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The role of colors in modeling birth space ambiances

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ABSTRACT

Color is an integral component of architecture. It is an expressive element which deals with lighting distribution and many other aspects. It has a preponderant role in defining and personalizing the character of space and its ambiances. In this study, we will focus on women in labor and how users perceive colors in such specific spaces through the sensitive experience carried out in birth institutions, how color can be integrated in the birth space, how it takes part of a special event, and how it modifies women perception. Our research is at the crossroads of several disciplines. It focuses on analysis of stress levels for women in labor in different obstetric spaces, using Electrodermal Activity (EDA) tracking that evaluates the arousal via skin conductance measurements. This quantitative study will be correlated to a qualitative one which is based on a descriptive approach that consists in the analysis of the role of color in birth ambiances by using photos of different birth spaces and information collected in different surveys. Thus, the goal of this paper is to identify ways of choosing colors in the obstetric space and recommending appropriate ambiances to improve a wellbeing experience of giving birth without stress and anxiety.

Keywords: *ambiances, birth space, color, birthing women, electrodermal activity*

INTRODUCTION

Through cultures, color manifests itself as a deep inherent quality linked to the substances of objects and not as a superficial mark, Tornay (1978: 126). It is used to identify groups, to convey symbolic meanings and to experience an aesthetic pleasure. It is a component of the social and physical world around us. It doesn't occur taken alone but it is associated to objects and events. Its perception depends heavily on the context (social, spatial, temporal, ambient, functional).

Color takes shape only when it begins to be perceived as a quality of a specific context. It is an expressive element in the design of life space which deals with lighting distribution. In primates, space perception is multisensory. Ambiances solicit different senses (Hussein, 2016), essentially through visual perception; color gives a sensual visual perception of space. It is one of different aspects of visual perception through which, in other primates, the exploration of any space begins.

Rather, color is considered as a tool that influences the user's perception and behavior. Thus, color has an important role in the user's space experience. Color reveals certain meanings and symbolism in a close relation to psychological and physiological effects that it produces. Each color is associated with a certain mood, a certain environment that affects the user's space perception and emotion. It plays a

role in creating ambiance of pleasure, excitement, content and comfort for a user that supports the function of a space. In hospital space, color can be a therapy. It can play a role in the healing process. Thus, in the medical field, color is important since it has the ability to heal and to comfort. In terms of ambiance, color creates “welcoming”, “homey” and “pleasurable” ambiances to ease the stress of patients by the use of warmer color tones. Birth space and birthing woman represent a pertinent research case and we will explain in this paper how color design influences sensitive experience for birthing women.

METHOD

This study is at the crossroads of several disciplines. In order to understand the deep relation between color in birth space, the event of birth and women perception, we varied the methods. Our research is composed of two parts: a qualitative study which will be correlated to a quantitative one. When choosing the fields of study, two different cultures are taken into consideration to explore a diversity of color space experience, which are the French and the Tunisian ones.

Indeed, the qualitative study is based on a descriptive approach. The descriptive method is adopted to analyze the colors used in three different French birth spaces situated in Grenoble. We chose to analyze a delivery room and a maternity room of a hospital maternity, a clinic maternity and a homebirth. The process of analysis begins with collecting photos and information in a survey. The process depends on the identification of the properties of used colors, its ambiance as well as its effects on women during the birth event. Further, and by adopting a transposition of the results of the French qualitative study, we selected Tunisian maternities that have the same architectural and ambient characteristics as identified in the French ones. Then, we carried out our quantitative study that focuses on the analysis of stress levels for women in labor in the Maternity and Neonatology Center of Tunis, using Electrodermal Activity (EDA) tracking that evaluates the arousal via skin conductance.

In this second part of our study, a multidisciplinary experimental protocol of two components is applied. It is organized as follows: A spatial characterization consists of analyzing colors used and capturing the emotional state of women in labor using Electrodermal Activity. In addition to this, the sensitive experience of women in labor has been recorded also through surveys.

To realize this experimental protocol, a wearable biosensor device called E4 was used that measures emotional states (stress, excitement, happiness, and more). Its data can be visualized by the software “E4 manager”. Our target population was about five women in labor aged between 25 and 32 years.

In this work, we will present the results of one case that is representative of all studied cases and shows how we can detect objectively the effect of an ambiance (light, color, odor, sound) on women in labor, and how an architect can model space conception taking into consideration those parameters. The E4 sensor was worn by to each woman in the delivery room and the measurements stopped when she was transferred to a maternity room. The itinerary chosen to be analyzed was during the transfer from the delivery room to a maternity room. It takes about ten minutes. During this time, a record of the woman’s feelings toward the ambiance, and specially the colors, was done by taking notes and comments.

RESULTS AND DISCUSSION

During our qualitative study in the French field, we visited, photographed and analyzed from the architectural and ambient viewpoints three different types of space. We carried out surveys and did ethnographic observations to identify the relationship between space, color and the user's perception. The French maternities were: Maternity of the University Hospital Center, Maternity of Clinic Belledonne, and the homebirth "La Maison."

Beginning with the Maternity of the University Hospital Center (Figure 1), the colors used in the delivery and labor rooms were white, a warm shade of yellow, and a calming grey. When asked, a woman who was giving birth there said, *"The yellow is a brilliant and happier color, color of the sun, of joy; it makes the room shine."* While another woman explained her dissatisfaction with the grey color: *"The spaces are good enough... apart from the delivery room. It is grey and austere. It depressed my husband too."*

Some research done by Nikolic and Nikolic (2012) and by Tofle et al. (2004) proved that yellow evokes energy, dynamism and excitement, and its brilliance is most often associated with the sun. It stimulates the activity of women in labor. In physiologic delivery rooms, a pastel blue-green color scheme was added to previous colors. It is a great choice for creating a natural ambiance. The pastel blue-green color gives the impression of being in a garden. It has a calming effect. Research shows that green, the color of plants and nature, represents growth and life (Tofle et al., 2004). In the maternity rooms a pink pastel color was chosen for the walls with white and grey for the flooring. This combination creates a pleasant ambiance. It symbolizes nature and flowers, creating a calm and fresh ambiance.



Figure 1: The use of colors in the Maternity of the University Hospital Center, Grenoble. Photo: Ichraf Aroua, 2017.

In the Maternity of Clinic Belledonne, which is a private healthcare space (Figure 2), shades of a pink pastel color were used for the delivery room in order to offer to women in labor an ambiance of intimacy and warmth. One of the reactions was: *"The delivery room has very bright colors, it has different colors: a pink, a green and the blue turquoise; beautiful colors."*

In the physiologic delivery room, a dominance of grey is observed with a touch of green. Indeed, studies of Nikolic and Nikolic (2012) showed that the green has a positive effect on the reduction of anxiety and pain. Grey is a neutral color; it is used to create a neutral ambiance, to highlight the green color.

For the maternity rooms, orange was used. This color symbolizes energy, it evokes warmth, comfort, and reassurance (Tofle et al., 2004). A woman giving birth there was not satisfied with the use of orange. She said, *"The orange paint on the wall... It's really very concrete, it is not something that is warm and welcoming... It is orange... like it explodes in my face."* This showed that the color effects on a woman is something personal, related to one's taste and background.



Figure 2: The use of colors in the Maternity of Clinic Belledonne, Grenoble. Photo: Ichraf Aroua, 2017.

In the two previous maternities, the medical ambiance was really present. White dominated the walls and furniture. It has a clinical appearance; neutral and without vitality. Other colors were used partially. The homebirth (Figure 3) is considered as the recent form of birth space, which is seen as an alternative to giving birth at home. In this space, childbirth is considered as a natural process. It is characterized by a familiar and warm ambiance. The choice of color responds to these needs. The wall covered with wallpaper has a variety of colors ranging from white to grey giving a woman in labor a sense of security and tranquility. In addition to the use of residential furniture, the use of green, blue, pink and orange colors creates a welcoming and homey ambiance. An interviewed woman was satisfied of the chromatic ambiance: *"I found the maximum of privacy in this room; it is warm and colorful."*



Figure 3: The use of colors in the birth home "La Maison," Grenoble. Photo: Ichraf Aroua, 2017.

Since a safe and satisfying birth experience depends strongly on the level of stress experienced by the birthing woman, we had to verify objectively the impact of color parameter in modeling birth space ambiances, and thus affecting the perception of birthing women. Observations collected from our qualitative study on the French fields had to be completed by a quantitative study based on stress level evaluation. Detecting situations of stress due to an obsolete control of colors and light in birth environments is the ultimate goal of this correlation between qualitative and quantitative parts of our research.

To identify stress situations due to color and light parameters in birth spaces, we selected a Tunisian field of study where architectural design represents most of the recommendations picked up in French maternities: Maternity and Neonatology Center of Tunis. It deals with medical aspects needed in labor/obstetric spaces and friendly and warm ambiances needed in maternity rooms. Pictures of Figure 4 show the time-space interval chosen to be studied in this part, which is the time of transfer of a woman from the maternity room to the labor room, because of the variety of color and light ambiances. The delivery room is painted white. In the hall of the delivery block a linear touch of pink is added to the white walls. In the corridor, most of the walls are covered with traditional blue faïence. Finally, in the maternity room, only white is present.

A 25-year-old birthing woman who had a vaginal delivery without epidural is chosen as a case study to detect stress situations due to specific color and light ambiances. Figure 5 represents the curve of her Electrodermal Activity (EDA).



Figure 4: The use of colors in the Maternity and Neonatology Center, Tunis. Photo: Ichraf Aroua, 2018.

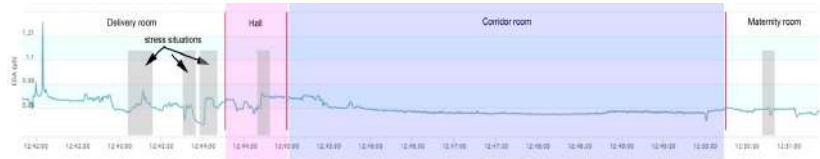


Figure 5: Electrodermal Activity (EDA) curve of a birthing woman.

In this EDA curve, we identify different stress peaks due to an increased stress level in the delivery room; some are related to the colors used, others to many physical parameters (mainly some sounds of clinical staff and monitoring machines). At the same moment of those stress peaks, the birthing woman complained about the white color. It was confirmed by the comments of the woman. When interviewing her about the space ambiance, she showed her dissatisfaction that the white color used frequently in delivery rooms: *"White color makes me feel cold and its neutral aspect is not cheerful; it is unpleasant."* The white color and bright light characterizing the hospital birth environment increased anxiety and fear for women.

We note on the EDA tracking that stress peaks persisted in the hall of the delivery block despite the use of a pink touch. It is due to the dominance of white color and bright light. This was confirmed by the comment of the woman: *"Despite the presence of the pink, it feels white and pale. I cannot forget that I am in a hospital."*

In the corridor, a slight decrease of the intensity of the EDA is observed; then it stays constant until the entrance of the woman in the maternity room. In this space, there exists a combination of white and blue colors but the light is less bright and less intense. This wall design is typically used in many Tunisian homes, so color did not play a major role here in decreasing anxiety of a birthing woman. Architectural materials evoking home design also played a role. These results are confirmed by the woman's comment: *"For me, the corridor is more pleasant by the faience colored in blue which makes me feel at home."*

In the maternity room, we detected on the EDA tracking a peak of stress and it was due to artificial light. At this moment, the birthing woman asked to turn off the light and to open the window. Many scientific studies showed that artificial light stimulates the cortex, provoking the release of adrenalin and inhibiting the physiology of birth. Being able to adjust the lighting also provides the opportunity to change the mood. Brighter light can encourage activity and lower lighting can create a greater sense of privacy.

CONCLUSION

We highlight in this paper a pertinent and original approach of detecting stress situations in birth space experienced by birthing women. There is the need for specific architectural design recommendations. In the light of the interest given to the question of the birthing woman and the birth experience in maternities, this study is pertinent as it shows the importance of careful coloring and lighting design in making the birth environment less or more clinical, affecting strongly the sensitive experience of such specific space users.

The analysis of the comments of women highlights that the perception of colors in space is more subjective than objective. It depends on the woman's personal experience, her background and her culture. In the case of the Tunisian maternity, women disapproved the use of white. For them it was cold and unpleasant, while a French woman perceived it as a symbol of hygienic and aseptic ambiance. We also observed that the use of monochromatic color schemes represents a bad choice for birth space because the positive effects of color are closely associated with other colors in the same space.

According to the results of the measurement of stress levels, we observe that every color creates a particular ambiance in a birth environment. It has a significant role in shaping the mood of women: stimulating or calming. The complexity of the hospital space showed that the stress situations can be caused not only by colors but also by other components of space like sounds and smells, which contribute to creating an uncomfortable ambiance.

The affective dimension of this study represents a new response that shows potential on the perceptual dimension of a given category of birth space users. The aptitude to personalize a given color design while considering age, culture, physical and mental capacities of a specified class of birthing woman is an important step forward. Such an objective would be aligned with a global well-being.

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Color as signal, landmark, symbol, imaginary in the city: The example of Bordeaux

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ABSTRACT

Color in architecture, despite its functions as a signal, a landmark and a symbol, remains largely absent at both the urban level and at the building level. The trend is towards the color chart, seeking harmony, but which sometimes gives way to monotony. In the case of a heritage city such as Bordeaux, the question of the use of color has also to cope with the UNESCO World Heritage protection of a large part of the city. Actions are limited by a concern for the relationship with what exists already, and as a result, respect for the historic and visual context gives rise to architectures that are discreet, or sometimes even banal. Nevertheless, there are designers in Bordeaux who dare to use color. Most colored buildings are part of a specific program or are in a key location in the city. By analyzing some urban and architectural examples, we show that buildings may be located in places of urban divide or that color may be used to identify a specific function. Logically, the further we move from the historic city center, the more colored buildings we encounter, yet colors nevertheless seem to be complex to manage. However, by determining the predominant colors and identities of a place, it is possible to focus a project more precisely and make it easier for residents to appropriate the space.

Keywords: *color, architecture, heritage, function, visual integrity*

COLOR AND ARCHITECTURE

Color is an integral part of our daily lives. It conveys codes, taboos, and prejudices that we adhere to without knowing it. It influences our environment, our behavior, our language and our imagination. In every country in the world, since prehistoric times, man has been attracted by color, creating symbolic messages around it that have been passed down through the ages in diverse activities and have become imprinted in his subconscious. In the field of architecture, while color is ubiquitous in interior decoration, it is more unusual to find it used on façades, apart from the color of the materials themselves.

The many functions of color in architecture

Color can assume different functions in architecture. When used as a landmark, it helps to find a place, and gives a city “legibility” as described by Lynch (1960). When used as a symbol, it becomes a collective sign, the result of an historical-social convention. It mobilizes people around a community identity, a basis for recognition and membership of a group. The color of buildings and urban spaces

enables us to find our way, to find our identity, and to dream. However, above all, color is the means by which the architect is able to express his sensitivity, his tastes, and his desires. Following trends is therefore neither an obligation nor a necessity. Today, however, the color chart is everywhere, seeking harmony, but which sometimes gives way to monotony.

Patrimonialization and coherence: many channels of vigilance

Many cities that are UNESCO World Heritage Sites, like Bordeaux, are “living historic cities,” and continue to evolve. As a result, the aim of the approach proposed by UNESCO (2011) is to ensure that contemporary interventions blend harmoniously with heritage in a historic framework. In the case of Bordeaux, as described by Callais and Jeanmonod (2017), UNESCO recommends a degree of vigilance regarding “the coherence and unity of the ensemble of classical and neoclassical buildings,” some of which are colored, some not, “and the quality of the public spaces.”

