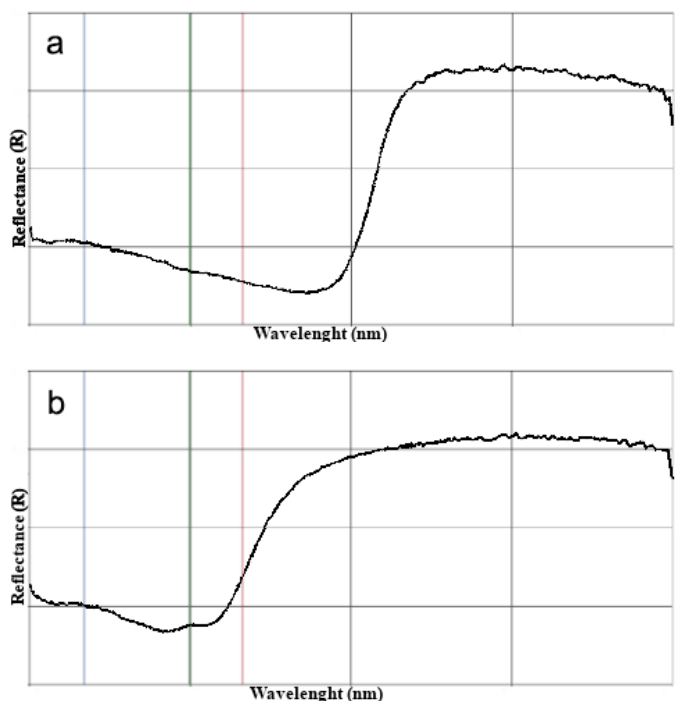

Figure 5: Reflectance spectra of indigo (a) and cochineal (b) extracted out of the file-cube using Specim IQ Studio.

3.3. *Hyperspectral imaging*

Hyperspectral data were acquired grouping samples both by hues (reds, yellows, etc.) and by the same type of dye in order to compare shades of the same dye etched with the three different salts.

Results show that spectra obtained with Specim IQ camera are comparable to those obtained with FORS. Indeed, for most of the samples it was possible to qualitatively identify the compound immediately after the acquisition of file-cube data. For examples, samples dyed with cochineal and indigo have the same spectroscopic features encountered in FORS spectra (Fig. 5). Quite the opposite happens with lac and madder both etched with alum which are difficult to discriminate, since spectra extracted out from file-cubes show a wide absorption band: at 400-550 nm in the case of madder and at 500-600 nm for lac.

The same consideration applies to the purple-bluish dyes, especially in the case of alkanet and logwood where spectra are not well resolved. Nevertheless, thanks to the use of the Spectral Angle Mapping (SAM)

algorithm, it is possible to map directly on the image pixels with similar spectral features to recognize areas where alkanet was used rather than logwood (Fig. 6).

Hyperspectral data of yellow dyes etched with alum show that, as predictable, it is impossible to identify dyes because all spectra extracted out from the file-cube present similar features. However, the SAM algorithm permits to distinguish the four yellow dyes applying a high tolerance angle between 2.56 and 1.81 rad.
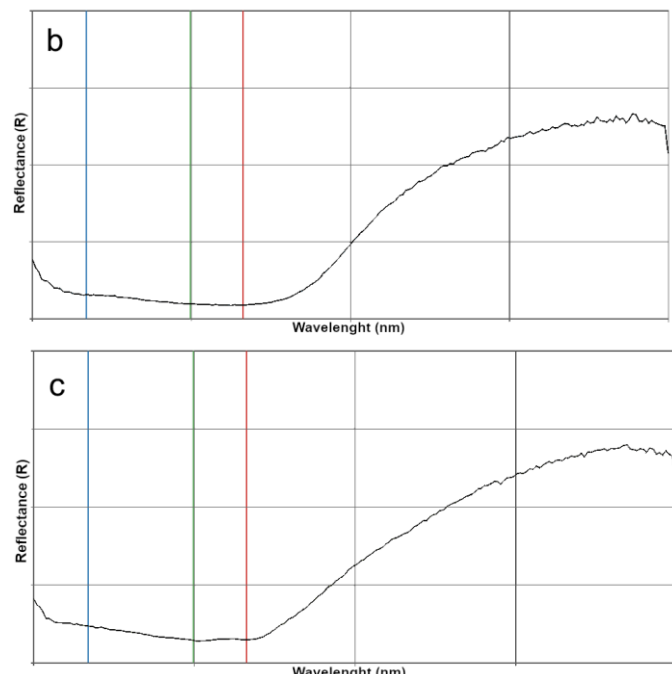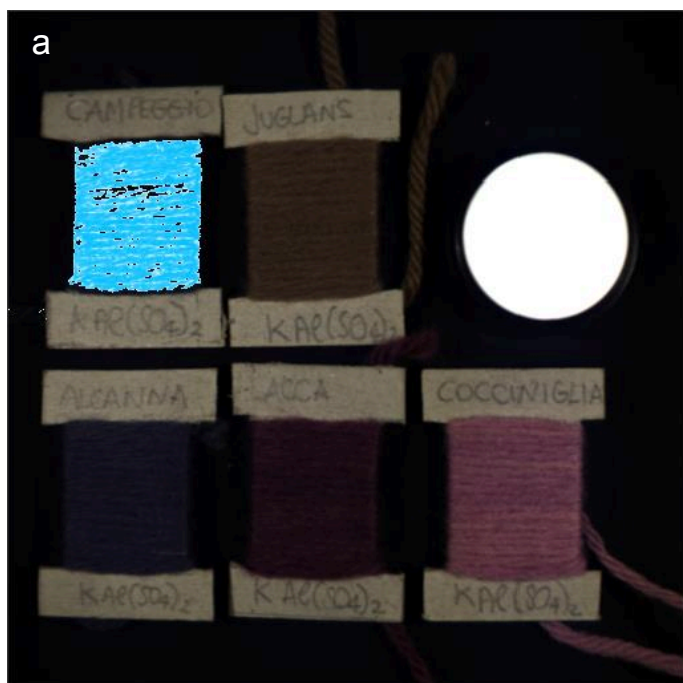

Figure 6: a) Areal distribution of pixel with the same spectral features obtained applying SAM algorithm on logwood file cube.Reflectance spectra of logwood etched with alum (b) and alkanet etched with alum (c), both extracted out of the file-cube using Specim IQ Studio.

4. Conclusion

Results obtained in the present study constitute the basis for the creation of a spectroscopic database that will be soon online on the IFAC-CNR website. The twelve dyes here analyzed represent only a starting point and it is already planned to include more dyes and typology of yarns in the future.

The acquired data show convincing results for a qualitative, in situ analysis to identify dyes. FORS was confirmed to be a valid technique to preliminary discern dyes according to their spectral features, being a non-invasive portable technique.

Finally, the Specim IQ camera permitted the non-invasive acquisition of imaging hyperspectral data on the set. Spectra extracted out of file-cubes were comparable to those obtained with FORS for most of the samples and made it possible a qualitative analysis on wider areas for each file-cube. Furthermore, the application of SAM algorithm permitted to map pixels with the same spectral features in order to recognize areas dyed with the same colorant.

5. 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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8. Short biography of the authors

Greta Peruzzi - Master student in Conservation Science at Sapienza University in Rome. Her interests involve non-invasive investigation of archaeological and historical textiles using spectroscopic techniques.

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.

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.

Franco Quercioli - is a senior researcher at the National Institute of Optics - CNR. He is an experimental physicist whose activities have covered the fields of: coherent optics, interferometry, optical metrology, holography, Fourier optics, optical engineering, confocal and non-linear microscopy and biophotonics.

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.

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The contribution of black color to visual rhetoric of Brazilian packaging of hair care products.

Camila Assis P. Silva[1], Thamyres Oliveira Clementino[1], Thalita Gonçalves[2]

[1] *Unidade Acadêmica de Design, Universidade Federal de Campina Grande, Paraíba, Brasil.* *silva.camila.assis@gmail.com, thamyres.oliveira.clementino@gmail.com*

[2] *Unidade Acadêmica de Arte e Mídia, Universidade Federal de Campina Grande, Paraíba, Brasil.* *thalitaogoncalves@gmail.com*

Corresponding author: Camila Silva (silva.camila.assis@gmail.com)

ABSTRACT

This paper consists of part of the results of a research in the field of packaging and the connotative uses of black color. The aim is to discuss symbolic values that black intends to evoke, beyond the already known concept of luxury and sophistication. The paper is both exploratory and theoretical, because we use rhetoric and semiotic approach to discuss the role of color, image and text in packaging design. Researchers divided the work into two phases. The first one consisted of investigating the possible meanings of black color in the packaging by going to point of purchases and analyzing existent packaging, cataloging them and finding common characteristics. The second phase consisted of a deeper analysis of each new approach found in the first phase. Researchers used semiotics as a theoretical framework to investigate visual rhetoric from the relationship among color, image and text. The discussion presented here consists of the results related to the self-acceptance new approach regarding the use of black color in hair cosmetic packaging.

The contribution of black color to visual rhetoric of Brazilian packaging of hair care products.

1. Introduction

Color is one of the fundamental elements in visual communication and its study is part of the basic training of any professional in the design area. In the field of packaging, whether for the purpose of a denotative or connotative message, the repeated use of certain colors in certain product categories ended up generating chromatic identities at points of sale. For this reason, color has long been used in its potential for communication, identification, and persuasion.