In order to respect the requirement to maintain a relationship with the existing architecture, the city of Bordeaux is well equipped with tools and experts. We should mention the CLUB (Local Bordeaux UNESCO Committee), which has an advisory role in architectural and urban projects, the PSMV (Safeguarding and Enhancement Plan), which deals with the area within the protected perimeter, the PLU (Local Urbanism Plan), dealing with heritage throughout the rest of the city, protection of the areas around historic monuments across virtually the entire city, and the ABF (Architect for the Buildings of France), which supervises all projects carried out within the protected areas.

Color and visual integrity in Bordeaux

Today, the only projects that are permitted are those which are simple and unremarkable in style, with a stone façade, and which do not disrupt the landscape, or projects whose architectural quality can allow for a degree of individuality, especially through color, and particularly in the case of public facilities.

In some cities, UNESCO experts have refused projects because they detracted from the city’s visual integrity. This is defined as the means of “identifying, conserving and managing historic areas within their broader urban contexts, by considering the interrelationships of their physical forms, their spatial organization and connection, their natural features and setting, and their social, cultural and economic values.” (UNESCO, 2011: 59) However, being listed as a World Heritage Site is not necessarily a constraint to architects’ creativity. Some designers venture to use color, whether at the urban scale or the architectural scale. In this article, we explore the various manifestations of color to be found in the city of Bordeaux and identify their specific features.

THE COLORS OF THE CITY

When we talk about color in a city, we must first distinguish between short-lived color and long-lasting color. Short-lived color lasts for only a short time and includes advertising posters, paintings, street art, shop signs, etc. Long-lasting color is the color of materials, whether natural or dyed. Long-lasting colors give a place its chromatic identity, irrespective of whether they are natural or created artificially by the addition of dyes.

In Bordeaux, the stone has a range of hues, associated with different local quarries, and these dominate the landscape of the historic center, giving it its homogeneity (Figure 1). When an urbanization or architectural project is carried out, color is used either to enable the project to merge into its setting, or to differentiate it. Although stone is the predominant material in Bordeaux, building

in stone or respecting the stone color tones is not a stipulation in the planning documents.



Figure 1: Bordeaux, city of stone. Photo © A. Herbert.

Although there is no stipulation, a certain hierarchy emerges in Bordeaux, linked with the nature of the urban landscapes and the degree of heritage protection. The further we move from the historic center, the more freedom we see in the choice of colors. For example, the Bassins à Flots district is differentiated from the historic city (Figure 2). It has uniformity through its dominant material, metal. The colors of the metal cladding are varied, ranging from blue-gray to azure via black. The city of stone and the city of metal are adjacent yet differentiated, while both have the same underlying principle, that of unity.



Figure 2: The Bassins à Flots district: two apartment buildings (left two); Cité du Vin (right). Photo © A. Herbert.

Architects are rational in justifying their choice of colors for a project. This was the case for the wine museum Cité du Vin (2016) designed by Agence XTU, whose “golden highlights evoke the white stone of the Bordeaux façades.” (Figure 2, right) However, this justification is often merely a point put forward to promote a subjective choice. Lenclos and Lenclos (1982) set out the basis for a discussion and methodology on color and housing from which several architects have drawn inspiration.

To objectivize the choice of colors as much as possible, Servantie (2007) highlights the need to know and define the hues of the setting in which the project is to be created. In this way, the colors of the building can be defined more precisely according to the approach to be adopted (tone on tone, contrast, and more).

Despite the development of these methods, color still eludes us and always has an element of subjectivity. However, by determining the dominant and identifying colors of a place one can position oneself more precisely within a project. Color is complex to manipulate, this is why there are different systems and tools available, such as color charts, to help deal with color in the city, especially a historic city. The complexity of the issue lies in the balance between the preservation of a chromatic identity and creative freedom.

COLORED ARCHITECTURES

Differentiating a building from its context is not a straightforward process, nor is it without repercussions; the decision must justify the risk, otherwise it can result in the city being less legible with many landmark buildings. Noury (2008) points out that, “Regarding colored architecture, there are two ways in which it can be embedded into its surroundings: integrating a new building into the urban landscape by harmonizing shades of color, or making a new construction contrasting visually with its environment.” In Bordeaux, we find that most contemporary colorful buildings are part of a specific program or are in a key location in the city.

Color as transition in the city

The Hotel Seeko'o, located at the corner of Cours Edouard-Vaillant and Quai de Bacalan, was completed in 2007 by King Kong Architects (Figure 3, left). The remit was to produce a high-end hotel, and this building aspires to be seen and to be a reference point in the city. What is striking at first is its large volume made up of perfectly smooth white Corian®. Although a large part of the Bordeaux quayside offers up a uniform landscape, the urban fabric in this part of the city is “freer and less ordered”, according to Costedoat (2007). Traditional in terms of its urban location yet contemporary in its architectural style, construction material and color, the Seeko'o perfectly masters its role in the transition between the classical city and the renewal-taking place in the northern neighborhoods.

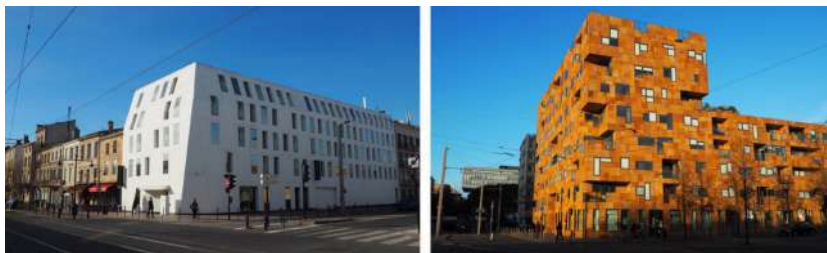


Figure 3: Hotel Seeko'o (left) Photo © A. Herbert. Square Pey Berland (right). Photo © A. Bousigues.

Square Pey Berland also illustrates this urban transition (Figure 3, right). Commissioned in 2006 by architects Arsène-Henry and Triaud, this building contains apartments, offices and shops and is located at the junction between the traditional city and the largely concrete-dominated ensembles in the Mériadeck district. The façade has a cladding of Brazil stone, colored brown ochre, and when the sun shines on it the block looks very bright and has been nicknamed the “gingerbread” building. This is a very heterogeneous building, creating the link between the classical city and the modern city, and is a reference point in the landscape.

Finally, the Arc-en-Ciel Building, designed by the architect Bernard Bühler is also located at the edges of different sections of the city, between the city of stone and some of the new urban ensembles (Figure 4). As its name suggests (“rainbow” in French), the specific feature of this social housing complex is its aesthetics, defined by glass strips in a dozen different and contrasting colors which alter the perception of natural light. The architect justified this approach by the need to enhance social housing, which, in his opinion, is usually “sad and somber”. Although the intentions of the architect, here or in other examples, are to enhance social housing and make it an enjoyable place to live, it can be argued that paradoxically, this addition of color may in itself be stigmatizing.



Figure 4: Arc-en-Ciel building. Photo © A. Herbert.

Color as a means of identification

Putting color on the front of one's home is a means of appropriation; it makes the building stand out from the rest. This color is a sign of identification for its occupants, it defines a unique space, their home; a customized dwelling which seems to be everyone's dream. If we consider collective housing, then the theory is quite different. The occupants are distanced from these issues and the framework for decision-making seems to give the architect sole responsibility for this choice.

If we look at the different stages in the design of the façades of the Stadion building, we see how this decision-making takes place, in a way that is becoming more and more widespread (Figure 5). The Stadion is a collective housing building containing 15 homes, built by LS Architects and Associates in 2011 on one of the Bordeaux boulevards. On its contemporary façade, volumes are highlighted in gray and yellow. These colors were chosen after a three-way discussion between the architect, the city's architect-consultant and the client.



Figure 5: The Stadion. Photo © A. Bousigues.

Color and materiality

The colors on the façades of the Stadion are used differently. The reconstituted fiberboard panels, the main constituent element of the façade, are through-dyed in gray. The manufacturer guarantees the consistency of the material over time, especially its weather resistance. Meanwhile, the loggias are painted yellow. By its very nature, paintwork requires maintenance. It is much less long lasting and is

therefore easier and less costly to change over time. According to Van Doesburg's definition (1924), the yellow on this façade is a decorative color, a means of decorating the surface, as a simple addition or ornamentation; the gray, however, is a plastic color as it becomes a material of expression and has "a value equivalent to all materials such as stone, iron, glass."

CONCLUSION

This analysis of some urban and architectural examples shows that in a UNESCO World Heritage city the use of color in architecture is associated as much with the architect's position and reputation, as with the building's location in the city or its function. Designers opting for color in architecture often feel the need to justify and rationalize their choice, in particular by focusing on the existing environment. Yet the color choice is usually influenced by subjectivity and hence by the architect's own tastes, or the tastes of other players in the city who intervene at different stages of the project.

Colored buildings may be few and far between in the city of stone, but they are often to be found in places of urban divide between two landscapes. The further we move from the historic center, the more colored buildings we come across. Color is also used to identify a building, to distinguish it from others, to allow its appropriation by adopting shades that are thought to be appreciated by the citizens concerned. In any case, colors seem to be complex to manage. Nevertheless, by determining the predominant colors and identities of a place it is possible to focus a project more precisely, thus making it easier for residents to appropriate the space.

ACKNOWLEDGEMENTS

The authors wish to thank Chantal Callais and Thierry Jeanmonod, who initiated this study, as well as the architects who agreed to answer our questions, allowing us to collect the data needed to finalize this work.

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Colour planning for the Market Square in Warsaw

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ABSTRACT

Research on history and theory of colour planning in the built environment has been undertaken as regulation of colour and has become crucial as the proliferation of unlimited hues of artificial paints that, when applied without guidelines, may easily lead to visual chaos in the built environment. This particular study concentrates on colour planning for the Market Square in Warsaw. The methodology employed included archival research and field studies. As a result, two colour proposals from 1928 and 1951–53 were detected, analyzed and compared with the currently applied colour scheme. It was questioned how the colour proposals have been created, introduced and maintained, and finally, what level of comfort a coherent colour proposal can bring into a place. The results achieved indicate that the analyzed colour schemes provided a warm and welcoming atmosphere to this representative square.

Keywords: *colour planning, architecture, urban design, Poland*

INTRODUCTION

A market square, usually a rectangular square surrounded by dwellings that housed workshops in a ground floor and flats above, is a very characteristic feature of a Central European city or town. Rooted in the Middle Ages, it has been a centre of an average Polish town for many centuries, and up to now, most of the market squares in Poland keep their original, historical urban form, but façades have often been rebuilt in different architectural styles over the centuries and colours were adjusted to the new circumstances, accidentally or planned.

As there have been many attempts undertaken to refurbish Polish market squares in the recent years, research on colour planning for market squares was undertaken in search for how colour was treated during those refurbishments. The colour proposals were examined in order to establish the way of how colour has been organized within such an important area; what role does it play, what image does it help to create, and finally, how does it contribute to physical ease and well-being of both inhabitants and visitors.

So far, a few examples of colour planning for Polish market squares were presented in the literature. Attempt to coordinate colour in Wrocław was discussed by the author of this article (Białobłocka, 2017; Białobłocka and Urland, 2019). The main ideas of a colour proposal for Płock was briefly presented by Romuald Kozioł (Kozioł, 1964). Conservation issues related to colour were the subject of the conference taken place in Warsaw in 2015. Apart from conservation issues a few examples of colour

planning were mentioned in the conference proceedings: selected issues related to colour proposals for part of the old town in Gdansk (Kriegseisen, 2015; Kołodziej and Brzuskiwicz, 2015), the old town in Warsaw (Kania, 2015), and the old town in Lublin (Żywiecki, 2015).

In this paper, the case study of Warsaw is discussed. Two colour proposals for the Market Square are presented from the point of view of the colour composition, and compared with the current situation.

METHOD

The methods employed included archival research, interviews with people responsible for colour in a city, and field studies. Archival materials were examined including architectural design projects, comments in the press, building regulations and guidelines on colour. Field studies were conducted in different daylight conditions. Research was conducted in 2017.

As a result, two colour schemes of Warsaw Market Square were detected. Data was found and analyzed in regard to the methods of inspiration, design, and implementation. Furthermore, the following features that are associated with comfort were examined: ease, freedom from hardship, repose, relaxation, serenity, tranquillity, contentment, content, well-being, cosiness, enjoyment.

THE 1928 COLOUR PLANNING FOR WARSAW MARKET SQUARE

Attempts to coordinate colour within the Old Town of Warsaw were made in 1928. The group of seventeen artist under the leadership of Zofia Stryjeńska prepared the colour proposal for the Market Square in Warsaw in order to prevent further degradation of the historic old town. The characteristic feature of this design was its colourfulness, the use of vivid hues and contrasting colour compositions that was partially linked to the Expressionism movement in art and partially inspired by folk art (Kania, 2015: 9).

The walls of eight buildings on the north side (Dekreta) are painted alternately two light colours: different shades of yellow and grey. The walls are lighter and the architectural details darker. Out of eight façades, seven are enriched with colours added to the corners and cornices. Both geometrical and floral patterns are used. Sgraffito covers the whole elevation of one building. Apart from grey, the following hues are applied on architectural details: black, blue, brown, green and red. As a rule, one colour is applied to the wall surfaces whereas two or three other hues are used on the details. Ground floor levels are not differentiated from the upper levels (Source 1).

The west side (Kołtąta) is characterized by strong contrast of light and dark, low and highly saturated hues applied in an irregular way. Out of ten façades, three are monochromatic, painted blue and grey-blue; four façades are enriched with wall painting and have the ground floor level differentiated with a contrasting hue; three façades seem to stand out from the row as they are covered with strong, contrasting hues: brown-orange and blue, yellow and blue, and peachy and blue (Source 2) (Figure 1).

The use of various strong hues is characteristic of the row of eight buildings on the south side (Zakrzewskiego) as each building is painted differently, with light or dark colours. Five façades are two-coloured: blue and brown, green and yellow, ultramarine and grey, red and pink, and, creamy and yellow. Two façades make the impression to be monochromatic, yet small surfaces are enriched with different colours. One façade is fully covered with wall-paintings (Source 3).

Similarly, colourfulness is also the first feature to be spotted on the east side of the market square (Barssa). The thirteen façades on this side are painted green, grey-blue, orange, pink, and yellow. The architectural details are painted either with a neighbouring shade of the hue applied to the façade surface or with a contrasting hue. This row is colourful, but colours are applied with no rhythm. Yet the lightness of the colours used is a feature that differentiates this row from the two other colourful rows (Source 4) (Figure 1).

The colour design described above was implemented in 1928. The main plea in the press was the lack of colour harmony, the other was the lack of reference to the original, historical colours (Kania 2015: 10).



Figure 1: Warsaw, the 1928 colour proposal for all four sides of the Market Square. Source: Muzeum Warszawy, call number: MHW 15965-68. Author unknown. Photo: Rafał Chmielewski.

THE 1951 COLOUR PLANNING FOR WARSAW MARKET SQUARE

The other colour proposal for the Market Square was part of the reconstruction of Warsaw Old Town and was under preparation in the years 1951–53. One of the first designs was made by the Mistoprojekt Group who presented a uniform colour proposal kept in grey shades with pastel tints, additionally decorated with horizontal frescos and sgraffito, whereas the other design by Wojciech Jastrzębski's team was kept in light hues (Kania 2015: 13–14). The team lead by Jan Sokołowski that based their concept on the previous greyish design by the Mistoprojekt Group, continued the idea of the so-called colour discretion and horizontal sgraffito decorations. Apart from a uniform colour composition, the colour proposal aimed to depict the market square as a happy workers' housing estate in line with the then official political doctrine (Kania 2015: 17).

The 1951 design by PKZ, Pracownia Architektury, consists of fifteen drawings for the Old Town including one side of the Market Square (Source 5). According to the design, the façades of the Dekreta side should be either two-coloured (six façades) or three-coloured (two façades): walls were to be painted one hue and the architectural details another hue (in five cases the colour of the opposite temperature, i.e., warm hue on the walls and cold hue on architectural details). The colours for the building façades were described on the drawings (from left to right): carmine red with grey ground floor; yellow; grey; green with gilding; pink with light yellow ground floor; grey-green with gilding; orange; and, grey-blue with gilding. The drawing was made in the aquarelle technique and as such, provides a feeling of a somehow uniform, light colour composition. The rhythm is introduced by the alternate, but not consequent, use of warm and cold hues applied to the façades and the architectural details. Façade painting is not included on the drawing, possibly because of its scale of 1:250 (Figure 2).

This colour proposal was implemented in the summer 1953 and was described in the press as a positive achievement (Kania, 2015: 21).



Figure 2: The drawing conserved in the museum provide information on colours only for the Dekreta side.
Author: PKZ Pracownia Architektury. Source: Muzeum Warszawy. Call number: MHW 130/Pl.

THE CURRENT COLOURS OF WARSAW: ANALYSIS OF 2017

The north side (Dekreta) is a multi-coloured composition with one monochromatic and seven two-coloured façades (while taking into consideration only colours of bigger surfaces, i.e. façades and architectural details). The façades are of various hues with no visible rhythm: two shades of grey, creamy, brown and yellow, two shades of red, and two shades of green. In seven cases the architectural details are painted creamy beige. In one case sgraffito imitates blocks of stone; and in one case the façade is enriched with painted floral compositions. The east side (Barssa) provides a feeling of balance in terms of colours used. The façades are monochromatic and the use of colours is limited to warm

hues (with one exception of a two-coloured scheme including blue and pink). However, at the same time the row is differentiated by the use of various shades of creamy, brown, and red.

The south side (Zakrzewskiego) makes the impression of a uniform colour composition for two reasons. Firstly, the façades (with one exception) are two-coloured with the architectural details being painted lighter and warmer hues, and secondly, the colours are limited to warm shades such as beige, brown, grey, olive, and yellow. Similarly, the west side (Kołtataja) is perceived as a uniform colour composition. The row of buildings is covered with shades of warm hues: brown, red and yellow, with the exception of two buildings painted grey (Figure 3).

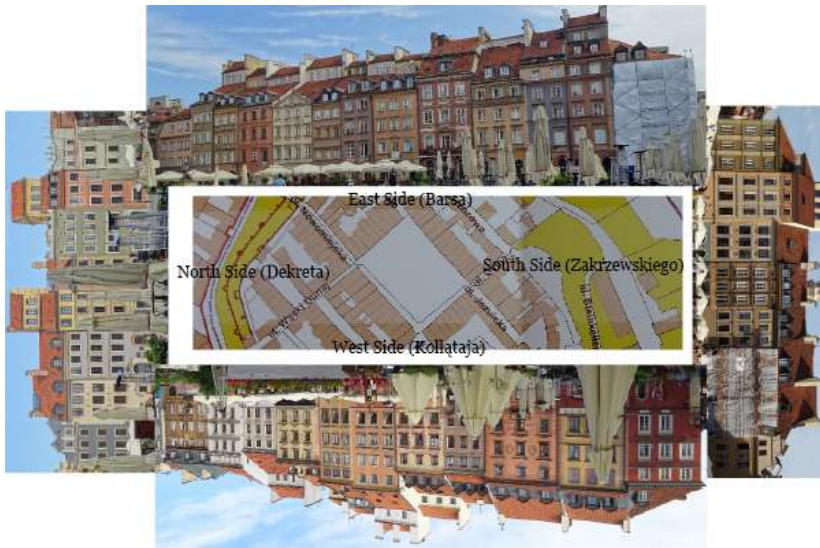


Figure 3: Colours of Warsaw Market Square as of August 2017. Photo: Karolina Białobłocka.

CONCLUSION

The 1928 colour proposal was characterized by multi-colourfulness and the application of strong, vivid colours – the features that are associated with gaiety and cheerfulness. Judging by the available drawings and descriptions, the other attempt to coordinate colour made in 1951–53 provided a more balanced solution: still colourful in terms of hues, but limited in terms of lightness and saturation and balanced with the application of grey associated with elegance and ceremony. This colour scheme aimed to create the atmosphere of a happy workers' housing estate in accordance to the then official political doctrine (Kania, 2015). The current palette as of 2017 is again dominated by warm colours that are associated with joviality, and partially balanced with grey and associated with elegance. The presented colour schemes discussed above indicates that warm hues are widely used and in parallel the application of grey took place. In this way, the feeling of cheerfulness is balanced by dignity and ceremony. Regarding the comfort of passers-by, it was provided partially by the application of red and

orange associated with enjoyment, but the feeling of tranquillity was limited to the use of blue and green.

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Archival documents

- Source 1: Muzeum Miasta Warszawy, call number: MHW 15965 Rynek Starego Miasta – strona północna /Dekreta, after 1929, author unknown.
- Source 2: Muzeum Miasta Warszawy, call number: MHW 15966 Rynek Starego Miasta – strona zachodnia /Kołatąja, after 1929, author unknown.
- Source 3: Muzeum Miasta Warszawy, call number: MHW 15967 Rynek Starego Miasta – strona południowa /Zakrzewskiego, after 1929, author unknown.
- Source 4: Muzeum Miasta Warszawy, call number: MHW 15968 Rynek Starego Miasta – strona wschodnia /Barsa, after 1929, author unknown.
- Source 5: Muzeum Warszawy, call number: MHW 130/Pl.s.

Color and the emotional character of interiors

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ABSTRACT

The paper presents the contents and results of an educational experience conducted within the Shapes, Surfaces and Colours module of the Master in Furniture Design by Poli.Design, Politecnico di Milano, in December 2018. This experience has allowed experimenting and evaluating the design implications related to the emotional response to color in terms of 4-color combinations and the possibility of using these experiences and connotative associations to build the emotional character of an interior.

The students' works were analyzed in part during the course process, to provide a basis for verification and shared discussion, and partly in retrospect, to verify and assess the presence of associative recurrences between the selected emotion words and the color attributes. The recurrent associations resulted from these verifications contribute to validate the possibility of dealing with the evaluation of the emotional response to color in terms of color combinations. In addition, the use of these associative assumptions to build the emotional character of the interiors, proved to be a useful didactic and methodological tool to relate color to the other design components, in particular to the shape, the material and the surface, and to show the potential value of a design process that is structured around the sensorial and emotional qualities of the environment.

Keywords: *color emotion, color design education, color combinations, color associations*

INTRODUCTION

The evaluation of the emotional response to color, or "color emotion", concerns both the aesthetic experience of color, or color preference, and the connotative experience of color in relation to concepts such as, for example, warm or cool, light or dark, heavy or light, and more (Sivik, 1970; Gao and Xin, 2006). As Sivik (1970: 43) points out, the prerequisite for this type of study lays in the fact that people actually prove to be sufficiently in agreement in their experiences and opinions about in relation to color.

A few studies have focused attention on the implications that can be established regarding the use not only of single colors, but also of color pairs (Ou et al., 2004a, 2004b) or of combinations of several colors (Kobayashi, 1991).

As noted by Küller (1981: 162) regarding this area of research and compared to the numerous studies conducted on single-color-without-context, there is a need for a greater number of studies aimed at evaluate color as part of a complex and meaningful situation.

Within this framework, the didactic experience carried out within the Shapes, Surfaces and Colours module of the Master in Furniture Design by Poli.Design, Politecnico di Milano, allowed to experiment and evaluate the design implications related to the emotional response to color in terms of 4-color combinations and the possibility of using such experiences and connotative associations to build the emotional character of an interior. This contribution presents the contents and results of this experience.

METHOD

The teaching experience conducted within the Shapes, Surfaces and Colours module of the 1st level Specializing Master in Furniture Design, Learning from the Italian experience, by Poli.Design, Politecnico di Milano, was conducted by the author in December 2018, over a period of 3 days and for a total of 21 hours organized to offer students theoretical content and practical-design feedback on such content. Following a teaching method that had already previously been partially tested (Boeri, 2019), the twenty-four students, from different nationalities, were asked to proceed in two phases.

The first one was configured to allow students to explore and experiment the design implications related to the construction of 4-color combinations associated with a selection of “evocative terms”, or emotion words, chosen on the basis of their recurrence in the literature addressing the emotional response to color, or color emotion (Ou et al., 2004a: 233), and their relevance to possible design developments. The terms selected, in the form of pairs of opposites, were: *classic-modern*, *cool-warm*, *dynamic-quiet*, *hard-soft*, and *heavy-light*.

The second one, introduced for the first time on the occasion of this course, was conceived to experiment and evaluate the possibility of applying the associations and palettes previously developed, to build the emotional character of an interior.

The first phase was developed by following and adapting a step-by-step process already adopted in other didactic forms (Boeri, 2019). In sum, the students were first asked to explore the associations that could be established between emotion words and color attributes by placing each of the proposed emotion words within an organized map on a vertical axis of lightness and a horizontal axis of saturation forming four quadrants also characterized by the association with the cool-warm polarity, assumed as an indicator of an evaluation mainly linked to hue. The map and the emotion words were illustrated to the students beforehand. This exploration had a dual purpose: on the one hand, to invite students to pause and weigh all the proposed emotion words before proceeding to the choice of which ones they wanted to develop and, on the other, to provide a basis for verification, comparison and shared discussion with respect to the results produced.

Subsequently, the students were asked to freely choose one or two emotion words from those proposed and to build a 4-color palette associated with each emotion word using standard color samples of the NCS, Natural Colour System and the NCS Navigator. The pre-set table, supplied to the students, envisaged that for each palette there would also be some evocative images useful to contextualize the palette in relation to the sought for association, the visual hierarchies that each color can take inside the palette and the characteristics of each color and color combination with respect to the color attributes using the NCS color circle and triangle (Figure 1, 2nd column left).

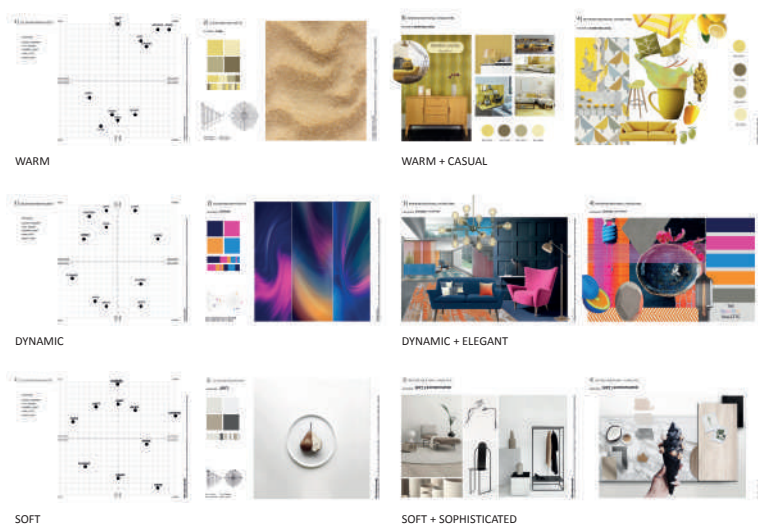


Figure 1: The horizontal rows show three examples of students' work ("warm", "dynamic", and "soft"), produced in the course's 1st phase (left two plates) and 2nd phase (right two plates) of the Shapes, Surfaces and Colours module (Professor: C. Boeri) of the Master in Furniture Design, Poli.Design, Politecnico di Milano (Director of the master: A. Deserti; Co-Director: F. Zurlo).

Compared to other teaching methods and purposes (Boeri, 2019), some changes were introduced concerning the selection of the emotion words, the setting of the exploratory map provided to the students and the use of the NCS system and the NCS Navigator also in the phase of selecting the colors.

In a second phase the students were asked to apply the associations they found, between the emotion words and the palettes previously developed, to build the emotional character of an interior. In sum, the students were asked to develop two moodboards able to describe and synthesize through images the emotional and sensory characteristics of an interior space, referring to the domestic or retail environment, using as main reference the emotion word and the relative color palette already developed, and declined according to a further connotation to choose from within a new selection of proposed emotion words: *casual-elegant*, *playful-serious*, *simple-sophisticated*. The work, divided into two plates, initially involved the construction of a moodboard aimed at creating a strongly evocative suggestion of the "character" of an internal environment connected to the emotion words choices and subsequently the construction of a relative inspirational material-chromatic scenario (Figure 1).

The students' works were analyzed in part during the course process, to provide a basis for verification and shared discussion, and in part in retrospect, to verify and assess the presence of associative recurrences between emotion words and color attributes both with respect to the initial exploration and to the colors and organisational schemes used for the construction of the color combinations (Figures 2 and 3).

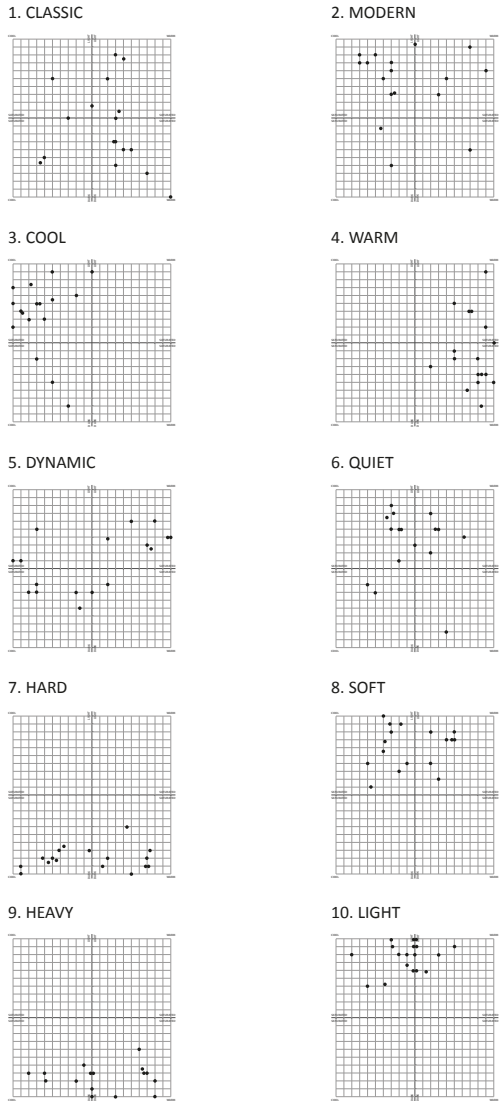
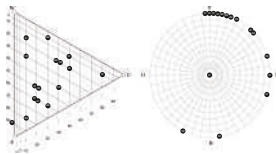


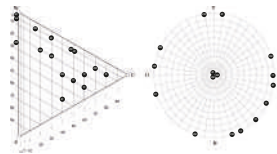
Figure 2: The map provided to the students to explore the associations that can be established between the selected emotion words and the color attributes. The results of the exploration, referring to a total number of 17 works submitted (1 incomplete for the quiet and heavy emotion words), were visually rearranged to show the presence of possible recurrences in relation to the attributes of lightness and saturation and to the cool-warm polarity for each word.