Denotative message refers to analogical information, that is, the use of color by similarity, mentioning the product it contains. The use of color in packaging, in turn, is not limited to the obviousness sometimes important and necessary for the immediate recognition of a product. The symbolic use of color by metaphor rather than analogy is quite common. It is the use of color in the construction of a connotative message. The connotative use of color becomes possible through meanings that we have built over the years, as well as from established cultural conventions. It is notorious that the use of color in its connotative aspect is somewhat more complex, given the subjectivity and influence of the cultural context. However, when we correlate its use with both image and text it becomes easy to infer the symbolic meanings of color.

Among the different possibilities of using colors in packaging design, the black color aroused our attention our attention because it is not quite common to find a naturally black product, except automotive products made from oils and greases and some foods like beans. Despite this, in recent years, we have seen an increase in the use of black in food and cosmetics. Which made us infer the probability that this is due to a connotative intention. According to the historian Michel Pastoureau (2011), for centuries the meanings of this color oscillated in an ambivalent way, among positive and negative perceptions: life and death; profane and religious; mediocre and sovereign; to name a few. In the case of packaging, the author points out the symbolic relationship between color and the concept of luxury and sophistication, and it is common to find them in high-value perfume, jewelry, and alcoholic beverage packages.

It is notorious that the use of color in its connotative aspect is somewhat more complex, given the subjectivity and the influence of the cultural context. However, this connotative aspect is important once the companies seek to differentiate their products at the point of sale. For that reason, in this paper, black will be addressed as connotative information on packaging. Moreover, we present the rhetorical contribution that this visual element has presented in Brazilian hygiene packaging that promotes the acceptance of curly hair and female empowerment.

2. The mediatized rhetoric of packaging

In the mid-twentieth century, with the advent of supermarkets, packaging began to acquire new functions in addition to containment, protection, and transport (Camargo & Negrão 2008:26). As the figure of the counter salesperson disappears, the packaging starts to be 'silent salesman' (Pilditch 1961). From then on, we have come to understand packaging 'as: a system whose function is technical and commercial and aims to pack, protect (from the production process to consumption), inform, identify, promote and sell a product' (Camargo & Negrão 2008:29). The authors also state that it is necessary to 'understand that packaging is a permanent presence in the communication process' (Camargo & Negrão 2008:34). Therefore, considering its communicational and persuasive functions, and understanding that the packaging constitutes a support for a 'hybrid visual-verbal language' (see Santaella 2001), we argue the importance of studying and analyzing the relationship between verbal and non-verbal elements under the perspective of rhetoric.

The researcher Samuel Mateus says that Rhetoric in the 21st century should be called Mediatized Rhetoric (Mateus 2018:158), once it contemplates 'persuasion realized (and potentiated) through the Media' with both verbal and non-verbal content. In this sense, studying rhetoric nowadays and in communication media, such as packaging, is to consider the study of verbal rhetoric and of visual rhetoric. Consequently, it is necessary to recognize the symbolic and communicative aspects of both verbal and non-verbal elements. Certainly, considering packaging, not everything is rhetorical, just as not everything is rhetorical when it comes to information. In certain circumstances, what is intended with the message is just to inform. Data such as: food sales denomination; list of ingredients; net contents; expiration date; instructions on how to use; those are examples of technical information that has no intention of persuading, so there is no rhetoric. Likewise, the use of colors and images can only be related to a denotative message. However, messages that discuss the product's advantages, as well as 'connotative information' (Scatolim 2006:5) such as colors, images, and textures, can be considered a 'rhetorical exercise insofar as it seeks to persuade (make believe) spectators to modify a behavior' (Mateus 2018:21).

Thus, it is proposed as 'mediatized rhetoric' of packaging, the ability that it must communicate from the combination of words of persuasive character and visual elements (including colors) with the final intention of transmitting certain values to the consumer. Unlike classical rhetoric, which is based on speech and argumentative techniques of verbal language, on the mediatized rhetoric of packaging, designers and marketers use visual language techniques in line with short advertising texts. Hence, one must understand the characteristics of verbal rhetoric commonly used in packaging, as these will guide the selection and application of color in the packaging.

2.1. *Analysis of rhetoric by a semiotic approach*

Visual rhetoric, as well as verbal rhetoric, is based on the arrangement of basic units of language. As to visual rhetoric, the language is understood from the concept of 'image', which is composed by the union of shapes, colors, figures, among other visual elements that compose a visual message. According to Joly (2012), images provoke associations capable of identifying objects, attributing to them a certain number of sociocultural qualities elaborated through conventions. In the semiotic approach, it is possible to understand communication through the image considering it as a visual message. After all, semiotics studies the sign process (semiosis) in the construction of messages meanings, taking to account their use context.

Signs are any event that produces an interpretive effect, such as words, images, colors, sounds, among others. According to Peirce's semiotics, signs can be analyzed through their internal properties about what they represent - and all their application possibilities - or in the interpretive potential that awakens in their user effects on the interpreter (Santaella 2002). The sign relations take place through the object that gives rise to a semiosis. We consider the object as immediate when it represents, indicates, resembles, suggests, or evokes a dynamic object, that is, the original object. Moreover, a sign can present itself as an icon (by similarity), index (by suggesting) and symbol (by convention)

Knowledge about semiotics makes it possible to choose and use signs that are strategic for communicative purposes. According to Santaella (2002:70), "Colors, textures, composition and shapes have great power of suggestion: a color resembles something with the same color; a shape resembles something that has a similar shape, and so on". These elements and strategies of visual language can be adopted as a rhetorical resource. In the case of packaging, the decision of which look will be used must be centered on the consumer and on the possibilities of reading that he or she will make from each exposed sign.

Considering the visual language of the packaging, it is important to emphasize that in the image, color is one of the most important elements to compose the rhetoric. 'Color is an important element of product identification and product association' (Camargo & Negrão 2008:177), in addition to having a strong symbolic character. Unlike the texts on a package, colors can be identified from a greater distance and, therefore, have a first impact on the consumer, along with the visual elements of shape, dimension, and space. In this case, perhaps, colors symbolic character is already in evidence and the consumer may have intentionally selected a packaging because of it, in the search for a product category or a specific benefit. However, it is to the extent that the consumer interacts with verbal information that color will have the potential to act as persuasive information.

It is known that 'there is no meaningless color. The impression caused by each color is determined by its context, that is, by the interweaving of meanings in which we perceive it' (Heller 2013:18), with the meaning of colors being somewhat dynamic. When applied to packaging, it is the context of use of these colors (type of product in which they are applied, and verbal speech linked) responsible for the perception of their meaning. It is argued in this paper that both the color is influenced by verbal discourses, and in the same may be able to potentiate the effect of words on the consumer.

3. Case study: the use of text, image and black color in Brazilian cosmetics

The research presented in this paper was carried out in the Brazilian market. Firstly, we aimed to investigate the connotative approaches to the black color usage in food and personal hygiene products packaging. For this, we carried out a field research in some of the main points of purchases of Campina Grande city (Paraíba, Brasil) to understand to which extent black color is used in packaging.

The first stage consisted of cataloguing products packaging that predominantly adopted the black color. To do so, we developed a chart to register the front image of packaging, products' category, company's name, and keywords taken from packaging publicity texts. In this phase, we identify three current symbolic approaches: health, self-acceptance, and superior quality. In this paper, we present the analysis and discussions related to the self-acceptance approach, taking to account the use of black color in hair care cosmetic product packaging. Then, we move forward to a second stage, which consisted of a deeper analysis of self-acceptance approach identified in the first phase. So as to confirm the

specific use of black, we expand the analysis comparing those black colored packaging with other packaging from the same company. In this second stage of the research, we aimed to understand how the other visual elements could contribute to the consolidation of the symbolic discourse linked to black color. After all, since color is one of the elements that compose an image, understanding the use of color also means understanding its relationship with the meanings of the other visual elements that make up the packaging. To the extent that consonance was identified among the use of such visual elements, we could infer the potential of that color to generate chromatic identities at points of purchase.

Therefore, we performed an analysis of the textual and visual rhetorical resources presented in the packaging visual design. We elaborated a third chart that allowed us to observe the resources present in the packaging,

highlighting them as agents of rhetoric. This time, the intention was to understand whether these resources corroborate the construction of an oriented discourse. That is, a discourse that could favor the consolidation of chromatic identity through convention.