1. CLASSIC



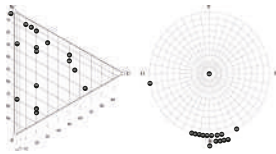
Total works: 4

2. MODERN



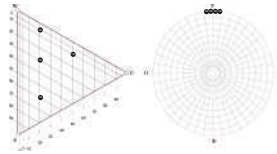
Total works: 4

3. COOL



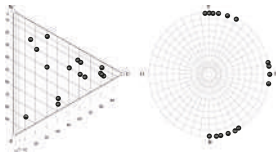
Total works: 4

4. WARM



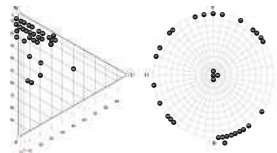
Total works: 1

5. DYNAMIC



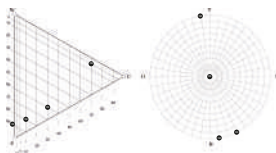
Total works: 4

6. QUIET



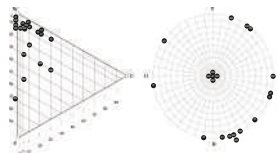
Total works: 8

7. HARD



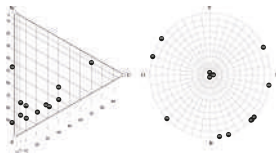
Total works: 1

8. SOFT



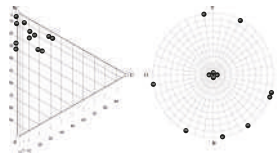
Total works: 5

9. HEAVY



Total works: 3

10. LIGHT



Total works: 3

Figure 3: The results of the analysis of the colors and the patterns used for the construction of the 4-color combinations associated with the selected emotion words, conducted on a total number of 37 works, were visually synthesized using the NCS triangle and circle. The 4-color combinations associated with each emotion word can be identified by the letter F = female or M = male and a progressive number.

RESULTS

The initial exploration results, in relation to a total number of 17 works, were visually rearranged to show the presence of possible associative recurrences in relation to the lightness and saturation attributes and the cool–warm polarity for each emotion word (Figure 2). In particular, the results show a concentration of associative evaluations mainly on the axis of lightness for the hard–soft and heavy–light polarities, and a noticeable concentration mainly on the axis of saturation for the dynamic–quiet polarity.

The results of the analysis of the colors and organisational schemes used for the construction of the palettes, carried out in retrospect on a total number of 37 works, were visually synthesized using the NCS triangle and NCS circle to show the presence of possible recurrences and their relevance in terms of hue and/or nuance (Figure 3). In particular, the most relevant results, also taking into account the number of works that could be analyzed for emotion words, show: for *cool*, a recurrence in the colors used in relation to the hue (concentrated in an area of the circle between R90B and B20G); for *quiet*, a recurrence in the colors used in relation to the nuance (mostly concentrated in an area of the triangle with blackness between 05 and 20 and chromaticness between 0 and 30); for *soft*, a recurrence in the colors used in relation to the nuance (mostly concentrated in an area of the triangle with blackness between 05 and 30 and chromaticness between 0 and 30); for *heavy*, a recurrence in the colors used in relation to the nuance (mostly concentrated in an area of the triangle with blackness between 40 and 90 and chromaticness between 0 and 40); for *light*, a recurrence in the colors used in relation to the nuance (concentrated in an area of the triangle with blackness between 05 and 30 and chromaticness between 0 and 30).

CONCLUSION

The results of this didactic experience contribute to validating the design opportunities offered by the possibility of dealing with the evaluation of the emotional response to color in terms of color combinations. In addition, the use of such associative assumptions to build the emotional character of an interior seemed to be a useful educational and methodological tool to relate color to the other design components, in particular shape, material and surface, and to show the potential value of a design process structured around the sensorial and emotional qualities of the environment.

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Putting color projects in the public art space into practice: A case study of Public Art Project II at the National Museum of Marine Science and Technology

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ABSTRACT

This paper deals with color studies carried out on Badouzi Island in Keelung, located on the northeastern coast of Taiwan, and is a typical fishing community that expanded in the 1980s to the largest harbor in northern Taiwan. The development of public art in Taiwan has gradually moved towards the goal of establishing urban uniqueness. As opposed to the past, when art was merely placed in public spaces, the relationship between the art object and its environment has been greatly enhanced in recent years. Taiwan's Culture and Arts Reward Act 1992, the public art regulations, were recently adjusted and the concepts started to be more non-materialistic and activity-oriented. The National Museum of Marine Science and Technology (2014) found its home in a converted power plant, a cultural heritage site. The Museum launched the public art project "Art Power-House: Transformation and Joins Among the Differences" to remold its environment. Environmental color research based on Lenclos' methodology was carried out, including a cross-seasonal color survey, to further artistic interventions on site. As well, public workshops were held in which people were invited to learn from, explore, analyze, and recreate colors of the environments of their daily lives. The main goal is to help protect the local culture of Badouzi Island and establish a visual aesthetics.

Keywords: color survey, public art, environmental color, Badouzi Island, National Museum of Marine Science and Technology

THE COLOR RELATIONSHIP BETWEEN BADOUZI ISLAND AND PUBLIC ART



Figure 1: Badouzi Island.

Judging from the present circumstances, an ill-arrangement of colors on Badouzi Island (Figure 1), where the National Museum of Marine Science and Technology (NMMST) is located, has led to the island's visual disorder. And the reason that it is so far challenging to carry out any environmental color plan in Taiwan is that the specialists involved lack systematic training in color, and they do not know how to use colors professionally. Integration is needed for interdisciplinary work. Environmental color planning in Taiwan is not even seen as a professional skill yet. Overall, surveys and discussions on environmental colors are few.

The National Museum of Marine Science and Technology entrusted the author Hwei-Lan Chang to carry out a public art project entitled "Art Power-House: Transformation and Joins Among the Differences." Through this project, the museum encouraged people to learn about oceanic culture and technology through educational and appreciation events. It also offered support to the cultural and creative industry and the tourism industry through promotional activities. In the future, if Badouzi Island can become a region with well-planned colors, it will become the most practical and influential source of art education. Keelung shall also become a wonderful museum city in this way (Chang, 2013).

"Art Power-House" systematically reshaped environs through public art. Artists with various kinds of expertise were invited to share ideas through discussions. Furthermore, NMMST has been converted from the old Northern Taiwan Fossil Fuel Power Plant building, which is a cultural heritage site and therefore retains important historical value and cultural characteristics, shaping a dialogue between traditional culture and contemporary art. Most importantly, the museum is a "linkage" and a "boundary-breaking force." It is "art" and a "medium," a "tool" and a "moving artwork."

Long before the Preparation Office of the National Museum of Marine Science and Technology was established, Badouzi Island's landscape, industry and population had been changing day-by-day. After the inauguration of the museum in 2014, based on the museum's highly unique environmental and historical features, we set goals for "Art Power-House" that focus on community aesthetics (Chang and Du, 2012). While allowing art to thrive alongside environs, as well as highlighting the museum building's historical value and cultural features, we tried to come to a consensus on environmental aesthetics with local residents and advocate it. We hoped to see environmental transformation take place. Well integrated into daily living space, the artworks were defined as community-based interactive public art. That is, we used art to "open up" spaces that are beneficial for improving public environs. We invited people to share their thoughts and take part in our work, thereby acknowledging/creating a sense of belonging for all community members, an "identity of space" of Badouzi Island, and a sense of worth of the local ocean culture (Figure 2, top). We also carried out field research on environmental colors, hoping to rediscover the historic-cultural context of the colors of Badouzi Island, lost in the process of urban development. We wanted to rebuild an "archive of artistic energy" with a contemporary look, in addition to yielding room for imagination for local industries and inventing new cultural traditions with our artistic sense and creativity.

Since this was a public art project, we adopted the research approach of Jean Philippe Lenclos (Lenclos and Lenclos, 1990; 1995; 1999) to collect, arrange and extract Badouzi's color spectrum. The point of this applied art-inspired method was to learn the representative colors of the region as comprehensively and objectively as possible, and use these to explain the close relationship between architectural colors and the colors of natural and cultural landscapes. The results were presented through writings accompanied by pictures, as well as interviews with local elders and the general public. We used the following means to present colors: first, we hand-painted the color samples and made color charts for on-site comparison. We then created digital image-based records of the colors, as well as records from spectrometers and colorimeters. Digital photos were kept as references,

because it is easy to output such photos and they are useful for computerized simulations. Lastly, upon finishing environmental color surveys and analyses, we proceeded to computerized simulations, which are helpful for imagining and evaluating environmental colors for the future. The results could be used for further work (Figure 2, center).

THE FLOATING COLOR CODES OF BADOUZI ISLAND

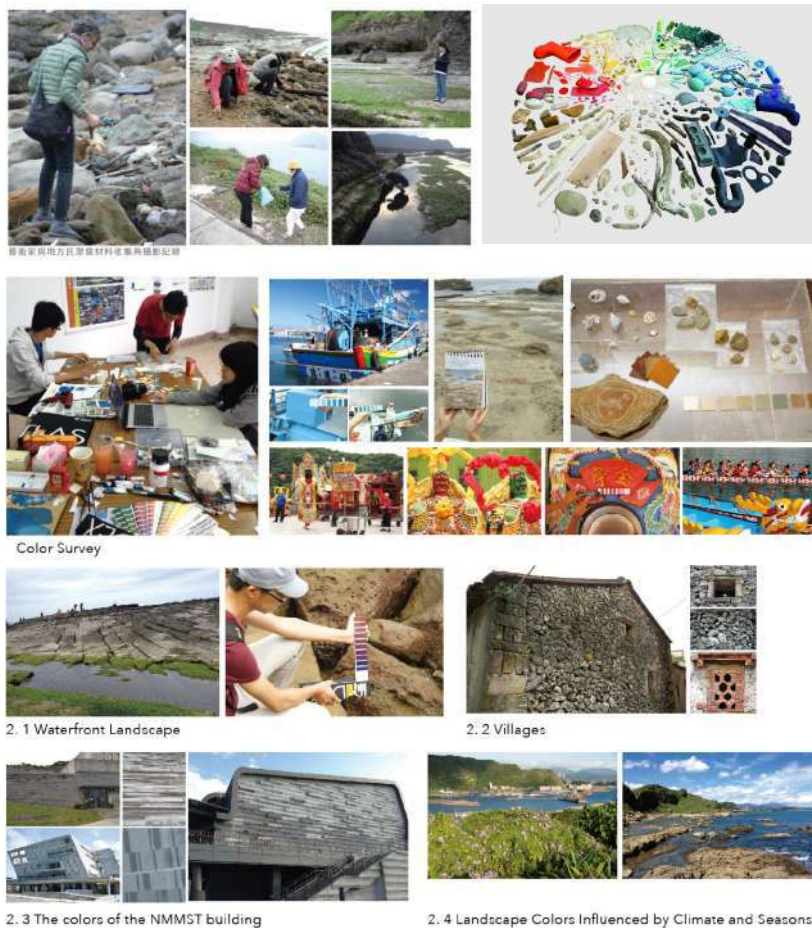


Figure 2: People were invited to participate in our workshops and share their thoughts about color (top row). Color survey process (center row, bottom row).

Badouzi Island's environmental colors, coming from both nature and culture, are a mixture of natural environmental colors and man-made environmental colors. In some areas, because it is not possible to specify which colors are natural and which are man-made, the colors are defined as transitional or "combined environmental colors" (Chang, 2011). Also, due to geological and natural conditions, as well as a range of exploitations that took place in different times, the island's color palette varies depending on the area in question. This palette is considered the "terroir of colors" here. We explored Badouzi's colors according to the following environmental features.

Badouzi Island's waterfront colors are made up of physical and non-physical elements. The context of the island's waterfront landscape, physically speaking, comprises mountains, water, rocks, geological formations, and earth. Biologically speaking, it comprises plants, animals, algae, and other microorganisms. Light and meteorological conditions work wonders with time and season. There also are factors created by humans and a changing set of waterfront environmental colors take shape



Environmental Color Spectrum and Color References

Figure 3: Badouzi's environmental color spectrum and color references.

The Daliao Stratum here takes a northeast-southwest direction and it tilts towards the south after it rise up a long time ago. It took shape in the early Miocene era (about 20 million years ago) as a neritic environment, mainly consisting of sandstones, siltstones, and sand shales. The sandstones, containing calcareous cementation, are hard enough to resist erosion. When attacked by ocean waves, weaker shales collapse slowly, leaving solid sandstones. The different levels of erosion result in a range of beautiful wave-cut formations, such as capes, cliffs, platforms, and trenches.

Located on the on the east of Heping Island in Keelung City, Badouzi Island used to stand alone on the sea, facing the north side of Keelung Mountain. Since the Qing Dynasty, it has been a famous fishery village of Keelung. During the Japanese Rule, the Japanese filled in earth here to create new land, and as a result it became a small peninsula, after being connected to Keelung Mountain, and Badouzi Bay also took shape. Water is deep and sands are shallow here on Badouzi Island, making it a great natural fishery port. Tidal range is rather small here. A rock cape, it is one of the few old fishery ports that are still functioning quite well today in Taiwan.

The nationalist government turned the port into a modern one in 1975 and all construction work was finally completed in 1980. Badouzi became a large-scale, well-planned fishery port of the North Coast - the largest fishery port of northern Taiwan. Formerly an operational base for fishery boats farther afield, it now serves for coastal fishery businesses. Fish in the surrounding seas are many, mostly squid which have in fact been an important food for locals since the Qing Dynasty. In nearby fishery villages, it is common to see seaweed being dried under the Sun, as well as "fish huts" that serve as food processing plants. Near sunset, rows of boats, decorated with white lights, slowly set sail to the sea. They will catch squids at night.

Villages

The houses of early local villages are mainly built with coral stones (Figure 2, bottom). Other than the colors of these regional building materials, these residences also retain the colors of earth and bamboo. The western-style houses built at a later time are of red brick. The ones constructed after people's finances improved show the cement color. The houses of even wealthier families show the colors of tiles on the exterior. There were not many options in terms of windows and doors, although they can affect a building's appearance a great deal. Due to the climate, boat paints have been used for building exteriors so as to make them waterproof.

The colors of the National Museum of Marine Science and Technology building

Grey is the main color tone. This is to fit the original colors of the old power plant building, and also because architect Lin Chou-min believes that grey is the friendliest color to surroundings, although it might not be a popular color for most people. With grey being the main color tone, the museum building is presented in rhythmic hues of grey, using a range of construction materials that are naturally grey.

Landscape colors influenced by climate and seasons

On a cloudy day, the area looks peaceful, refined, and covered in muddy colors. The range of color hues seems to keep changing subtly. On a sunny day, colors change alongside light and shadow as sunshine goes strong in some hours and turns weak in others. Color contrasts are more intense, and the saturation and brightness of colors get higher under the sun and lower when away from the sun. Other than weather and light, coastal Badouzi's colors are affected by the location, depth, and speed of ocean water, as well as the surrounding scenery. These allow the colors to change more flowingly and finely.

FOLLOW-UP AND SUGGESTIONS

We held a presentation and a talk on our art and color research workshops, including the environmental color spectrum and color samples we acquired through "Art Power-House:

Transformation and Joints Among the Differences” (Chang, 2013). Although Keelung has not yet been fully developed into a museum city, we hope that this study on the environmental colors of Badouzi Island can be used for relevant design and color planning in the future, setting examples for the use of colors in cultural space. In this environmental color project, we invited people to join our work as a way to teach and promote art, while preserving Badouzi’s natural environs. We also offered a set of standards based on the existing regional colors, whilst promoting conservation of regional colors and landscapes. We avoid improper pairing of colors so that the region can retain its sense of beauty. The last we wanted is a disorderly display of colors, even ruining the original color combinations. Applying the principle of color harmony, we provided color suggestions which not only reflect Badouzi’s regional characteristics but also are orderly, harmonious, lively, and creative. Environmental color spectrum and color references are important tools. We analyzed and arranged color samples and concluded an environmental color spectrum and color references, based on mountain landscapes, ocean landscapes, farms and fields, highway landscapes, and village landscapes, as well as Badouzi’s animals and plants.

PRINCIPLES FOR SETTING ENVIRONMENTAL COLORS

We identified the scope of the project and the main man-made facilities in each area, as well as the ones that may affect environmental colors. Taking into account the color structure of these areas, we offered suggestions for use of colors. We wanted to ensure that the original environmental colors would be retained and color structure would be further developed. According to each area’s natural and cultural characteristics, as well as the local government’s landscape conservation, planning and management goals, our suggestions for color structure are as follows: (1) Wave-cut platforms: Retain the shapes and colors of the coasts, while maintaining natural views. (2) Mountains and valleys: Retain and even strengthen the shapes and colors of mountains, while maintaining natural views. (3) Highways: The highways should be in tune with its surrounding mountains and seas, whilst highlighting the main landscapes nearby. (4) Mountain villages: The villages should be in tune with its surrounding nature, whilst retaining their birds-eye-views. (5) National Museum of Marine Science and Technology, a core area for development: Retain the natural scenery and old streets nearby, while developing a unique museum identity, and also provide high-quality tourist services to the public.

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Traditional and new colors of architecture in Valdivia, Chile

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ABSTRACT

This work presents an historical journey of Valdivia's architecture and its colors, since before its foundation in 1552 to the present. The methodology is based on a bibliographic review of the city's history and architecture, and direct observation of new architecture. The research results focus on architectural landmarks, from the period of the indigenous population, through the Spanish conquest, the arrival of German immigrants, modernity, and the present. The new creations by architects and professors of the School of Architecture include interesting color proposals in which the author has been actively engaged. From the history of Valdivia, we can conclude that the color of its architecture has been linked to the materials available in the region and to the culture of the human groups that have inhabited it. Color in the form of paint and new materials has also been used as a sign of economic status, as a sign of belonging and identity, and in response to different architectural styles. From the projects carried out by the architects of the School of Architecture, the question remains as to how color will continue to develop in the future of the city.

Keywords: *architectural color, architecture, Chile, Valdivia, history*

INTRODUCTION

The city of Valdivia, located in Patagonia, 800 kilometers south of Chile's capital city Santiago, was established in 1552 by the Spanish conqueror, Pedro de Valdivia, on an ancient indigenous city called Aynil, where the city center is now located. The conqueror's purpose was to prevent the seizure of Spanish landholdings by other seaborne empires, such as the English, Dutch or Portuguese. The first city, built of stone, was completely destroyed in 1599 by indigenous people and rebuilt with wood in 1645. In 1820, the city of Valdivia gained independence from the Spanish Crown, and in 1850, a group of German settlers arrived in the city, establishing different types of factories in Collico and on Teja Island, and changing the city's aspect (Cordero, 2003; 2014) (Figure 1). Many historical documents give accounts of the German influence on the architecture and social life of the time (Muñoz, 2005).

At the turn of the 20th century, neoclassical and modern concrete architecture emerged, although most of it was destroyed by a fire (1909) and an earthquake (1960). Recovery efforts were slow. From the Pinochet dictatorship (1973–1989) Valdivia, like the rest of Chile, adhered to the neoliberal political and economic model that led cities to an expansive urban development of low quality (Martínez, 2009). The city began incorporating styles such as postmodernism and other international architectural trends.

The establishment of a School of Architecture in 2000, with a new vision about the city, and the creation of the new Region Los Ríos in 2007, with Valdivia as its capital city, pushed architecture to new and more bold frontiers in terms of styles and colors.

Today, the city has a population of 150,000 inhabitants and extends over 1,000 square kilometers of land that includes a large number of urban wetlands. Valdivia is surrounded by rivers, native forests and lies 16 kilometers from the Pacific Ocean, which transforms it into a touristic attraction.

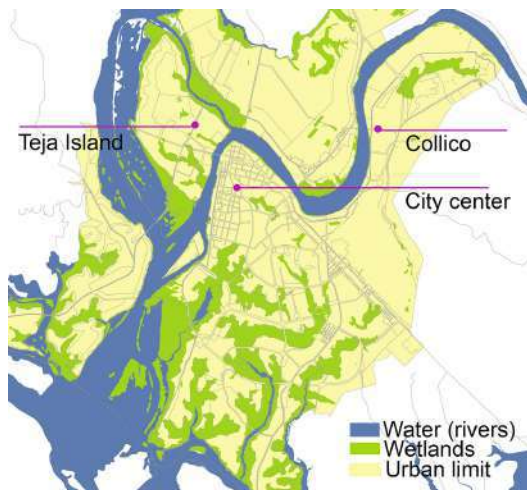


Figure 1. Valdivia map with its rivers, wetlands and some neighborhoods (Source: Elisa Cordero, annotations on a map by Fundación Forecos).

METHOD

A bibliographic review of the city's history and architecture, as well as direct observation of the contemporary architecture was carried out. The author's material was used to present chromatic projects built in recent years.

RESULTS

Upon the arrival of the Spanish conquerors, the region was populated by Mapuche Indians who had houses, fruit trees, sport sites and a rich trade with indigenous people from the coast and inland (Guarda, 2001). This original Mapuche house (Ruka), still used but only for tourist or ritual purposes, is built in wood and covered with thatched, so its colors are of the material itself (Figure 2, left).

The Spanish conquerors founded their city on the Mapuche city, called Aynil, and named it Valdivia, in honor of the conqueror Pedro de Valdivia. The first houses were built in stone, as they did in Spain; however, after the earthquake of 1575 and the destruction of the city by the natives in 1599, they began to build in wood. In this second period, and as a defense against the natives and pirates, the two stone towers that still exist in the city, and the forts that are on the coast, were built (Figure 2, right two). The Spanish-Chilean city is described, in texts of that time, as a group of very low houses, oak log

walls, and roofs of larch boards covered with moss and upstart plants (Pérez-Rosales, 1970: 470). We could venture that at that time the color of the city was that of natural materials, wood and stone.



Figure 2. Ruka Mapuche (Source: Flickr); The Spanish Tower (Source: Wikipedia); Mancera Island Fort (Photo: Elisa Cordero), all buildings in the colors of natural materials.

After the independence of Valdivia (1820), only from 1850 onwards German settlers began arriving through a government project to populate southern Chile. Many settlers brought money and soon began building houses and industries, which gave an important economic boost to the sleeping city. The houses, in neoclassical style, were built in wood and some of them lined in galvanized iron sheets with different designs (Pérez, 1894: 12). Painted mainly in yellow, that is a color that until today characterizes these constructions (Cordero, 2003). White was also used in some industrial buildings and warehouses, due to its low price (Figure 3).



Figure 3. Contrast of colors between the houses of the businessmen and the working class. Kunstmann industrial family house in Collico, painted in light yellow, with green details and a red roof (left); workers' houses of the Anwandter brewery on Teja Island, painted in strong colors (right). Photo: Elisa Cordero.

At the beginning of the 20th century, industries began to build houses for their employees. Most were not painted although some were covered with carbonyl, which is a black product, made from petroleum. In the 1970s and due to changes in the economy, employees agreed to buy these houses and painted them in different colors, to mark their identity on their new property (Figure 3, right).

Already at the end of the 19th century, the center of Valdivia began to populate with new concrete buildings, in neoclassical style, destined for housing and commerce. Some of them had the color of

those materials, or yellow, white, or another light color. After the great fire of 1909, which destroyed twenty downtown blocks, the city was rebuilt in Art Nouveau, Art Deco and the International Style, and continued its growth, supported by the economic well-being of its industry (Figure 4).



Figure 4. View of Paseo Libertad, with façades of different styles and new colors. Photo: Elisa Cordero.

In 1960, the world's largest earthquake recorded with an instrumentally documented magnitude occurred in Valdivia (Hernández, 2011). It was assigned a magnitude of 9.5 on the Richter scale by the United States Geological Survey. Most of the buildings collapsed, and the few that remained, had to be repaired and renewed. As of that date, the city stagnated economically, a phenomenon that had already been announced midcentury. After the earthquake, many modern, one or two-floor chalet-style homes were built in the natural colors of wood and stone, combined with white or dark red details (Cordero et al., 2014; 2017).

The Austral University of Chile, founded in Valdivia in 1954, opened the School of Architecture in 2000. The German architect Ernst Kasper (1935–2008), who from the beginning was the school's advisor and a visiting professor, was a great defender of colors in architecture. The school also created a color course in architecture that helped train generations of young students in the use of color. From that moment on, the city began to witness a change in style and color. Together with the appearance of new materials and colors, the arrival of architects to the school, who came from other cities, gave a boost to architecture with new projects, mainly buildings for the university. The first was the building for the School of Architecture with colors inspired by the home of Ernst Kasper (Figure 5). The creation of a new administrative region in 2007, whose capital is Valdivia, gave a further economic boost to the city with the consequent increase in construction.

New shapes appeared, and along with them new colors. The Faculty of Philosophy and Humanities sought to camouflage its building with colors of the green forest of the botanical garden, and the Faculty of Dentistry showed the strength of its architecture through red colors. A residential building for students in the form of a reversed cradle, gets its colors in stark contrast to the colors of the environment, and the Engineering Laboratories Building, takes its colors from the rusty sheds of the river ports in the neighborhood (Figure 6).



Figure 5. House of the architect Ernst Kasper in Aachen, Germany (left). School of Architecture in Valdivia (right). Photo: Elisa Cordero.



Figure 6. A) Faculty of Philosophy and Humanities; B) Faculty of Dentistry; C) Student Building; D) Engineering Laboratories. All projects by Roberto Martínez. Photo: A, B: Fabián Arriagada. Photo: C, D: Elisa Cordero.

CONCLUSION

From the history of Valdivia, we can conclude that at the beginning the color of the city's architecture was linked to the materials available in the region and to the culture of the human groups that had inhabited it.

Later, in the 1850s, German settlers, when painting their houses, established an identity connection with yellow, which until today remains as a distinctive color of German architecture in southern Chile. On the other hand, the working class built its identity around a much wider and more striking range of colors for its homes, colors that we can find today in different neighborhoods that were created surrounding the factories.

Diverse architectural styles and their colors arrive late to Valdivia, as in other cities in the rest of Chile. Likewise, the styles and colors adapted to the materiality and local idiosyncrasy.

With the arrival of the new School of Architecture, the formal and chromatic imaginary of the city opened up. Many students, now professionals, contributed to this opening.

The influence that this school has had on the architecture and its colors of the city and the region, has not yet been studied. Obviously, it is not the only variable in the architectural evolution of the city. However, there is no doubt that after thirteen generations of young architects and the construction of several emblematic buildings, it is assumed that it has had an impact on its history.

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Color and environmental symbiosis

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ABSTRACT

This work aims to make a theoretical-conceptual reflection to the domain of color through simple ecological structures coupled with products that constitute waste, on which a new look spreads cooperation forms among architecture, nature, and people. Supported by a critical ecological message, interventions should make people reflect on good day-to-day practices, on the surplus of consumables produced that do not fit in the recyclable chain, and also to be a provocateur through Art that proposes intervention. The use of color intends to create a cheerful spirit and positive emotions, to internalize the desire to contribute to a better life quality and to allow a sensitive look at the world. The ideographic and physical space proposes a didactic game, the creation of events and the interaction between people of different ages, status, and cultures through the spread of artistic and experimental experiences. From these statements, the work consists on the creation of intervention models themed in various contexts improving the environment, finding forms of ecological interaction between design and color with natural structures. One way of asking ourselves about the civilizational sense, the necessity of saving resources and the use of the most precious material that is: the idea.

Keywords: *color, symbiosis, environment, event, Baubotanik*

INTRODUCTION

To draw attention to the ecological issue of the public space that involves nature and to its experience is essential. The architects, worried about these problems, reflect on natural systems allied with structures of geometrical or topological expressions (Klooster, 2009; Pawlyn, 2011). In the first phase, these concerns were reflected in the art of gardens. In the current phase, the manipulation of materials show patterns, textures and waste recovering by a new architectural and artistic attitude.

The didactic of the system also allows people to participate while using their artistic and manual skills. Events with different themes grant new types of uses and enjoyment of spaces to contribute to the creation of civic awareness, to the creation of a representation of nature, and to the importance of color in public space.

The message is ecological and critical. It occupies an area of intervention that is still left open in the public space, after the decrease of urban art that expressed messages intended for the collective memory, through statues and sculptures paying tribute to personalities and relevant historical events.

It also involves the creation of metallic structures that originate a symbiotic system with trees so they can resist typhoons. Other structures can rectify nature wounds of nature and human-damaged environments such as quarries, through aesthetic containers of covered spaces with several types of uses, functions, activities, and events. The effects can be achieved with low-cost materials, using only skill and nature allied with technique and creativity. This aspect is essential to resolve current issues. In all circumstances, the proposals may induce people to reflect on the good habits of daily life, on the environmental systems, and on the excess of consumable materials produced that do not enter in the recyclable chain. From an ecological point of view interventional systems can be created, or through Art as an “agent provocateur.”

The use of color – in structure, ephemeral elements, lighting, and plants – aims to create positive emotions, a sensitive way of seeing the world so the ritualization of time can be understood and, consequently, the appropriation of space. In the urban space the cultural and environmental purposes are unified with nature and art, creating atmospheres that equate the environmental issues of our time, under the sign of color that develops the sensitive domain. We can also refer to the festivals of light and color that exist, for instance, in the south of France or in annual festivities. In these, color is used to create sceneries of excellence that have been spread all over the world. One can draw an analogy to the popular festivities of *Campo Maior* in Portugal.

THEORY

The interventions mentioned above are based on traditional cultural aspects and on teasing actions made through art. In intellectual terms, they have been mainly developed by the artistic vanguards of the beginning of the 20th century. In the 1960s, those were involved in moments of social criticism and had a significant expression in the Pop Art movement that decontextualized and amplified the objects and their fragments.



Figure 1: Cool Greenhouse, Lisbon. Photo: Rui Duarte, 2019.

This trend, which by analogy, can be related to the creation of environmental megastructures, cold greenhouses and, in a certain way, with the invention of concepts. (Figure 1) For example, in the “birdcage”, the Snowdon Aviary (1960-64), at London Zoo, designed by the architect Cedric Price and the engineer Frank Newby on the initiative of Lord Snowdon, visitors enter the space where the birds

fly freely. One can quote Bob Dylan's song *Ballad in Plain D*, when he asks: "Are birds free from the chains of the skyway?"

Today, one can refer to different artistic positions, change concepts and establish analogies. The algorithms also explore the infinite field of complexity. Apart from the continuity of the tradition and the ruptures of creation, there are symbiotic processes that are based on nature using several scales. The theory is essential to problem solving.

In this context, there are relevant cultural trends that work as a starting point. Traditionally, Japan ritualizes the view of flowers in springtime (*Hanami* - flower viewing), being "*Sakura Matsuri*" the festival of cherry blossoms. This spirit of the enjoyment of nature proceeds with viewings colors in autumn (*Momijigari* - autumn leaves hunting). "*Kōyō*" means the red leaves that symbolize the autumn. An event is the golden explosion of the *Ginkgo (Icho)* these millennial trees symbolizing peace and longevity, beauty and resistance, as they survived the atomic bomb, as did the Bamboo. *Icho Namiki* means "a row of Ginkgo trees" and is a well-known avenue in Tokyo. (Rainnycool, 2017) The ritualization of the mutation of nature expresses time, sensitivity, identity, and collective memory.

The supports for the plants can create allies totally covered with colors. It is a practice that explores colors and smells. There are systems that, like pergolas, belong to the art of the gardens and do the intersections with the public and the private urban space. Nevertheless, the logic can also be inverse and dislocated from the tradition. It can create ruptures as a critic of the destruction of nature and, from that principle, develop mixed systems. It is also in this critical domain that, in environmental terms, one can add shade and water, creating refreshing areas, essential in hot climates. The institutional events are excellent opportunities to implement innovative solutions but the results are scarce. Nevertheless, one can make conclusions on the issues developed.