4. Results

Field research and packaging cataloguing allowed the discourse analysis of companies when they use black color. The figure below shows the second chart model with some of the packaging catalogued. By comparing them, we could perceive they are in consonance with the discourse. This analysis allowed us to infer that we can indeed use color as visual rhetorical element, serving as resource for the construction of specific speeches.
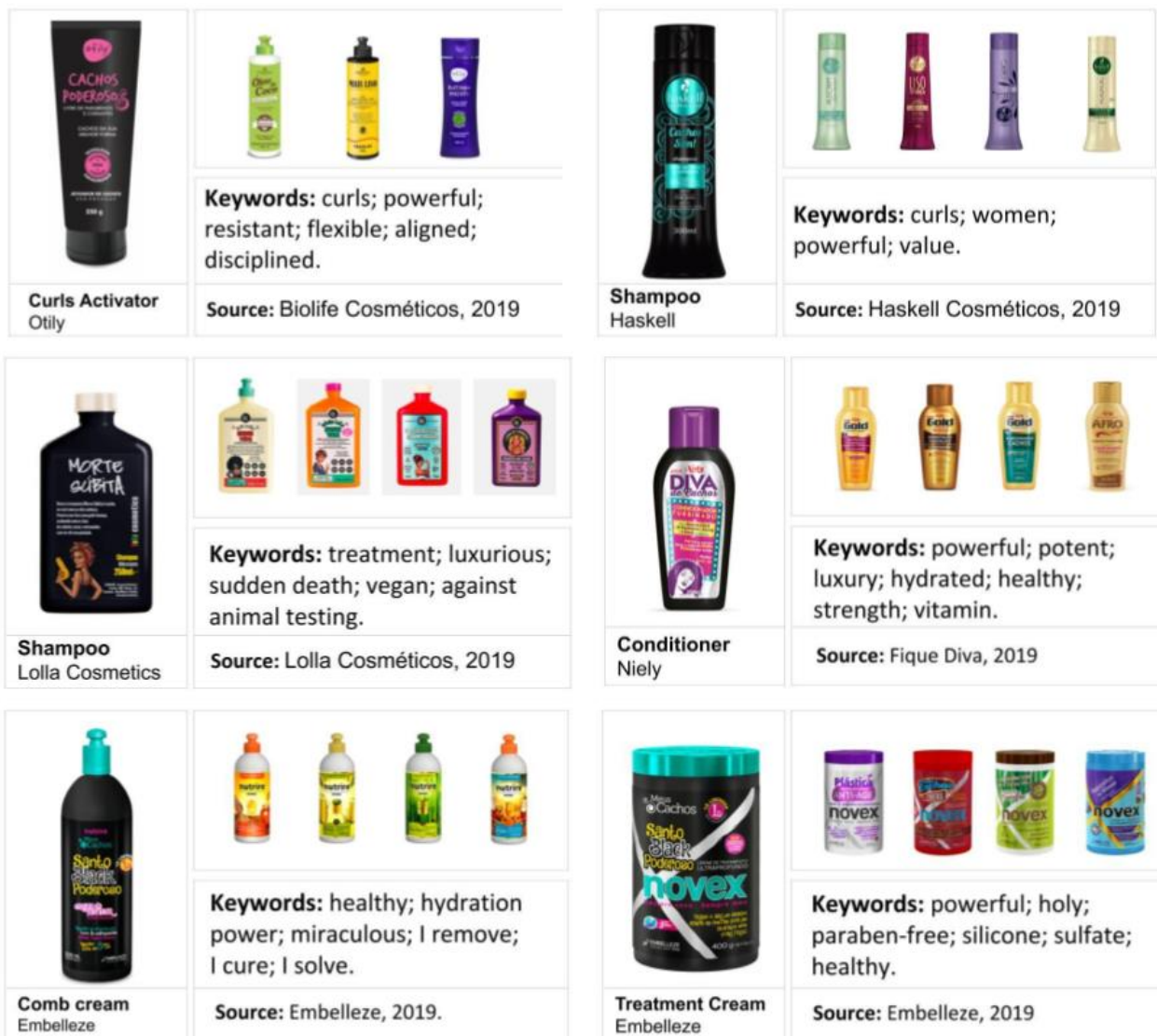

Curls Activator Otily
Keywords: curls; powerful; resistant; flexible; aligned; disciplined.
Source: Biolife Cosméticos, 2019

Shampoo Haskell
Keywords: curls; women; powerful; value.
Source: Haskell Cosméticos, 2019

Shampoo Lolla Cosmetics
Keywords: treatment; luxurious; sudden death; vegan; against animal testing.
Source: Lolla Cosméticos, 2019

Conditioner Niely
Keywords: powerful; potent; luxury; hydrated; healthy; strength; vitamin.
Source: Fique Diva, 2019

Comb cream Embelleze
Keywords: healthy; hydration power; miraculous; I remove; I cure; I solve.
Source: Embelleze, 2019.

Treatment Cream Embelleze
Keywords: powerful; holy; paraben-free; silicone; sulfate; healthy.
Source: Embelleze, 2019

Fig. 1. Visual analysis of the use of black in the acceptance promotion category. Source: Prepared by the authors based on the research carried out.

Packaging with a predominance of black color stand out as carriers of speeches aimed at promoting acceptance to the detriment of other companies' packaging, which with disparate speeches, also adopt different colors with different purposes. This sort of predominance in packaging allows black color to be elucidated as a rhetorical resource to reinforce textual and imagery discourses. To further understanding this strategy, we extracted the main packaging verbal information (Figure 2) to analyze the possibilities of correlation between image and text.

Packaging / Verbal message	
Packaging 01	Powerful curls. Bunch at its best. The "*Otily Powerful Curls*" Curls Activator has exclusive AminoRepair technology, a mass repository composed of biofunctional amino acids and innovative active bioadhesive, obtained from the association of Chia and Flaxseed polysaccharides, it adheres to the hair fiber, forms a resistant and flexible film, which defines and protects the curls, keeps the hair flexible, disciplined, aligned and with natural appearance for longer.
Packaging 02	**_Curls yes_**! Developed for *powerful women*, **_Curls yes!_** is a line of products for **frizzy** and curly hair, created exclusively to highlight the best of each curl and enhance the natural beauty of the hair"
Packaging 03	Daily and very luxurious treatment for hair thirsty for life. Also excellent for use after staining or other chemical processes. Our sudden death treatment is like that, **either you love it or you don't know it**. It penetrates the hair strands without asking permission, ending the days of dry and blown hair **without pity or mercy**. Sudden death.
Packaging 04	Contains coconut oil + D-Panthenol + Shea + 6 **powerful** oils. It leaves hair soft, **powerful** and lighter. *Phyna** fragrance, a luxurious consistency, hydrated, healthy and soft threads, **curls** that shine. **Brazilian slang for the Portuguese word fina, which can be translated for posh*
Packaging 05	**Completely relaxed**, without parabens, petrolatum, silicones, and sulfate. It still contains in its formula the intense oil of **baobab** seed, which besides having a miraculous hydrating power, is perfect **for you who brings attitude and power in your head.** I remove the tangled knot. I cure weakened strand of hair. I remove dryness. I solve everything in 3 minutes.
Packaging 06	I bring the beloved shine. I remove the split ends. I undo knots. Cure frizz, **Holy Powerful Black**. Contains **Baobab** seed oil. Without parabens, petrolatums, silicones and sulfate.

Fig. 2. Verbal message contained in the 11-packaging selected for analysis. Source: Prepared by the authors based on research

We could verify the use of black in personal hygiene packaging to promote the empowered female and the use of curly hair. All packaging we analyzed used, to expose this approach, verbal message oriented to the promotion of female empowerment and the use of curls. They used catch phrases or tips, as observed through the words highlighted in the previous figure.

It is important to highlight that the black packaging selected present as textual discourse two ways to promote acceptance: one being linked to the use of curls; and the other encourages female empowerment. Nevertheless, in addition to the textual, it is also possible to find the use of images that also reinforce the meanings imbued through the texts presented. From the six-packaging presented here, we selected only three of them to a deeper analysis in the present paper [1]. They can be observed in the following image analysis charts, which was based on semiotics.

In the analysis of these packaging, we can find somehow the textual discourse reinforced by the images that refer to the concept of 'promoting acceptance', such as images of women with curly hair and with attitude or illustrations that evoke it. Thus, it was possible to observe symbols and icons associated with female empowerment and the use of curls as imagery recurrence.

The contribution of black color to visual rhetoric of Brazilian packaging of hair care products.
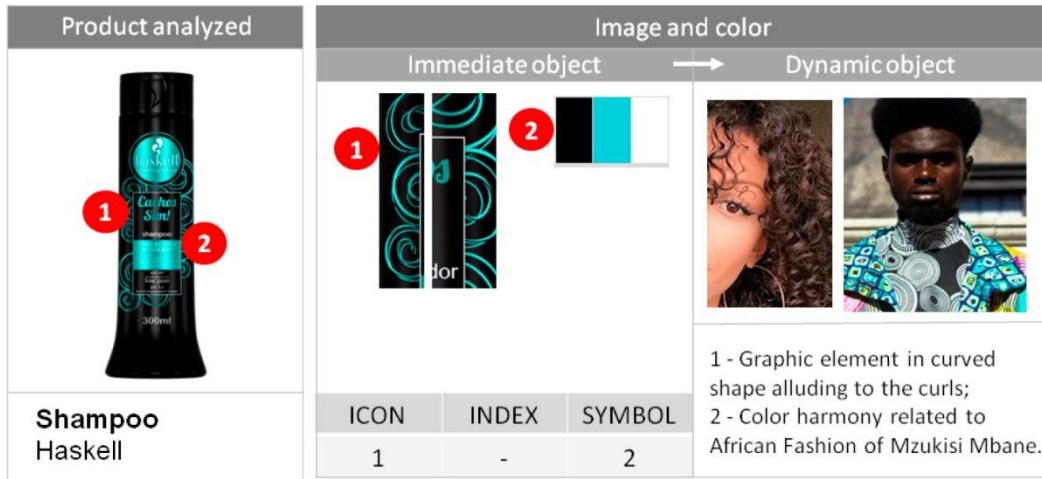

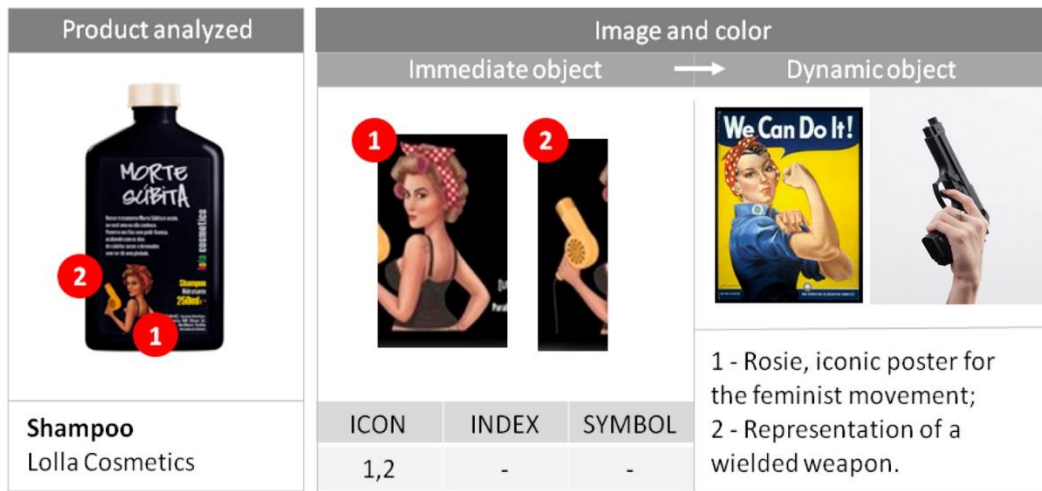Fig. 3. Semiotic analysis of Packaging 02 [2].

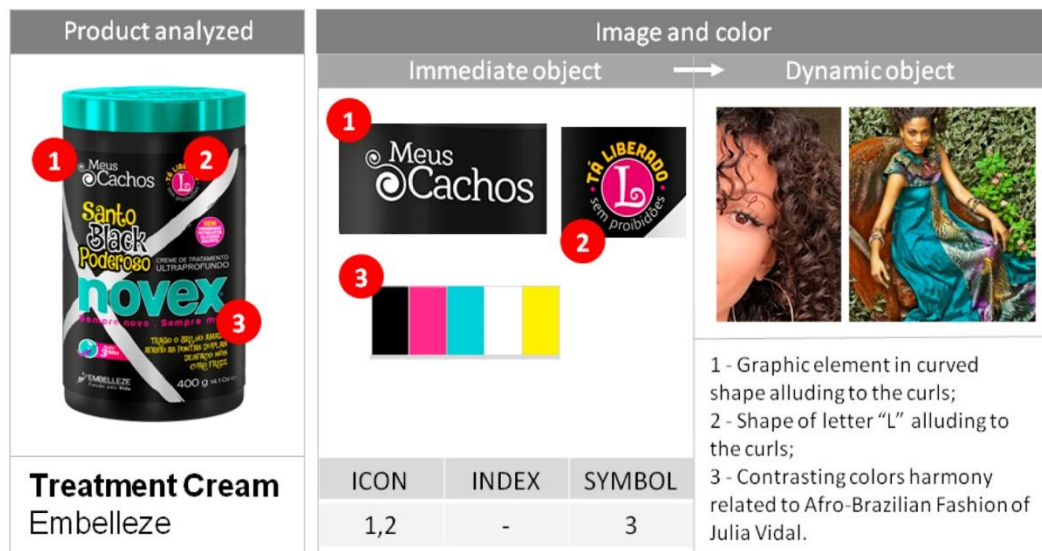
Fig. 4. Semiotic analysis of Packaging 03 [3].

Fig. 5. Semiotic analysis of Packaging 06 [4].

Among these visual references to reinforce the discourse, we cite the case of the poster known as Rosie, which is a symbol of the feminist movement and was created in the 1940s by the American government with corporate intentions. The image showing a strong and apparently independent woman became famous in the 1970s as a symbol of female empowerment (Heine & Sales 2020). The use of the female image on the packaging refers to this feminist symbol, the handkerchief in the hair and the woman's position refer to Rosie, thus being an icon, since, according to Santaella (2002) they refer to their objects through the similarity.

The vibrant and contrasting colors, present in most of the packaging analyzed, can be associated with color harmony found both in contemporary Afro-Brazilian and African fashion. African multicolor way of dressing has influenced Brazilian culture (Vidal 2018). In the process of adapting to the new culture - imposed by slavery - blacks 'brought dance, rhythm, colors, brilliance and adornments, which are present in African Brazilian fashion' (Harger & Berton 2013). According to the authors, society has neglected the potential market for the black public for a long time.

By using colors, which can be symbolically associated with Afro-Brazilian and African culture in those packaging, companies, reinforce the market niche aimed. The symbol is a sort of sign in which the association is given by a convention process. Therefore, the symbolism of those colors could be aroused using other visual references from Afro-Brazilians such as curly hair. The growing wave of Afro-Brazilian people empowerment coupled with women's empowerment motivated companies to seek new formulas for their cosmetics as well as changing their marketing plans. This fact can be noticed when 'internet searches using the terms curly and curly hair, according to data released by Google BradLab, increased 232% and 309%, respectively, in the last two years' (Silva, 2017). In this same universe of images, we identified iconic figures of curls in the researched packaging, referring to the wavy hair.

5. Final considerations

The research revealed the adoption of black color in packaging from categories that were unlikely, such as personal care products. This demonstrates the way of perceiving color as a visual resource, extrapolating analog adoption and expanding it to new meanings that benefit communication. The first stage allowed the verification of the connotative use of black color in packaging of the investigated categories, through shared speeches, which together demonstrate the ability to construct meanings about issues emerging in the current context, such as promoting acceptance.

The connotative use can be clearly seen as a strategy for the differentiation among black packaging and its competitors at the point of purchase. The research carried out demonstrated the black color being used as an indication of differentiation at the market shelf. Due to the visual contrast, those packaging with black color stand out more than the other ones. At the first glance, color takes our attention. At a second moment, other visual and textual information exert their communicative functions. The use of color associated with a textual discourse and specific and recurring images, among the universe of packaging investigated, corroborate the connotative use that the black color promotes in hygiene products.

The meanings we attribute to the black color in this research are confirmed by the content of the textual speeches and the types of images used. The recurrence in the use of black color linked to the concept of promoting the acceptance of curls and encouraging female empowerment leads us to infer the emergence of a chromatic identity for the category of hygiene and personal care products. This is because, in the field of packaging, the repeated use of certain colors in certain product categories ends up generating chromatic identities at points of sale, which assist in communication through assigned meanings.

It was apparently made possible the connotative use of black in hygiene products because a convention established by the companies responsible for the packaging design. Faced with a demand for differentiation, linked to the emergent discourses in the social context, black tends to be configured as a convenient option. However, we argue that its symbolic value will depend on the quality of textual and visual messages. As color, image and text are integrated in your rhetorical exercise; the chances of a package persuading your audience will be increased.

The repetitive use of black in packaging in the hygiene and personal care sector, linked to the same type of textual and visual discourse, contributes to the perception of a common meaning: promotion of acceptance and empowerment. Being black the color of strength and social struggle. With that, the perception and representation of the black color becomes one. It is likely that other products with a similar configuration and represented by the black color will be perceived as such.

The packaging with a predominance of black color, found during the research, demonstrated a new perspective for the adoption of color in the current context. It consists in

the use interconnected to the construction of a connotative approach, through issues that have been recently erected in the social space. Important topics such as acceptance have been the subject of discussion, and therefore have been consolidated in the public's imagination. This issue apparently aroused the need for differentiation in companies, with black being an apparently satisfactory alternative.

If, on the one hand, the use of black color brings up the discussion of new possibilities of rhetorical approach in the segment of hygiene and personal care, other colors that have been used for a long time in this category of products certainly present discourses that are worth studying. To continue this study, we would recommend carrying out a packaging investigation based on the sales verbal discurse, instead of starting it based on the black color of the packaging. Afterall, do other colours could also promote curly hair empowerment and acceptance in the context of hygiene and personal care?

6. Conflict of interest declaration

The authors declare that there is no conflict of interest regarding the publication of this paper.

7. Funding source declaration

7. Acknowledgement

8. Short biography of the author(s)

Camila Assis Peres Silva - Design Professor at Universidade Federal de Campina Grande. Doctor of Science (USP), master in Design (UERJ) and bachelor in Industrial Design (UFRJ). Specialist in Marketing and E-learning (UFF). Conducts research and teaches in the areas of packaging design, color, visual perception, user-centered design, usability, history, and design theories.

Thamyres Oliveira Clementino - Doctor of Science (UFPE), master in Design (UFCG) and bachelor in Design (UFCG). Conducts research in the areas of visual perception, Design for sustainability and packaging design.

Thalita Oliveira Gonçalves - Graduated in Languages and qualified in Portuguese by the State University of Paraíba (SUPB, 'UEPB' in Portuguese). Undergraduate student in Educommunication ('Educomunicação' in portuguese) at the Federal University of Campina Grande (FUCG, 'UFCG' in Portuguese).

Notes

[1] The six charts are available at https://drive.google.com/drive/folders/1CFpoRQXgy8eB9oyYnVqRTvq40dCydSR0?usp=sharing

[2] Figure elaborated by the authors based on the images available at: http://www.haskellcosmeticos.com.br/produto.php?id=6; https://www.naturallycurly.com/curly-hair/curls; https://theculturetrip.com/africa/south-africa/10-designers-whore-bringing-south-africas-style-to-the-world/ (Accessed 15 June 2019).

[3] Figure elaborated by the authors based on the images available at: https:/lolacosmetics.com.br/cabelo/; https://americanhistory.si.edu/collections/search/object/nmah_538122; https://unsplash.com/photos/c676QsBVUTg (Accessed 15 June 2019).