In this context, there are different processes of integration of color in nature, creating a symbiosis of environmental interventions. In actuality, there are multiple ways that unfold creativity, developed by investigations in architecture and design, such as the case of Mitchel Joachim and Michael Silver, who, among others, explore important common advances of diverse interdisciplinary fields in their recent book. "XXL-XS represents the emerging discipline of ecological design by assembling a wide range of innovators with diverse interests. Geo-engineering, synthetic biology, construction site co-robotics, low-energy fabrication, up-cycling waste, minimally invasive design, living materials, and molecular self-assembly." (Joachim and Silver, 2017)

METHOD

Due to the principles referred to in theory, one can explore several abstract methods, through diagrams, or explore hypothesis, creating analogies. Lars Spuybroek in his book *The architecture of variation* (2009) conceived one of the analogous methods by systematization based on nature and textiles. The state of the art must identify the big narratives, the process, and the small narratives. The big narratives refer to invariants of collective memory even in absentia, as in the case of the hanging gardens of Babylon. The process explores variables that are placed in the change of concepts. The small narratives elect any type of theme or circumstance to explore poetic qualities through art. Also, the dual strategy balances between natural and artificial structures and, inside these systems, of processes and different phases. This means that, besides getting a final form, one can also develop generative systems, metamorphoses with openings to several solutions, divided through time, according to the seasons and relevance of themes and circumstances.

EXPERIMENTS

HYBRID SYSTEMS: The *Baubotanik* method refers to the construction of organic structures, from live plants, a method created by Ferdinand Ludwig, Coordinator of Research Group *Baubotanik* at IGMA of the University of Stuttgart, Germany. These experiences are made with trees that must be flexible, resistant and that have a fast growth, such as is the case of a plane tree, poplar, birch, or willow.

SYMBIOSES: The creation of metallic structures that support trees can constitute a symbiosis between nature and rationality, creating systems of support to nature, reinforced by the color red, by counterpoint. (Figure 2)



Figure 2: Tree supported by metal structure, Príncipe Real Square, Lisbon. Photo: Rui Duarte, 2019.

MATRIX: The creation of a metallic structural matrix can create conditions that avoid the destruction of trees, by storms.

METAPHORIC: The theme of nature was explored in two paradigmatic pavilions at the Expo 2000 Hanover.

The Pavilion of Estonia (Figure 3), designed by Koko Architects is an experimental architecture that takes advantage of environmental metaphors of their country by referring to water, ice, the unreachable blue of the sky and sea and the vegetable elements of nature. In a quadrangular matrix the trees that look like carrots are placed on top of the pavilion. This undulating set creates the idea of wind through a mechanical system of come and go.

The Pavilion of Switzerland by Peter Zumthor, who took advantage of modular wooden elements placed rationally, configuring plans and spaces stands out as if it were a principle of storage of materials to be used in the construction that meanwhile served to build a neoplastic labyrinthine environment.

CRITICAL LANDSCAPES: Geometric colored structures integrate burned trees and constitute critical activators under the forest conditions nowadays, exposed to destruction by fire and devastations.

GEOMETRY / NATURE: Urban art (nature) + color (light, support, plants) correspond to an action, viewing the existence of shadows and refreshing spaces as in the Pavilion of the USA at Seville Expo '92.



Figure 3: Pavilion of Estonia, Expo 2000 Hanover. Photo: Rui Duarte, 2000.

RESULTS AND DISCUSSION

Conceptual process explores different approximations to nature and closes the ancestral cycle of using living trees. We can also refer to the tree roots used as structures for bridges, e.g., the living-root bridges in India, created by the Khasi people that can last 600 years.

The *Baubotanik* principle involves the natural growing process that lingers (Oommen, 2015). It uses ancestral knowledge of gardening, adapted to a way of building that unifies sculpture, engineering, and the trees to metallic elements and other materials, so hybrids can be obtained between living nature and technology.

It is a way of understanding the time of nature as a fact inherent to the process, in a period of great intensity of changes. In this natural system, one can consider the state of the art: ancestral knowledge of farmers, horticulturists, and gardeners.

The *Baubotanik* project also pays attention to the aging of trees, so that their articulations grow to combine and gain strength, allowing the support of great weights (as in the bridges of the Khasi people). The process of shaping defines the stages of evolution and involves gardening knowledge such as pruning, flexion, fixation, and graft. The shaping of trees as a process is made so that the saps can mix until it reaches a point on which the structure is completed.

Being the *Baubotanik* Architecture organic, the trees keep on growing naturally, according to the configuration set.

This view, besides being particular and restrictive, amplifies new fields of ecology and design. It can be seen as a didactic method to revitalize the occupation of public spaces in cities as the interventional growing process catches attention of weather and manipulation processes of nature.

It is always necessary to make regular maintenance. Besides the technical aspects, one must pay attention to the atmospheric conditions, the existence of water and has to be careful regarding contaminations.

The critical message involves the control of the natural process and the ruptures. Either the trees are alive or dead, they can be used in a project of symbiosis. These are elements on which color, texture, and their daily use can be valued.

CONCLUSION

From the art of gardens, models – that articulate with nature and reason – are developed through a diversified set of interdisciplinary interventions themed in several contexts to improve the environment through ways of ecological interaction, between design and colors, unified with these natural structures, to constitute critical factors. The theoretical-conceptual reflection mentioned at the beginning involves analogies. As with Detlef Mertins: “The recent re-engagement of architecture with generative models from nature, science, and technology is itself part of a larger history of architects, engineers and theorists pursuing *autopoiesis*, or self-generation. While its procedures and forms have varied, self-generation has been a consistent goal in architecture for over a century, set against the perpetuation of predetermined forms and norms.” (Mertins, 2004: 360)

It is proposed to create ephemeral structures that reintroduce Urban Art through a method of intervention that involves the reversibility of elements and avoids waste. Valuing the reuse of materials, taking advantage of color, textures, and light, it is a didactic alert and an appealing counterpoint. It is an experiential polarity that creates a symbiosis with the surroundings and spreads a civic attitude through Art.

The results are interventionist and non-interventionist and are located at three levels: creation of a theoretical framework of operatic (theatrical) and operative intervention (action) from the state of the art; the creation of working hypotheses through models and principles of interventions; and their desirable application in the urban and rural reality or in the territory of structures themed in the most varied circumstances and contexts.

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Grey to blue: Approaching ambiguity through colour

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ABSTRACT

We live in a time of global uncertainty. Humanity finds itself in environmental crisis, as resources necessary for human survival diminish and life on earth is threatened. In the face of this uncertainty, we are confronted with discomforting ambiguity. The discourse of environmental humanities looks at reframing existing approaches of being in the world. It proposes a focus on “entanglements,” which prefigures turning away from individualistic and discordant thinking towards a mode of operating that highlights connection and relationship. Colour has evolved in the living world as an essential structure to support life processes. Much like every aspect of our interconnected world ecology, colour too is subject to the current environmental crisis. With unprecedented rates of extinction, we are losing colours and unique colour combinations in our environment. In examining the world, we tend to focus on divisionary approaches, in which the subject of study is categorized for discernment. Though colour is an ambiguous, unstable and constantly shifting phenomenon. Colour studies have traditionally favoured a divisional approach, dividing the spectrum into categories and individualized colours. In this drive towards divided categories, we often forget that we are dealing with one spectrum, and that strict division is artificial. José Luis Caivano’s gradualist approach to understanding colour falls closer to the natural aesthetic experience of the visual field and corresponds with the interconnected ecological approach. The author aims to link the non-divisionary, gradualist approach in colour to “entangled” environmental thinking and examine this through art practice as an effective tool for comprehending invisible ecological interconnectedness in the time of the “Anthropocene.”

Keywords: *ambiguity, art, colour, ecology, entanglements*

A SPECTRUM OF LIFE

Colour has evolved in the living world as an essential structure to support life processes: “In nature, colour is a result of evolution: as a result, all the colours of flora and fauna are exactly as needed and appropriate for the conservation of life forms. Brightly coloured habitats such as coral reefs or fields of flowers are also part of complex communication systems, as are birds, insects and other polychromatic life forms. Once the balance of natural colour is altered, the affected forms of life adjust or disappear. Thus, the survival of over 60 percent of all plant species on Earth is dependent on pollination by bees, whose long-distance orientation derives from specific colour spectrum of flowers” (Buether, 2014: 7–8). Environmental humanities has emerged as a response to the growing environmental challenges facing life on earth today, out of the need for a more balanced approach to environmental issues. It

aims to resituate the human within the wider ecological structure, challenging a pervasive anthropocentric ontological exceptionalism. The key proposition of the environmental humanities is to focus on “entanglements” between human and other-than-human agencies, moving away from the divisionary individualistic mode and towards interdependencies. Faced with the challenging and multifaceted contemporary ecological situation, borders are becoming fuzzier and we find ourselves in the space of ambiguity.

Exploration of the ambiguous is especially important now that humanity has stumbled into the age of the “Anthropocene,” defined as the epoch in which humans have become the dominant global geophysical force (Steffen et al., 2007). One of the foremost contemporary thinkers on the state of ecology today, Timothy Morton, argues that we live in a time of ambiguity and a resultant anxiety (Morton, 2016: 232). Yet, he suggests that ambiguity is precisely what we need to expose ourselves to today, “True and false might not be that different,” says Morton, “Ambiguity is the space in which really true things can be said. Ambiguity isn’t vagueness, ambiguity is an accuracy signal” (Morton, 2018). Within this context, contemporary art practice with a focus on colour as a spectrum could contribute towards these important discussions and help unravel the more “entangled” thinking on being a part of the world.

José Luis Caivano proposed a new approach for understanding colour – a gradualist hypothesis – whereby the focus lies on “The moments of transition, gradations and transformations that allow moving from one category to another, with a better understanding of how the relationships are produced and the ways in which those differences occur” (Caivano, 2018). Rather than employing divisional approaches to understanding colour, and visual phenomena in general, Caivano’s gradualist method falls closer to the natural aesthetic experience of the visual field and how life on earth operates from the ecological perspective.

Entangled through art

Anthropologist, cultural ecologist and philosopher David Abram argues that a crisis in perception is one of the key reasons for ever-growing environmental concerns (Abram, 1997). What humans perceive as the reality of their environment frequently differs from the actual processes that occur, often in invisible ways, with many aspects of our complex world ecology overlooked or misconceived, especially at time of ambiguity may be when outcomes are not easily anticipated. Now, more than ever, we are all aware of the rapid changes around us, but often unaware of how we should act. So, what do we do in the space of ambiguity and how could the exploration of colour through contemporary art practice offer an efficacious platform for this inquiry?

The notion of entanglements could serve as a way into the space of ambiguity, in which art can physically manifest this ambiguity in relatable and emotionally resonant ways. Morton talks about art as a powerful tool for “ambiguity tolerance training” (Morton, 2017). Artistic practice lends itself perfectly as a platform for exploring the ambiguous. “Uncertainty is typically not desirable in everyday experiences, but uncertainty in the form of ambiguity may be a defining feature of aesthetic experiences of modern art” (Jakesch and Leder, 2009).

Colour, as one of the key instruments of visual perception, explored through contemporary art practice, offers a powerful tool for visualizing the ecological entanglements which might not be obvious, or even visible to the human eye. A deeper exploration of colour as a spectrum could contribute towards these important discussions and help unravel the more “entangled” thinking on being a part of the world.

Colour and colour extinction

Colour plays a key role in the aesthetic experience of visual perception and as a way of reading an environment and orienting within it. It is also a means of communication between the different species – between human and non-human worlds. Understanding colour has most often been approached through the process of breaking the visual field down into categories, those of individual colours. While this divisional micro-perspective has proven enlightening, the inclusion of a macro-perspective – investigating colour as a boundless spectrum – might offer a more holistic understanding of colour, articulating the interconnectedness of all things as observed through ecology.

This interconnectedness we often fail to perceive when reality superficially appears to be so separated, leading to actions that are as destructive to ourselves as they are to the conceptualized “other.” As a species, we have a strong desire to resolve things, to understand, to uncover, to divide into categories. We also know, however, that there are many unknowns, and there always will be. The balance is often too skewed towards maintaining definition and classification, rather than also accepting that reality can be ambiguous, and the borders are somewhat enforced.

Colour and its dynamic nature might be a very useful tool for shared extrication, with contemporary art practice attuned to ecological concerns enabling a productive platform for exploration. Often perceived as a background, static property of objects, the influence of colour within the larger environmental context is rarely seen. In this crucial time of pressing environmental changes, there may be wide-ranging insights from greater exploration and analysis of spatial colour distribution. How, within this context, can contemporary art practice employ colour to a particular effect, which in turn might present new insights about environmental processes and enhance people’s awareness of their environment?

In 2017, the European Space Agency reported that the colour loss of the Great Barrier Reef – or coral bleaching – can now be observed from space (ESA, 2019). Knowing that, in nature, colour developed as a result of evolution to support life processes; the presence of colour, its richness and vibrancy, can be seen as a signifier of life (Buether, 2014). As species disappear, we lose the colours, and especially the particular colour combination, of the departed organisms. As an example, the Carolina parakeet – a small neotropical parrot, which before 1918 spanned the forests of the United States, the only indigenous species of the neotropical area within the US, and one of the only two indigenous parrot species in the US, has been lost. Its unique and tantalizing combination of greens, yellows, reds and pale pinks will no longer brighten the forests, as the species was declared extinct in 1938.

The species loss over the last few decades has been so extreme that scientists are now considering we might be in the midst of the sixth mass extinction (Barnosky et al., 2011). Thinking of these losses, it raises the question of how many colours and colour combinations we have already lost. Are the sci-fi visions of dystopic future with their achromatic landscapes our destined future? With a great number of species already gone, and a large number of those entangled with us, might we soon be caught in the same vortex.

Artistic propositions

My recent work exploring ecological entanglements took the form of a series of art pieces investigating ecological interactions through colour and its spatio-temporal dynamics, reconsidering perceptual boundaries in search of new possibilities of how spaces are shared with non-human others. A series of abstract interactions entitled “Grey to Blue: Ecological Entanglements” is explored through sculptural, photographic, moving image and sound based works, drawing attention to the role of colour in the

living world, while highlighting ecological loss and absence (Figures 1, 2, 3). Various organisms in interconnected relationships and interacting with the environment are translated into ambiguous colour forms that release our perception from preconceived separateness and division.

Taking inspiration from the natural world, these artistic propositions deal with the removal of borders and boundaries to create positive ambiguity. Even the spaces in-between become an equal part of the experience. Each artwork explores how everything is entangled, the in-betweenness of things and how seemingly separate objects, bodies and phenomena relate.



Figure 1: *Torch Ginger / Lesser Violet*, detail, installation, 2019 (left). Photo: Yulia Kovanova. *Pawpaw / Dark Flower Scarab Beetle*, detail, sculptural installation, 2019 (right). Photo: Kenny Lam.



Figure 2: *Avocado / Giant Sloth*, installation, 2019 (left). Photo: Machal Jesionowski. *Mango / Stegomastodon*, instant image installation, 2019 (right). Photo: Yulia Kovanova.

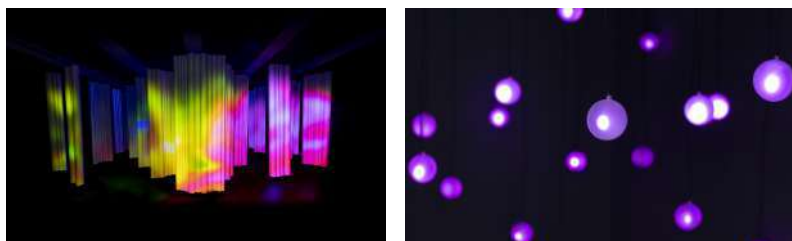


Figure 3: *Red Silky Oak / Swallow-tailed Hummingbird*, installation, 2019 (left). Photo: Kenny Lam. *Purple Coneflower / Rusty Patched Bumblebee*, installation, 2019 (right). Photo: Kieran Gosney.