[4] Figure elaborated by the authors based on the images available at: https://www.embelleze.com/creme-de-tratamento-novex-meus-cachos-santo-black-poderoso/p?idsku=158&gclid=CjwKCAiAr6-ABhAfEiwADO4sfQPjhi9y0caj6vqXlCn55SjKgWGRjjDfi5XTi_TJMEV4r9Or3Ymz_RoCRgIQAvD_BwE;https://www.naturallycurly/curly-hair/curls; https://www.facebook.com/julia.vidal.etinias/photos/a.557553467638764/1951435691583861/?type=3&theater (Accessed 15 June 2019).

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Quick Gamut mapping for simplified color correction

Matteo Cereda[1], Alessandro Rizzi[1], Alice Plutino[1]

[1] *Department of Computer Science, University of Milan, Milan, Italy. cereda.matteo95@gmail.com, alessandro.rizzi@unimi.it, alice.plutino@unimi.it*

Corresponding author: Alice Plutino (alice.plutino@unimi.it)

ABSTRACT

This paper presents an alternative simplified method to convert color spaces more quickly than using the traditional gamut mapping. The conversion is carried out in the two-dimensional xy chromaticity diagram, through an affine transformation, which remaps the color chromaticity only. The affine transformation applies to the colors of the original image the values obtained by solving two linear systems of three equations using the coordinates of the input and output color spaces. Then, these values are applied to each xy coordinate of the image color obtained from its RGB values.

Purpose of this alternative method is not the colorimetric accuracy, but testing is an oversimplified version can lead to acceptable results. In image and video editing, the steps of color correction and color grading are often performed by the *expert's eye* using various image editing tools and software. This approach overshadows the colorimetric aspect, focusing just on the aesthetic enhancement. The proposed alternative gamut mapping method, named Quick Gamut, will be presented through application examples.

1. Introduction

When talking about color reproduction in digital systems it is fundamental to define the concept of color gamut. A color gamut is the set of colors that can be reproduced by a specific device (e.g., monitor, printer, photographic film). Each device or media has a different color gamut, so the colors that we see in a monitor cannot be reproduced by a printer or by a different kind of monitor. A common way to compare different color gamut is through the x y coordinates of the CIE 1931 chromaticity diagram. As defined in (Ramanath, 2014):

"Gamut Mapping refers to the process of translating colors in one device's color space to that of another. This process is performed on colors in images and video so as to create a rendition of a source image (typically in a capture device's color space) in an output device's color space while meeting several rendering intents: absolute and relative colorimetric fidelity, perceptual accuracy, and the problem of saturation – each of which trades off one color property at the expense of another".

Since gamut mapping is a current open issue in computer science and color analysis, through the history different methods and approaches to perform it have been proposed and this issue has been recognized also by CIE (Commission Internationale de l'Éclairage), which set up the Technical Committee 8-03 on Gamut Mapping.

The state of the art on gamut mapping is really wide and complex, therefore in this work we will not report a survey or a technical comparison among gamut mapping methods, anyway we suggest the works proposed in (Morovič, 2001) and (Morovič, 2008) for a detailed survey on gamut mapping techniques.

In general, the traditional methods of automatic color spaces conversion and gamut mapping from a device to another are colorimetrically accurate, but in some cases the result is not perceptually satisfactory, and it needs to be edited manually. In this paper, we present an alternative method that implement an oversimplification of the classic gamut mapping approach.

In contrast to traditional gamut mapping, the proposed method applies a geometric simplification, which consists in mapping the colors only in the two-dimensional CIE xy chromaticity diagram and applying an affine transformation that remaps colors chromaticity (Wolf, 1961). In this paper, we propose some preliminary experiments and applications of this method, called Quick Gamut on some images, to assess if the decrease of computational complexity (which becomes linear) could provide satisfactory results.

2.1 Affine transformation

Quick Gamut uses an affine transformation based on the following formula (Weisstein, 2002):

$$\begin{cases} X = ax + by + e \\ Y = cx + dy + f \end{cases} \tag{1}$$

Where, *X* and *Y* are the coordinates of the new color space (output) and *x* and *y* are the old coordinates (input). Before applying the transformation, it is necessary to know *a, b, e, c, d* and *f* values. These values can be obtained by solving two linear systems of three equations, one for *x* and the other for *y*, using the coordinates of the three fundamental components of the input and the output color spaces.

$$\begin{cases} X_r = ax_r + by_r + e \\ X_g = ax_g + by_g + e \\ X_b = ax_b + by_b + e \end{cases} \tag{2}$$

$$\begin{cases} Y_r = cx_r + dy_r + f \\ Y_g = cx_g + dy_g + f \\ Y_b = cx_b + dy_b + f \end{cases} \tag{3}$$

After the values computation from the previous systems, it is possible to map each pixel of the image from the original color space to the output color space by applying Formula 1.

2.2 Quick Gamut mapping

In order to map the colors of the original image in the new color space, it is necessary, at first to convert the input RGB values into x and y chromaticity coordinates then, apply the affine transformation and at the end convert the new x y coordinates into RGB values.

The steps to apply Quick Gamut mapping are listed below:

1. Normalize the RGB values over [0, 1];
2. Perform the gamma correction (i.e., raise each normalized value to gamma);
3. Multiply the color space transformation matrix by the RGB vector;

The product between the transformation matrix and the RGB vector is shown below:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = [M] \begin{bmatrix} R \\ G \\ B \end{bmatrix} \tag{4}$$

Where, M is the transformation matrix given by:

$$\begin{bmatrix} X_r & X_g & X_b \\ Y_r & Y_g & Y_b \\ Z_r & Z_g & Z_b \end{bmatrix} \qquad (5)$$

The transformation matrix varies according to the color space (i.e., Adobe RGB (1998), sRGB).

4. The values obtained from the above multiplication have range [0, 1] and are mapped in the XYZ color space.
5. Convert the XYZ values into xyz coordinates with the formulas:

$$x = \frac{X}{X + Y + Z} \qquad (6)$$

$$y = \frac{Y}{X + Y + Z} \qquad (7)$$

$$z = \frac{Z}{X + Y + Z} \qquad (8)$$

In this case, it is enough to know only the x and y coordinates because we are working on a two-dimensional space.

6. Apply the affine transformation to the obtained xyz coordinates (Formula 1);
7. Map all the pixels in the image to the output color space with the affine transformation and convert the new coordinates back to XYZ values using the formulas:

$$X = \frac{x}{y} Y \qquad (9)$$

$$Y = Y \qquad (10)$$

$$Z = \frac{1 - x - y}{y} Y \qquad (11)$$

8. Normalize and clamp the CIE XYZ values in the range [0, 1];
9. Convert CIE XYZ values to RGB color space using the inverse transformation matrix:

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = [M^{-1}] \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} \qquad (12)$$

10. Apply the gamma factor (rising the RGB values to *1 / γ*), and multiply the values by 255 to bring them back into range [0,255];
11. Clamp all the RGB values into the range [0, 255].

2.3 Example of Quick Gamut mapping applications

In the examples that will be shown, the sRGB coordinates are obtained by a linear transform with the matrix reported in Formula 13 and the inverse transformation matrix in Formula 14 (Anderson et al., 2020).

$$M = \begin{bmatrix} 0.4124564 & 0.3575761 & 0.1804375 \\ 0.2126729 & 0.7151522 & 0.0721750 \\ 0.0193339 & 0.1191920 & 0.9503041 \end{bmatrix} \quad (13)$$

$$M^{-1} =$$
$$\begin{bmatrix} 3.2404542 & -1.5371385 & -0.4985314 \\ -0.9692660 & 1.8760108 & 0.0415560 \\ 0.0556434 & -0.2040259 & 1.0572252 \end{bmatrix} \quad (14)$$

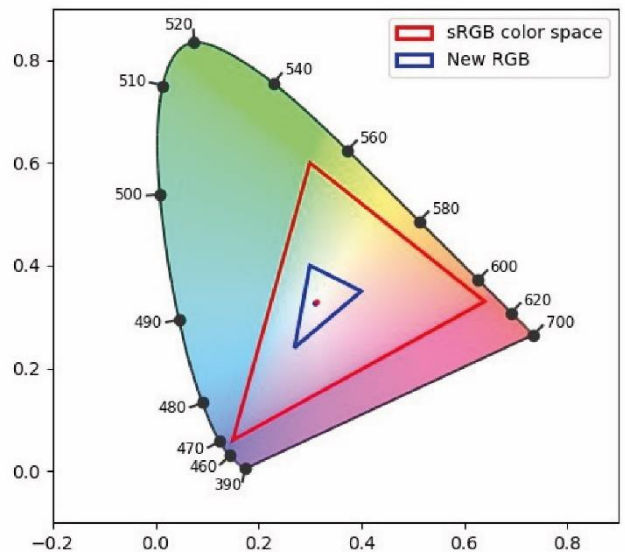| New RGB color space		
R	x	0.4
	y	0.35
G	x	0.3
	y	0.4
B	x	0.27
	y	0.24
White	x	0.3093
	y	0.3260

Tab. 1 Color space specifications.

Fig. 1 Input and output RGB color spaces.

Fig. 3 (left) Quit Gamut mapping application, (centre) original image and (right) gamut mapping performed through Photoshop.

Fig. 2 ColorChecker.

In Figure 1 is reported an image of a typical input RGB color space (sRGB) and the destination color space computed using Quick Gamut mapping (see Table 1).

To show the performances of Quick Gamut applied on an image, in Figure 2 is reported a comparison between an image mapped using Photoshop and an image mapped using our method. Here, it can be seen that Quick Gamut offers a perceptually satisfactory result without loss of details, in contrast to Photoshop that produce images with flat colors.