A sculptural installation (Figure 1, left) comprised of thin multi-coloured wooden rods looks at the interaction of a hummingbird and its flower as the bird enters the flower to feed on nectar. The coloured lines representing the flower interpenetrate the colours of the hummingbird, creating one spatial experience. The audience can walk through the piece, thereby entering the hummingbird-flower experience.

Another installation (Figure 1, right) considers how flowers attract insects through their shape and colour. Two-metre long rods, suspended vertically and painted in the colours of a pawpaw flower, open wide to allow visitors to enter the flower, duplicating the insect's journey.

A pile of soil spanning almost six metres in length is studded with casts of avocado stones of different shapes and sizes (Figure 2, left). The sculptures are absolutely white; their hue is missing – reflecting the extinct large mammals who would swallow and distribute the avocado stones. Thousands of years ago, these great giants, such as the six-metre-tall giant sloth, would be attracted by the ripe avocados and mangos, swallowing the entire fruit with its pit, helping the plant to disperse its seeds far and wide. Those animals are long gone, yet the fruit has not caught up to this reality and continues to call for its lost partners through colour as one of the key features.

A long strip of instant photos (Figure 2, right), suspended from the gallery ceiling and continuing on the floor, examines the changing colours of a mango as it ripens and spoils – from greens to yellows, oranges and reds. The mango fruits are lying on the forest floor waiting for their great giants, slowly transforming, slowly losing colour. The images are of an actual mango fruit as its colour changed, taken with in-camera blur. The details of the mango skin are removed, giving focus to the shifts in colour.

In a dark space is a blurred video of a brightly coloured hummingbird and a flower projected onto an imposing fractured “screen” made of suspended paper tubes (Figure 3, left). Accompanying the visual is a sound piece that carries the audience through the columns.

The lights piece (Figure 3, right) is looking at the relationships between bees and flowers through colour and movement – as a single bee flits from flower to flower in search of nectar. The lights are mapped to the bee's movement, while the colour of the flashing light is that of the flower, so the piece creates an experience of a bee-flower as one entity – alive only in coexistence.

Resting in the unknown

The world operates as one interconnected ecology, yet we fail to see the connections. There is a discrepancy between what we perceive as happening in the environment and what actually occurs, with a large number of visual signals remaining unnoticed or misunderstood. This misconception left us in the space of ambiguity and led us into an environmental crisis, with the planet now largely contaminated by industrial pollution and species disappearing at an unprecedented rate.

Contemporary art practice has a crucial role to play in this time of environmental urgency, when an increased understanding of often invisible processes happening within the environment is a requirement. Focusing on the gradualist approach to colour, alongside the idea of entanglements, has the potential to rearticulate the role and possibilities of contemporary art practice within the larger perceptual reframing efforts in response to key environmental issues. In paying closer attention to entanglements and recognizing how interdependent we are in the wider web of life, the agency of the human can be reconsidered and de-centred.

Searching for that moment of ambiguity, resting in it, living in it, and finding comfort – oscillating at the biting point between sharpness and blur; like settling down in a foggy land, where the spaces between – the invisible – thicken, masking body and landscape; looking for those spaces, spending time in them, where thoughts do not fail to grasp onto separated elements; then slowly, as the fog

dissipates, one might still embody that feeling of togetherness, fully entangled, and proceed the journey in gratitude and in kind to that larger self. This oscillation is what might allow us to be present in the world of forms and move into the fully entangled and interconnected experience of life as ecology describes it, but which is too challenging to perceive merely through the senses. Vision is what so often misleads us, like the elusive and ambiguous nature of colour as light. As much as it is wonderful to hold onto something, there is value in learning to completely let go in the unknown, to trust, and act with care and attention.

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Colour as a DNA marker of ceramic products

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ABSTRACT

Originally produced with local raw materials and manufactured by ancestral processes, ceramic products have always been the result of knowledge transmitted from generation to generation. They reflect and reinterpret traditional, individual and collective formal vocabularies, integrating fragments of the day-to-day life of the local society, which conferred a geographical and sociocultural singularity revealing their local, regional, and national identity.

From intrinsic to extrinsic characteristics, from raw materials to formal language, it is possible to find a plethora of combinatorial markers that characterize and differentiate these ceramic products – in other words, their DNA. Among such DNA markers, colour has been a geographical and cultural “locator” par excellence of ceramic products: either by the colouration of raw materials, or inks or glazes, or by adopted colour schemes, which reflect not only the local availability of pigments and oxides, but also local taste and culture. Furthermore, the characteristics of firing – an alchemical process revealing a myriad of chromatic solutions based on acquired and arcane knowledge – confer a unique character to such ceramic products.

The globalization of markets, technologies and cultures has given way to the emergence of transgenic ceramics, uprooted from their origins. Despite the resurgence of the appreciation of local knowledge and traditions as a reaction to this scenario, can we still identify clear references to their origin – ceramic chromatic DNA markers – even if these artefacts are the result of this “transgenic mutation”? Does colour, as a DNA marker of ceramic products still exist?

Keywords: *colour, ceramic, product design, identity, DNA*

INTRODUCTION

This paper is part of research on the colour of ceramics, bringing together reflections on some of the aspects from the accumulated experience of a professional and academic career based on research, experimentation and practice in the areas of ceramics and colour.

These DNA markers are visible in ceramic products’ specific characteristics: From the raw materials, affording technical characteristics (hardness, thermal and abrasion resistance), and visual features (texture and colour), to the shape and size, the graphic elements, the pattern layout design, the colours and adopted colour schemes, reflect not only the local availability of pigments and oxides, but also

local taste and culture. The way these markers are combined results in distinctive formal languages, DNA matrices that enable us to visually recognize the origins of a certain ceramic product.

CULTURAL COLOUR SCHEMES | UNIQUE OR MISCEGENATION?

The discovery of the maritime routes between Europe and the Far East boosted the spread of oriental products in countries with ports along these routes. Chinese porcelain achieved great success, which is why they had such a huge influence on European ceramic production. Portugal and Holland were some of the most important distribution centres along these routes and we find clear influence of Chinese porcelain in both countries' ceramics both in the formal vocabulary and in the colours they used.

Other ancient routes explain clear similarities between the chromatic palettes of pottery – the intense blues and yellows found in the Middle East (Uzbekistan, Iran and Egypt) were also found in North African pottery (Tunisia and Morocco) – that expand from there to the Iberian Peninsula and Italy. The island of Mallorca, in the Western Mediterranean, was the starting point for the Arab-influenced plates manufactured in Spain to reach Italy, where they were an inspiration for the Majolica (phonetic deformation of the name of the island of Mallorca) of Urbino (Costa, 2000). The Iberian sea journeys took the ceramic's shape and colour to Central and South America, where even today there are traces of this legacy, both in terms of heritage, as well as the current artistic and industrial production, particularly in Mexico and Brazil (Figure 1).



Figure 1: Colour schemes miscegenation, Chinese porcelain. Photo: <http://jimcorbettourism.co/antique-blue-and-white-dishes/>; Delft tiles. Photo: @hermitage_museum; Portuguese tiles. Photo: Carla Lobo; Moroccan, Spanish tiles. Photo: Carla Lobo; and Mexican tiles. Photo: <http://www.mexicanarchitecture.org>.

Through trade and its geographical location, Portugal has benefited from a range of inputs from different countries and cultures to compose a very specific and diversified chromatic language, specific in each ceramic typology, and in different geographical parts of the country. There is everything from tiles to utilitarian and decorative crockery, including figurative elements, where we find different chromatic syntaxes, directly related to the raw materials available in situ and local preferences. In the northern and southern part of the country red clay is very common, a reason why utilitarian pottery predominates, decorated with white slip (north) and with a wide and quite saturated colour palette (south). In the centre we find greater diversity, from the red clay bricks and tiles to the white earthenware decorated in blue and white, or with transparent coloured glazes. Here there is an important utilitarian and decorative ceramic centre, Caldas da Rainha. In addition to its own formal vocabulary, the coloured transparent glazes are unique and an unmistakable reference to the identity

of the glazed Caldas pottery. The raw materials used to colour the local lead glazes (characterized by deep colours, an intense shine and a unique depth, only possible by the presence of lead) came from the local workshops. The lead came from waste pipes and was the base of all the glazes, the iron that made the “honey yellow” colour came from the blacksmiths’ workshops, others such as copper, manganese and cobalt oxides (green, brown and blue) were acquired on purpose (Horta, 2014). Even today these four colours, which later included “cherry red,” are recognized as being the colours of the Caldas Glazes, colour markers of the ceramics of the region (Figure 2).

The blue and white tiles (in the 16th century), or the blue, white and yellow ones (in the 17th century) are the most common colour schemes. Although other colour schemes have also prevailed (cobalt blue, iron or antimony yellow, purple/manganese brown and copper green), since their proliferation at the beginning of the 17th century, these were the first to be recognized as the prevailing colour scheme of the Portuguese tile – as their chromatic DNA marker.



Figure 2: Portuguese ceramic colour schemes. Red clay slipware (north of Portugal). Photo: Carla Lobo; red pottery from the south of Portugal. Photo: <https://www.herancasdoalentejo.net/olaria-bulhao>; Caldas da Rainha coloured glazes, 18th century tiles. Photo: Carla Lobo.

Raw materials also have a local character, with variations depending on where they were extracted. Chinese kaolin provides a whiter porcelain than Portuguese kaolin, Dutch cobalt blue is different from Middle Eastern and Mexican cobalt blue. The minerals in the water used in the ceramic manufacturing process determines the tonality of the ceramic body, glazes and paints. Even if the raw materials are the same, we may have clear variations as far as the resulting colour is concerned, that is, they are intrinsically related to the specificity of place (Lobo and Durão, 2011; Shu, 2009; Swirnoff, 2000). Swirnoff emphasizes the link between raw materials and local colours, relating them to different cultural sensitivities to colour: There are chromatic preferences, intrinsic to socio-cultural heritage and clearly related to soil composition, flora, climate, and the quality of local light, stressing that combining these factors with formal vocabulary reflecting culture and folklore, creates specific chromatic syntaxes in harmony with the setting where they are created and not found in other locations, which enable us to identify their origin.

CERAMIC COLOUR

In short, we can say that the ceramic colour occurs because of three factors: 1) raw materials; 2) firing; and, 3) decoration.

First, the combination of the raw materials that make up the different ceramic materials (earthenware, terracotta, stoneware and porcelain) gives rise to the intrinsic colour of the ceramics

(warm white, red, light yellow and cool white, in particular). The presence of certain compounds in clays such as iron oxide will contribute to the red of the terracotta, and the introduction of kaolin will contribute to the purity of the white porcelain.

Second, firing temperature determines not only the type of molecular structure of the ceramic product but can also directly influence the colour of the ceramic and its decoration. In the case of ceramic bodies rich in iron oxide, an increase in temperature represents a decrease in the luminosity of the red, and the characteristic red of the terracotta turns dark brown. The colouring agents used in the decoration change significantly under the action of heat, and at lower temperatures (around 1000°C) a varied and more saturated chromatic palette is possible than at 1400°C, where most of the oxides and pigments are significantly altered, and the chromatic palette tends to be less saturated.

Third, as far as decoration is concerned, there are multiple possibilities ranging from glossy or matt coloured glazes, transparent or opaque glazes, the underglaze and in-glaze inks and coloured slips that can be applied over the biscuit fired ceramic or over the glaze in a wide range of colour combinations.

The extrinsic colour is determined by the combination of the colour(s) of the glaze(s), paints and slips, and the ceramic body. When the glaze is opaque, the colour of the piece will be the colour of the glaze; when the glaze is transparent, the perceived colour will be the combination of the colour of the glaze and the colour of the ceramic body. The thicker the layer of glaze, the more saturated the perceived colour will be. When there is decoration, the chromatic intersection is even richer, involving the colour of the ceramic body, the colour of the glaze and the colour of the paints and slips (Figure 3).

The different ways of articulating these factors define the chromatic characteristics of ceramic products. It is this singular composition that is transversal to the region's ceramic artefacts and that defines the chromatic DNA of ceramics.



Figure 3: Ceramic raw materials; polychrome glazed pottery. Photo: <https://pt.bordallopinheiro.com>; stencil brush painted tiles. Photo: Carla Lobo.

NEW SYNTAXES | SAME IDENTITY: COLOUR, AS A DNA MARKER OF CERAMIC PRODUCTS STILL EXIST

Today we are witnessing the desires to recover and revitalize local identities, bringing them back up to date so they can emerge themselves in current experiences. The evolution of the genetic code of ceramics is materialized in new shapes and visual syntaxes, where structural common denominators – DNA markers – are recognized through their colour.

We highlight some transnational examples, where the authors' projects clearly assume the role of colour as a DNA marker (Figure 4):

Ceramic House by Wang Shu | Jinhua, China. Covered in “ceramic tiles that were the products of Youse (ceramic color)” (Shu, 2009), glazed in 40 colours extracted from the chromatic palette of traditional Chinese ceramics (mainly celadon greens and browns) in order to create the perfect adaptation of the architecture to the place.

Oceanário, tile coating by Ivan Chermayeff | Lisbon, Portugal. Decision to use blue and white tiles, developed from Moorish inspiration motifs, was based on the recognition of the tile as a native material of Lisbon architecture, namely the cobalt blue and white pattern tiles.

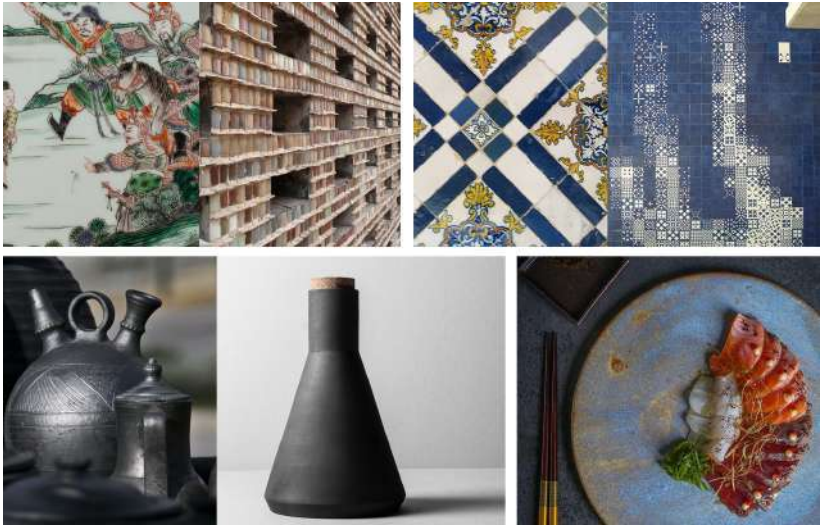


Figure 4: Chinese tile, Kangxi period. Photo: <https://www.jieruitangcollection.com/thecollection>; Ceramic House. Photo: <https://adcitymag.ru/keramicheskij-dom>; 17th century Moorish-inspired tiles, Oceanário de Lisboa. Photo: Carla Lobo; black pottery from Bisalhães. Photo: <https://www.portugalnummapa.com/barro-preto-de-bisalhaes>; pitcher from Bisarro Ceramics. Photo: <https://www.bisarro.pt>; Pernambuco Blue. Photo: Germannya D’Garcia.