2.4 Quick Gamut mapping assessment

To evaluate the precision of Quick gamut conversion, we tested this method on a ColorChecker (Figure 3). In Table 2 are reported the CIE L*a*b* values of every patch of the ColorChecker after a gamut mapping performed using Photoshop and using Quick Gamut. The differences between CIE L*a*b* values have been computed using ΔE* difference (Mokrzycki and Tatol, 2020). Since Quick Gamut provides a strong geometrical simplification to map the color values in a new space, the color difference ΔE* is high for some patches. Nevertheless, the linearity of the affine transform makes this method particularly easy to compute.

Colore	Photoshop			Quick gamut mapping			Δ			
	L*	a*	b*	L*	a*	b*	ΔL*	Δa*	Δb*	ΔE*
1	38	8	11	37	4	5	-1	-4	-6	7.28
2	64	11	15	64	8	6	0	-3	-9	9.48
3	53	5	-18	50	3	-6	-3	-2	12	12.53
4	46	-8	14	44	-1	6	-2	7	-8	10.82
5	56	9	-23	55	6	-6	-1	-3	17	17.29
6	74	-17	4	72	-3	-1	-2	14	-5	15.00
7	58	19	22	59	12	17	1	-7	-5	8.66
8	55	13	-27	40	6	-13	-15	-7	14	21.68
9	52	27	11	46	14	6	-6	-13	-5	15.16
10	35	11	-17	30	7	-6	-5	-4	11	12.73
11	82	-11	22	73	-4	16	-9	7	-6	12.88
12	71	5	22	69	8	20	-2	3	-2	4.12
13	49	12	-25	31	5	-12	-18	-7	13	23.28
14	62	-19	16	56	-7	9	-6	12	-7	15.13
15	45	26	17	37	16	9	-8	-10	-8	15.09
16	84	-6	23	80	3	23	-4	9	0	9.85
17	59	22	-12	47	15	-5	-12	-7	7	15.56
18	60	0	-15	53	0	-9	-7	0	6	9.22
19	97	-1	2	97	4	2	0	5	0	5.00
20	81	-1	0	82	5	1	1	6	1	6.16
21	67	0	0	67	4	1	0	4	1	4.12
22	51	0	0	51	3	1	0	3	1	3.16
23	36	0	-1	36	2	0	0	2	1	2.24
24	22	0	-1	22	2	0	0	2	1	2.24

Tab. 2 CIE L*a*b* values obtained from Figure 3. Highlighted in green the values between 0 and 2.99, in yellow the values between 3 and 4.99, in orange the values between 5 and 9.99, in blue the values greater than 10

3. Conclusion

In this work, Quick Gamut, an alternative simplified gamut mapping method has been presented. This method works only on the two-dimensional chromaticity information of the color spaces involved.

The preliminary tests carried out in this work, showed that despite the high color differences between the images obtained with traditional gamut mapping and with this method, the new proposed method can be use to provide a quick transformation for the color correction of images and/ or videos.

4. Conflict of Interest

The authors declare no conflict of interest.

5. Declaration of funding sources

6. Short biography of the authors

Matteo Cereda – He graduated in Computer Science for digital communication at the University of Milano. As a great passionate of digital videos and photos, during his university experience he chose to deepen the multimedia field. This allowed him to gain skills in video and image processing, image enhancement and color correction.

Alice Plutino – She recently obtained the PhD at the Department of Computer Science, University of Milano. Her research interests are: Colorimetry, Image Processing, Data Digitization and Archiving with a particular interest in applications on Film Restoration. She is author of many scientific works, member of the Organizing Committee of AIC2021 and part of different workshops and conferences.

Alessandro Rizzi – He is Full Professor at the Department of Computer Science at the University of Milano, teaching Multimedia, Colorimetry and Film restoration. He is doing research since 1990 in the field of digital imaging with a particular interest on color, visualization, photography, HDR, VR and on the perceptual issues related to digital imaging, interfaces,

and lighting. He is co-chair of the IS&T Conference "Color Imaging: Displaying, Processing, Hardcopy and Applications", Topical Editor for "Applied Color Science" of the Journal of Optical Society of America A, Associate Editor of Journal of Electronic Imaging, member of several program committees of conferences related to color and digital imaging, and author of about 400 scientific works.

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The Colors of Public Art in Pescara: 4 Keywords

Giovanni Caffio[1], Maurizio Unali[1]

[1] *Department of Architecture, Università degli Studi "G. D'Annunzio", Chieti-Pescara.*
giovanni.caffio@unich.it, maurizio.unali@unich.it

Corresponding author: Giovanni Caffio (giovanni.caffio@unich.it)

ABSTRACT

This paper is the latest result of a research – shared with a few scholars of the Department of Architecture of the University "G. d'Annunzio" of Chieti and Pescara – on how colors can shape the perception of contemporary urban space. In particular, we present here a research that investigates the complex relationships that colors and space of Public Art establish with the citizens, the city and the specific architectures of Pescara. Over the years, Abruzzo's city has been the setting for a series of interesting works of public art – both ephemeral and long-lasting – in which colors play a fundamental role in establishing paths of urban transformation but also as synesthetic acts and gestures of communication on different scales; artistic and socializing processes capable of releasing new aesthetic and participatory meanings to inhabit the collective and intimate space of urban spaces between art, architecture and design (and more). The works have been selected and divided using four keywords which highlight certain aesthetic characteristics of the colors that shape their perception. Ephemeral fluid red: *Huge Wine Glass* by Toyo Ito (in Piazza della Rinascita). Big Blue: A Fountain by Ettore Spalletti (placed in the square in front of the new Tribunal). Black & White: *Dream* by Millo (a mural painted on a blind facade of a building in the Fontanelle district) and *My safe place* (realized on a façade of a school). Habitable rainbow: The enchanted garden and Piazza Caduti del Mare by Franco Summa.

1. Introduction

This paper is the latest outcome of a study on how color can shape the perception of contemporary urban space (Caffio, Unali 2020). In particular, the aim of the presented research is the study of the representation project included in the complex spatial-temporal relations between city, architecture, art and color in the context of some examples realized within the Public Art in the city of Pescara. Over time, Abruzzo's city has been the scene of a series of interesting public artworks in which color has played a fundamental role in establishing artistic and social processes capable of releasing new aesthetic, "anthropological" and participatory meanings of the collective space. This research was shared by two professors from the Department of Architecture at the University "G. d'Annunzio" of Chieti-Pescara (Caffio and Unali, 2020) who, after outlining the general aspects of the subject, identified four keywords, mainly related to the meaning of the use of color in representational projects – semantic models for deepening and interpreting iconic projects –, dividing their work as follows: Giovanni Caffio studied two keywords in depth, "Black & White (but not only)" (chap. 5) and "The Big Blue" (chap. 4); Maurizio Unali the other two, "Ephemeral Fluid Red" (chap. 3) and "Habitable Rainbow" (chap. 6).

2. Four keywords for a visual journey in color

The keywords used in this paper refer to a hypothetical visual path in color that unites the works of a few artists who have contributed to transforming the face of the city of Pescara through their work, even when this is no longer present or because it disappeared or because it was ephemeral in its first conception. The lines of reading, which we propose in a deliberately provocative way, are intertwined in the space and history of the city, changing its image and use. Moreover, these are very different artists, coming from various experiences and disciplines, from art, architecture and street art, but who find themselves united by having left, also through the project of color, a deep imprint on the body of the city. From the "chalice" of Toyo Ito – a work that has remained in the collective imagination of Pescara mainly because of its unfortunate history, but that has affected and still acts as a unique case in which the absence of the work affects and generates more attention than its presence –, to the murals of Millo – interesting the work of this architect who, trained in the Faculty of Architecture of Pescara, gives a particular work of "architectonical street art" to the city where he studied –, the urban sculptures of the artist Franco Summa – whose artistic career has made color its hallmark –, up to the refined and ethereal poetics of an international artist like Ettore Spalletti. In conclusion, we drew a conceptual map (published in Fig. 1 in the form of "emotional collage") in which to synthesize the idea that from the proposed path we can understand how color can compose kaleidoscopic living spaces; how it can act as catalyst of experiences of "Public Art" heterogeneous in means and purposes, but always generating new meanings in the relationship between citizens and urban environment (Perelli, 2006).

Fig. 1. G. Caffio, M. Unali, A visual path "in color" on Public Art in Pescara, conceptual map, 2020 (detail, cf. Fig. 23).

3. Ephemeral Fluid Red

This visual journey in color begins with a work that turned ephemeral, *Huge Wine Glass* (Figs. 2-9). This is Toyo Ito's first work in Italy, a sort of urban "sculpture-fountain" consisting of a scenographic transparent parallelepiped with a square base (2 meters wide and 5 meters high) – inside which a sinuous red fluid is revealed, metaphor of a glass of wine with an empathic "made in Italy" taste – planted in a circle of water placed in one of the main public spaces of Pescara, Piazza della Rinascita (known as Piazza Salotto), on the axis of Corso Umberto I, which connects the railway station to the Adriatic Sea. But the unpredictable "poetics of the ephemeral" (Unali, 2010) reserved an unexpected fate to *Huge Wine Glass*: the shining transparent monolith (made of an acrylic resin, polymethylmethacrylate), inaugurated on December 14, 2008 in the presence of the Japanese architect, "broke" in February 2009 and was removed in September 2013 (and never reinstated), thus living only in the memory of those who saw it, as a radical temporary event, a sort of urban art performance (De Simone, 2021).

In the memory of the viewer, the project thus becomes a metamorphic narrative: a kaleidoscopic visual fulcrum of the urban space for its mutation according to the lighting conditions of day and night; an original impalpable liquid presence accentuated by the fluid red coloring of acrylic material that changes as the point of observation varies.

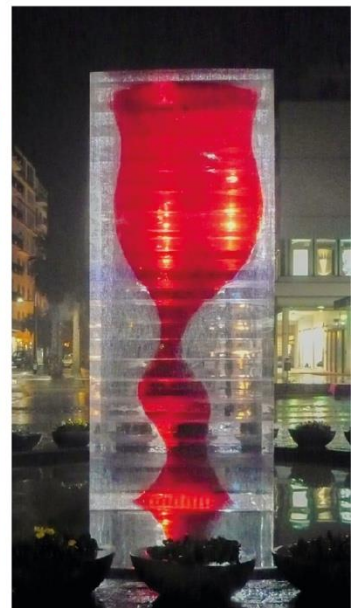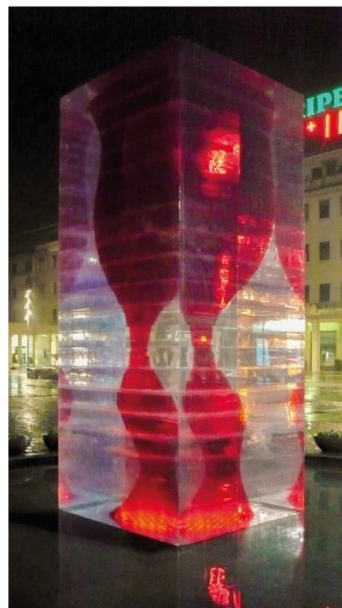*Figs. 2-4 - Toyo Ito, Huge Wineglass, 1999. Photo by Giuseppe Marino 2009.*

Fig. 5 - Toyo Ito, Huge Wineglass, 1999, detail. Photo by Giuseppe Marino 2009. Figs. 6-9 - Toyo Ito, Huge Wineglass, 1999. Photo by G. Caffio 2009.

4. The Big Blue

Ettore Spalletti (1940 - 2019), an artist internationally renowned (AA.VV, 2014), created two important works in Pescara: the first is the Fountain located in the square in front of the new Court of Pescara, the only public work designed and built by the artist in the Adriatic city (Fig. 10); the second one is a small chapel (Fig. 11) with the annexed Room of the Farewell, inside the private clinic "Villa Serena" in Città Sant'Angelo (Figs. 12-13). The fountain is a perfect ellipse of black marble, just a few centimeters high, within which, in an off-center position, there is a sort of hollowed-out blue pentagon and a small white circle that lights up at night as the water overflows from the edge and is collected by a recess hidden at the base. A metaphysical and ethereal work that plays with continuous references to earth, water and the celestial spheres of which it seems to be a sort of concrete map. As it rests on the ground, it seems to want to subtly reveal a hidden poetic meaning in the apparently random spaces of this Pescara suburb, a sort of "Zen koan" made of stone and water that invites observers to discover the secret relationships between the surrounding architecture. This absolute work, as absolute as its colors are – deep black, reflecting white and blue – reveals once again Ettore Spalletti's ability to use his personal chromatic research to create an unexpected bond between observer, work and environment; an accurate and sophisticated project that through its simple materiality offers a different perception of the contingent reality. A different poetics informs the second work, a sort of "gesamtkunstwerk" – and therefore a theoretical manifesto to better understand the sense and use of color in Spalletti's fountain – in which architecture and art converge and integrate. The chapel, built in the '60s, was completely redesigned. The interior pushes the observer to search for his own position, which escapes the strong axiality of the Greek cross plan and is moved by a continuous tension of the space generated by minimal fluctuations and reverberations among the archetypal objects places inside: cubes, parallelepipeds, folded planes, diaphanous statues and Venetian chandeliers are carefully organized to define the space of the sacred. As in the chapel, also in the Farewell Room, the colors of his personal palette – blues, grays, pinks and splashes of gold – seem to be arranged in veils that make the atmosphere vibrant, material and meditative.

Fig. 10 - Ettore Spalletti, Fountain, Palace of Justice 2004. Photo by Antonella Salucci 2015.

Fig. 11 - Ettore Spalletti, Chapel, "Villa Serena" private nursing home, Città Sant'Angelo, Pescara, 2017. Photo by Giuseppe Marino.

Figs. 12-13 - Ettore Spalletti, Sala del Commiato, "Villa Serena" private nursing home, Città Sant'Angelo, Pescara, 2017. Photo by Giuseppe Marino.

5. Black & White (but not only)

The architect-artist Francesco Camillo Giorgino, known by the pseudonym Millo, created two works in Pescara, the city where his now twenty-year artistic and professional career began (Caffio, 2015a and 2015b). The first, titled *Dream*, was painted in October 2017 on a blind facade of a building in the Fontanelle neighborhood (Fig. 14); the second, evocatively titled *My Safe Place*, was drawn on one facade of the Borgomarino elementary school (Fig. 15).

In his murals the artist always creates a distance, a separation made of contrasts of scale and color, between the urban environment, monochrome, aseptic, repetitive as an anonymous pattern in an infinite isometric space, and its childlike protagonists in color and out of scale. A metaphorical contrast made visible in a clear and brutal way, as much as naive, that pushes the observers to reflect on the estrangement between the collectively acted urban space and the individual and intimate life. Thus, in what has become the artist-architect's consolidated stylistic style, against a black and white background in isometric axonometry (a legacy, perhaps, of his architectural training) of a generic and cartoonish city, protagonists appear as giants that seem to come out of Jonathan Swift's pen.

In front of an indifferent background where airplanes and driverless cars circulate, these little heroes perform simple and personal gestures, almost as if they wanted to overturn the contemporary condition in which the city, with its rhythms and its economic drives, crushes and reduces its inhabitants to insignificant little insects.

In his drawings Millo tells the feelings and personal stories through a sort of archetypal and utopian man-woman binomial, the new Adam and Eve, who stand out and emerge as the real protagonists of urban life. This contraposition, this working for opposites (big-small, human-urban, feelings-rationality, micro-macro) finds its precise echo in the colors: pure black and white lines for the urban background while the only colors belong to the human figures present in the compositions.


Fig 14 - Millo, Dream, 2017. Fig 15 - Millo, My safe place, 2018. Photo by Giuseppe Marino 2019.

6. Habitable Rainbow

The idea of urban space as a shared civic place composed by infinite relationships (between people, memories, ruins, objects, nature, etc.) finds in the artistic research elaborated by Franco Summa (1938 - 2020), multiple design hypotheses (Summa, 2016). Among these, we choose two works by the "rainbow artist" for his city, Pescara, generous and passionate acts of joy to share with his fellow citizens. The first work is *The Enchanted Garden* (Figs. 16-17) created in 2018 in front of the residential complex designed by Mario Botta near the Tribunal. Sixteen six-meter-high

"menhirs" rise on a square plan, drawing a space made labyrinthine by the multifaceted use of color and the different conformations that the shadows generate as the weather and the hours of the day change. The second work is Piazza Caduti del mare (Figs. 18-22), inaugurated in 2020 after the artist's death. In the context of an urban requalification program, Franco Summa's vibrant square synthesizes a project shared with the inhabitants of the neighborhood, thus triggering new public spaces always under the banner of the idea of color as a catalyst of urban sociality and hope. A color that draws living forms, therefore.
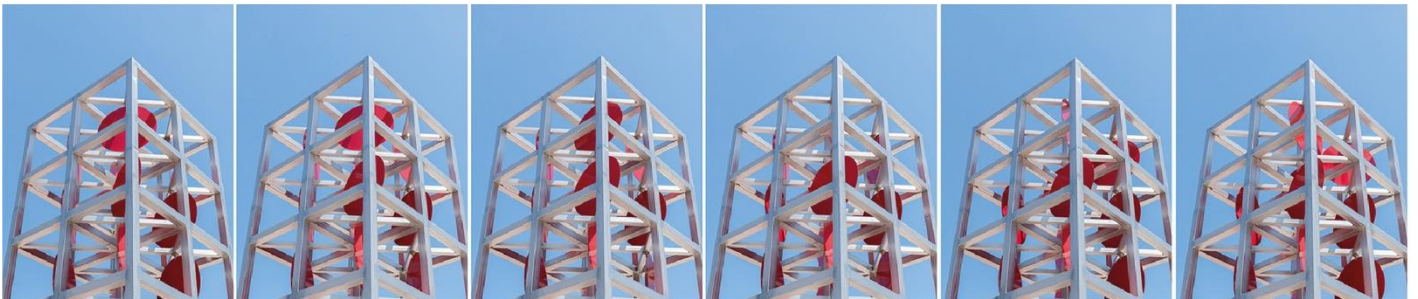

Figs. 16-17 - Franco Summa, The enchanted garden, 2018. Figs. 18-22 - Franco Summa, Piazza Caduti del Mare, 2020. Photo by Giuseppe Marino.

7. Pescara Colors: a final visual synthesis

At the end of this visual journey we felt the need to elaborate a conceptual map (Fig. 1 - Fig. 23) that represents a sort of synthesis "in color" of Public Art in Pescara, obviously referring only to the four key words identified; an empathic perceptive experience in which color is the medium of the project, both for what concerns the conformed space and for what concerns the ephemeral representation, that is the movement, the daily use, the "indifferent looking", the careful seeing, the participation: active sensors of living the contemporary urban experience. With similar objectives, finally, we represented some ideas of Public Art in Pescara through the elaborative form of the "semantic model" (Unali, 2019). These works are representation models, between research and didactics, that trigger thematic elaborative processes under the banner of "cultural hybridization" and "aesthetic recycling"; visual experiments to know, create, transmit, and elaborate ideas and forms (Fig. 24).

Fig. 24 (right). Semantic model (detail) elaborated within the didactics of the teaching of "Drawing of Architecture", prof. M. Unali, student Luigi Gasbarri. Degree Course in Architecture, Università degli Studi "G. d'Annunzio", Chieti-Pescara.
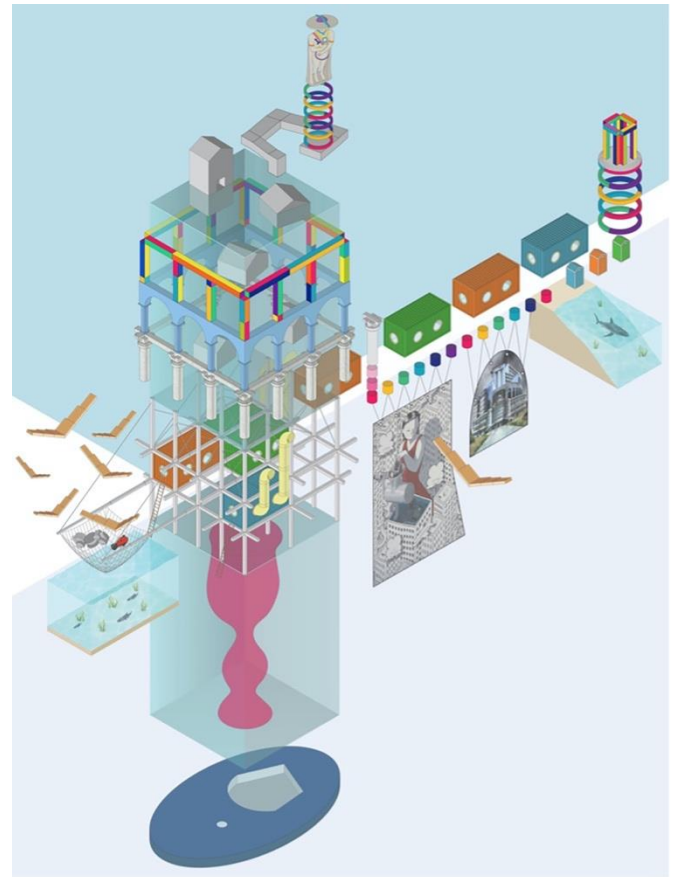
Fig. 23 - G. Caffio, M. Unali, A visual path "in color" on Public Art in Pescara, conceptual map, 2020 (detail, cf. Fig. 1).

8. Conflict of interest declaration

9. Funding source declaration

10. Short biography of the authors

Giovanni Caffio – PhD, Associate Professor in Drawing and Representation (ICAR/17) at the Department of Architecture of the University "G. d'Annunzio", Chieti-Pescara. His research activity focuses mainly on the themes of representation and communication of architecture through digital tools with particular attention to the urban and architectural space.

Maurizio Unali – Degree with honors in Architecture from the "La Sapienza" University of Rome, where he successively completed his PhD in "Disegno e Rilievo del Patrimonio Architettonico". He is full professor of Drawing Architecture with the Department of Architecture at the "G. d'Annunzio" University of Chieti-Pescara.

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BOOK REVIEW: Yellow, the history of a color

Renata Pompas

Michel Pastoureau: Giallo, storia di un colore, Ponte Alle Grazie, 2019.

Pastoureau, M. (2019) Yellow: The History of a Color. Translated by J. Gladding. Princeton: Princeton University Press.

The publishing house "Ponte alle Grazie", which for years has edited the Italian translation of the books on color by Michel Pastoureau - director in Paris of the "École pratique des Hautes études" and holder of the chair "History of symbolism in the West" - has published his fifth work on symbolism of colours: "YELLOW. History of a color" (€ 32). The book consists of the usual 240 pages in the cm. 23 x 23 format and stands out, as always, for the exceptional iconographic research. The text is divided into three large chronological chapters, subdivided in turn by subject, ranging from vocabulary to symbols, everyday life, social customs, scientific knowledge, technical applications, religious morals and artistic production. In the introduction, Pastoureau warns that yellow suffers from a limited number of documents on which to conduct research, which is why the book also includes gold and orange.

Chapter **A Beneficial color (From the origins to the 5th century)**

This chapter describes pigments, gold, dyes and the myths that described them.
In *The Ochres of the Palaeolithic*, he describes the procedures for preparing ochres by cave painters 30,000 years ago.
Gold occupies two sub-chapters:
In *The Blond Metal* he refers to the gold of the necropolises, bringing the prehistoric necropolis of Varna and the sarcophagus of Pharaoh Tutankhamun as examples.
In *The Mythologies of Gold* he recalls the Golden Age described by Hesiod; the myth of the conquest of Hercules' golden apples, that of Jason's Golden Fleece, that of King Midas who "represents the most ancient link between yellow, envy and avarice" and the legend of The Rhine Gold.
In *The Sun Cults*, he points out that the sun has always been associated with gold and, in its place, with yellow.

Turning to dyes, Pastoureau divides them into:
Dyeing yellow, in which he lists vegetable dyes, from saffron to reseda (which it is always translated as "guada") to safflower.
*Wearing yellow* in which he shows how until the late Middle Ages yellow in clothing was still appreciated.
The case of Clodius in which Cicero's mockery of Clodius is reported, describes him as a debauchee who wears yellow clothes, a purely feminine color.
The following conclude the chapter:
Lexicon teachings analyses Latin terms.
The silence of the Bible and of the Fathers of the Church where an abundance of gold does not correspond to a presence of yellow.
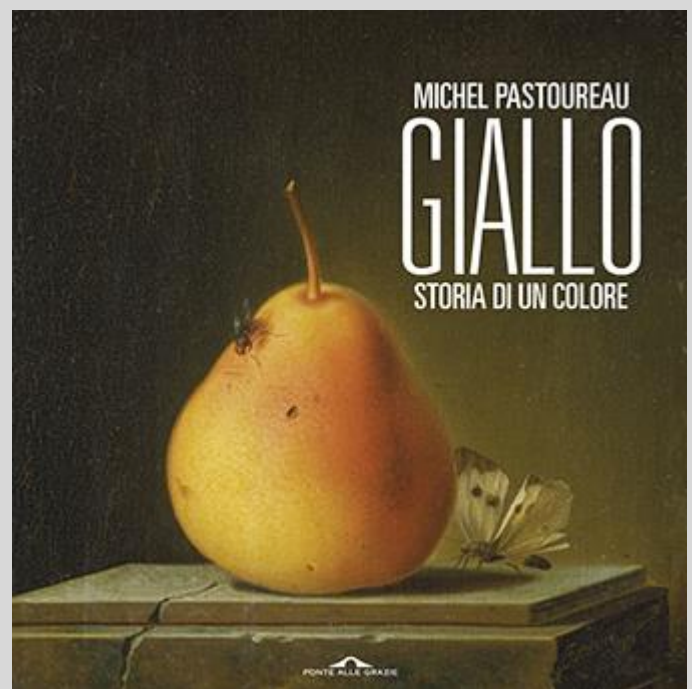
Chapter **An equivocal color (6th-15th centuries)**

From this century on yellow turns towards negative judgements.
The absence of yellow in Christian worship is linked to the previous sub-chapter by examining the liturgical code of colours established by Pope Innocent III.
In *Yellow in the Coat of Arms* Pastoureau, who is an expert in this field, examines heraldry.

In *An Ambivalent Symbology*, he makes the transition from the coat of arms to the robes of knights.

In *The Prestige of Blond Hair*, he describes how much they were appreciated in medieval courts.

In *Bile and Urine* he describes the medical practices of fluid analysis that charged yellow with filth and disease.

Envy, lies and betrayal develops the latter aspect, which by the end of the Middle Ages became the color of forgers , traitors and criminals.

The robes of Jan Hus and Judas shows how the yellow robe characterised traitors and became the symbol of Jewishness.

To the origins of the yellow star? Develops the theme of yellow in the representation of Judaism, while emphasising that there was no system of signs or colours common to the whole of Christianity.

Chapter **A little-loved color (16th-21st century)**

The chapter begins by noting how yellow is still a colour with a limited presence in Europe today and suggests that its decline stems from its instability in painting and dyeing.

Painters' Yellow is a section entirely dedicated to paintings and their reproduction.

Yellow of the scholars shows its diversified classification over the centuries.

Yellow in Everyday Life looks at the presence of yellow in painting, clothing and fabric samples.

Dictionaries and encyclopedias takes up the lexicological investigation of yellow from the first chapter, extending it to the 17th and 18th centuries in France.

Eastern trends attests to how the success of 'chinoiserie' in Europe briefly contributed to the fashion for yellow.

Discretion, transgression, modernity attests to how in the 19th century yellow denoted a series of negativities: from prostitutes to asylums known as 'the yellow houses' and more.

At the far reaches of yellow is Orange introduces this shade Pastoureau writes that it "began to distinguish itself from red at the end of the Middle Ages" and spread from the 14th century with the importation of new dyes: the "Campeche wood" from Central America (which in Italy we call "campeggio wood") and the pernambuco wood from South America (which in Italy we call "Brazil wood"). It concludes with the strong presence in contemporary signage.

Yellow in our time concludes the book, with the criticality that, for different reasons, yellow suffers in our society, where it is recovered for its visibility, for example in taxis, in post boxes, in the waistcoats of the eponymous political movement.

A book in which, alongside the historical seriousness of the text, the pleasure of the images predominates.