Barro Preto by Atelier Bizarro | Bisalhães, Portugal. Returning to an ancestral Portuguese technique of burning pieces in a reductive atmosphere, which gives them a black colouration, the studio develops a set of pieces with functions that are appropriate to the current *modi vivendi*, where the most obvious characterization factor is the dark/black ash of the pieces. This technique has been part of UNESCO’s list of intangible cultural heritage since 2016.

Cerâmica do Cabo | Pernambuco, Brasil | O Imaginário. Social integration and sustainability project where, “Each piece is developed from the appreciation of popular knowledge, the recognition of traditions, skills and use of materials, [...] [creating] product lines where shapes, textures and colours reflect the cultural and social values of the respective communities.” (Imaginário, 2006: 29) Several coloured glazes were developed, but only one was chosen as it was compatible with the ceramic body. It was a simple and accessible formula that was easy to apply and with guaranteed results in firing (D’Garcia, 2019). This is how “Pernambuco blue” was born, which today is synonymous with Cabo dinnerware.

From both the author's point of view and the observer's / user's point of view, we find that these examples show a direct link between ceramic colour and local identity as to the persistence of these colour palettes over time and their underlying roots (Ceramic House, Oceanário and Bisarro). And in the case of Pernambuco Blue, the name makes reference to the creation of a product where colour is one of the most outstanding factors along with its originality and the ease with which it is recognized and associated with the production of a demarcated origin.

FINAL REMARKS

It seems obvious that we can refer to the existence of a ceramic DNA and to consider colour as one of its distinctive markers. Considering the point of view of the user/observer, the perceptive potential that ceramic products have is directly related to colour, enriched by the civilizational meaning that we see in them. We consider that the holistic approach underlying the ongoing research will bring a new perspective on this subject.

In-depth knowledge of these aspects may effectively contribute to the sustainable development of ceramic products. This will lead to better environmental, economic and social understanding. Through the enhancement of collective cultural expression, we contribute to the perpetuation of cultural heritage and the consolidation of intangible heritage. We can also help sustain local economies, the manufacturing of products with local materials that has a strong impact on the carbon footprint associated with them and gives products authenticity and legitimacy.

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Glazed tiles in architecture: Color and sustainability

The Cathedral of Portoalegre in Portugal

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ABSTRACT

The intervention in the patrimonial building complex of the Cathedral of Portoalegre in Portugal covers two programmatic goals: rehabilitation of the architectural set of buildings, and the creation of adequate infrastructures for the introduction of a cultural dynamics program including exhibition areas that provide complementary logistical support to the church. The glazed tile (*azulejo*) is a material traditionally used in Portuguese architecture that can be considered a sustainable covering material due to its composition, its origin of raw materials, and its behavior throughout its life cycle. Based on documentary research carried out on the evolution of the building from its construction in the 16th century to the present, it was found that the steeples of the towers were covered in glazed tiles. At this moment there are no tiles left in the towers that can give us clues on the color. In the interior, the tiles remain in several stages of conservation. It is necessary to map existing patterns, reclaim broken tiles, and fill in the flaws with new tiles created using traditional techniques. It is also intended to coat the steeples with tiles, to restore the authenticity to the Cathedral. The whole intervention has as key concepts: reversibility, versatility, simplicity and sustainability with respect for Cultural Heritage principles.

Keywords: *glazed tiles, azulejo, steeple, sustainability, cultural heritage preservation*

INTRODUCTION

In the case of Sé Cathedral of Portoalegre, the Cloister and annex spaces, the goal of the intervention was to restore the Cultural Heritage site and create suitable infrastructures for its cultural revitalization.

The construction of the building was commissioned in the 16th century by D. João III King of Portugal. It is constituted by three naves covered at the same level by ribbed vaults and has the typology of the parlor churches (Santos, 1992: 21).

At the end of the 16th century, the towers of the Cathedral were built. According to archival documents of that period, glazed tiles were acquired in Lisbon to coat the steeples. They could have been coated by monochromatic glazed tiles or by glazed tiles with a chess pattern either in blue and white or in green and white (Patrão, 2002: 293).

The walls were built in stone masonry with lime mortar, with diverse types of coating and glazed tiles. There are panels with a pattern of the 16th century and Hispanic-Moorish glazed tiles reused from another church, Santa Maria do Castelo (Patrão, 2002: 290).

The glazed tiles in the interior of the Cathedral remained in several stages of conservation. In general, they are presented in wainscots that can go up to two meters in height. In the eighteenth-century Sacristy, they cover the totality of the walls. The *azulejo* panels feature figurative decoration in blues and whites (Figure 1).

The Cathedral of Portalegre was classified national monument of Portugal in 1910.



Figure 1: The ancient Sacristy, 18th century: lighting design proposal. Photo: RBD.APP, 2016.

THEORY

The glazed tile (*azulejo*) is a material traditionally used in Portuguese architecture and answers to almost all of the sustainable design principles.

It respects the specific characteristics of local materials and conditions. The *azulejo* is a sustainable product across all its life cycle. It is possible to conceptualize with glazed tiles to reduce the use of natural resources and minimize the environmental impact. The glazed tiles allow energy conservation as energy use is minimized throughout the construction project. In its production natural materials are used, which can be reused or recycled. The tiles also need little maintenance and provide a healthy environment while reducing and eliminating the release of toxins and pollutants. One can design with the flexibility to reduce residues generated by future refurbishing, reused and/or recycling (Pinheiro, 2015: 235).

METHODOLOGY

As a methodology, the tiles will be registered piece by piece – before, during, and after the intervention – in order to characterize the state of the art and the phases of intervention in terms of the whole set and of each tile.

The characterization of the damage they have has to be analyzed in depth, since what is visible to the naked eye does not correspond to the reality. Through touch it is verified that there are areas of

disconnection from the tiles to the support. The new tiles must have patterns that indicate the current intervention, in accordance with the principles of Cultural Heritage preservation.

Having this in mind, it is necessary to map existing patterns, reclaim broken tiles and fill in the flaws with new tiles using traditional techniques.

There is an undetermined but significant set of glazed tiles (a lot of them are broken), that are stored in bags and boxes in the west courtyard storage. There is also a set of glazed tiles in the south tower room that confine with the high choir. These glazed tiles must be stored, recovered and applied following the patterns to which they belong (Figure 2).



Figure 2: View of the glazed tiles stored in bags and boxes in the west courtyard storage. Photo: RBD.APP, 2015.

RESULTS AND DISCUSSION

In the wainscots of the Cloister, the glazed tiles with white, blue, and yellow patterns were placed randomly, having their origin and date unknown (Patrão, 2002: 294).

They are distributed in three wings of the Cloister, presenting a lot of faults detected by sight, especially in the east wall.

The north wing presents a lot of infiltrations by capillarity and neither has glazed tiles, nor is it possible to determine if they have ever existed there. We believe that this is the cause of the nonapplication of glazed tiles (Figure 3).



Figure 3: View of the north wing. Photo: RBD.APP, 2015.

In the existing panels in the other three wings, it is verified that the glazed tiles were put on after. Lots of them are loose from the wall in different states of degradation. The glazed tiles form patterns without unity, or they present disconnected themes applied only to fill in the spaces. There is also a lack of geometric accuracy in the system that should build a matrix (Figure 5, left).

In these circumstances, it is hard to maintain the authenticity of the existing panels and so the proposed solution is to take off the glazed tiles existing in the three walls of the Cloister and replace them by a stone wainscot of white marble (Figure 4). As Rui Duarte recalls, “Light before refracted is white, being white the sum of all colors” (Duarte, 2007: 6).



Figure 4: Existing west wing with glazed-tile wainscot, 2015 (left). Proposal with white marble of *Estremoz* wainscot, 2016 (right). Photo and rendering: RBD.APP.

To maintain the standards of sustainability, they will be replaced by a wainscot of white marble of *Estremoz*, without shafts, giving chromatic continuity to the white walls. The origin of this local material is a marble quarry at a distance of less than 50 kilometers.

The proposed white marble panels with an approximate height of 1.30 meters will be placed on the existing plaster face of the four walls of the Cloister, except in the corner arcs. In this way, a compatible spatial and chromatic unity is guaranteed with cleaning and maintenance advantages, avoiding the damage and dirt of plaster.

The white marble wainscot height aligns with the height of the glazed-tile wainscot that is lining the access to the stairs leading to the terrace of the Cloister and that extends all its way.

With this proposal, a spatial unity of the Cloister is guaranteed, having the colorful glazed tiles covering the antechambers as a counterpoint.



Figure 5: Example of a wainscot in the Cloister (left). Antechamber of *Porta do Sol* (Door of the Sun) (right). Photo: RDP.APP, 2015.

The antechamber of the entrance by the *Porta do Sol* (Door of the Sun) presents wainscots of glazed tiles placed randomly, with interrupted patterns and different states of degradation and origin (Figure 5, right).

In the antechamber of *Porta do Sol*, it is therefore proposed to take off the existing glazed tiles and to cover the totality of the three walls at full height with glazed tiles that are still in good condition, chosen from those stored in the deposit. In this way, it will be possible to create a homogenous pattern, ennobling the space of the entrance to the Cloister.

As well, in the access area of the stairs leading up to the Cloister's terrace, the covering of the existing glazed tiles that are in a reasonable state of conservation is maintained, only correcting the errors that exist in the patterns.

It is also intended to coat the steeples with tiles, in order to restore the authenticity of the image of the Cathedral.

No information was found on the colors and patterns of the glazed tiles. Thus, any color solution would be a fantasy and not subject to approval by the General Directorate of Cultural Heritage DGPC, supervisor entity of the heritage interventions. In this context the only possible solution was to coat the steeples with white tiles (Figure 6).



Figure 6: The Cathedral of Portalegre, Portugal. Photo: RBD.APP, 2016.

CONCLUSION

The covering in glazed tiles has the advantage of enhancing the material under the light and guarantees better maintenance for a longer time than if plaster was used.

Through the experience from works performed in the same monument, the finishing in plaster does not guarantee homogeneity, being subjected to infiltrations, according to the laboratory investigation studies and the technical recommendations.

The Cloister covering with degraded glazed tiles and without quality will be covered with marble, a local material (sustainability) with high aesthetic quality.

As no witnesses were found that clarified the chosen color to cover the steeples, we opted for the use of white glazed tiles for the covering that fit well with the white façades.

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Model of verbal chromatic abstraction in the management of a visual identity project

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ABSTRACT

For a long time, my particular interest has been focused on investigating the human capacity to distinguish and think about a wide range of colors that lack their own name, especially those that result from the combination of two basic (primary) hues, with the aim to expand the amount of memorable colors. The purpose of this paper is to discuss an operational model of color assignment of a visual identity project based on the signs of verbal language that I called the Chromatic Alphabet. The Chromatic Alphabet constitutes a model for the chromatic assignment of an entity by associating a color to its verbal signs, constitutive of its name. As a rule, it is similar to a simple syntactic conjugation, where a priori, we can demonstrate it by a logical relationship: • One name is different from another; • If a color is associated with a name; • The color will also be different from another. The results could be that the chromatic assignment of a visual identity sign, associated with verbal signs, allows us to achieve a repertoire of colors by combination, with the same syntactic rules as verbal language, and as a formal sign, it replaces the reference in the same way, its color (or chromatic range) accompanies the form at the same semantic level from which its main distinguishing feature comes: its name.

Keywords: *color, language, project, identity, color phoneme*

INTRODUCTION

A primary issue is if the immediate meaning of a graphic sign, and in this case a color, can directly replace the symbolized reality, or needs a high degree of conventionalism learning. This is, can a graphic sign be associated with a linguistic sign of symbolized reality?

If this theory applies to color, could color be associated with a linguistic sign? Could color have a semantic potential to identify groups, individuals, or things? If the principle of visual identification is difference, distinction, the semantics of color works as an identifying element in these relationships.

In the case of distinctive forms, on the contrary, we could say that, e.g., health entities (that belong to the same group) have their own attributes and have no relation of semantic attributes with other elements, such as gastronomy or finance. Therefore, their graphic representations must be differentiated and their meanings are different. Color as an apparent characteristic should have the same effect. This paper discusses a sensitive experience and a systematic approach in the chromatic designation of letters and words as a principle in the design process, showing a constructive diagram

of shape and color as a methodological proposal, based on the configuration of the “semiotype” as a modality to access forms of visual identification.

THEORY

In practice, the existing use in the design of visual images frequently refers to the representative and evocative power of signs, which for the recipient reflects a series of attributes of the represented entity. A certain abuse of this argument leads us to assume that different graphic signs automatically correspond to different references or entities, and that each attribute of an entity has its corresponding graphic expression, as if it were a perfectly structured language. In fact, even well-structured languages, such as so-called natural languages, cease to be a convention, as opposed to all analogical equivalence. They have nothing obvious or natural. It is about finding the limits beyond representation that is still an illusion, sustainable only of the fields other than semiotics and graphics, such as communication, advertising, economics, power, and more.

According to some Spanish studies near the end of the 1980s (González, 2004) and experiences concerning individual and social behavior of the representativeness of signs that were based on a test using verbal language, apparently better delimiting the semantic contents than graphics as a graphic meaning index, several premises were stated as follows:

The semantic analysis is based on studies of synesthesia, according to which there is a neural short circuit between several fields of sensory significance. The perceived sensations can be organized in bipolar form, determining a continuous space (from more to less).

The representational mediation of a sign is possible to decompose into a finite number of components, reducible to three categories: value (good–bad, beautiful–ugly scales, etc.), power (large–small, strong–weak, etc.), and activity (fast–slow, active–passive, etc.), although there are many others such as stability, tension, novelty, receptivity or aggressiveness.

The attributes of the entities can be limited to these three principal categories (value, power, activity), and the predominance of one or the other can give the essential character to the entity.

METHOD

In previous conferences (Prause 2004; 2006; 2014; 2016), I presented a paper in which I proposed a process of “construction” of visual identity using a methodological diagram to establish the characteristics of identification through three conceptual lines.

These conceptual lines are those based on the name, the form, and the qualities of the subject of visual identification, that is, they lead to the establishment of its nominal referents, its formal referents and its qualitative referents. Within this last line are included the chromatic references as attributes of an identification subject, in an associative semantic unit, as a “gestalt” comprising name, form and color (Figure 1).

The rationale of this proposal does not specifically rely on the qualities or attributes of color, but on the qualities and attributes of the identification subject, or rather, if a “custom form” is proposed for the visual identity settings, the color should also be “customized.” Already on that occasion and as a methodology to address the problem of visual identity, I commented on an experience made with the students, in the dual role as recipients and senders of visual messages, an experience that I have continued until today.

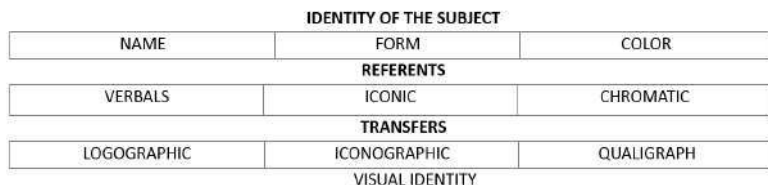


Figure 1: Methodological diagram of visual identity.

Using a test for verifying the students' cognitive relationship of color resulted in the fact that practically everyone found it difficult to "think" a color and "apply" colors that are within the range of "unnamed."

That is to say that beyond the primary and secondary colors, the intermediate colors lack their own name and therefore are difficult to identify, which is why we deduce that if we could verbalize them, the colors could logically be identified.

EXPERIENCES

The experience consisted of assigning a color to each vowel letter of the alphabet, if possible pure colors, and then the assignments of mixtures or compound colors would remain for the consonants. The vowels also have a greater importance when their phonemes are univocal and coincide with the amount of recognized colors.

The hypothesis is arbitrary but it was simpler to operate more directly without the mediation of other types of interference. The color assignment was established on the "sound" of the letter and not on its typographical form.

The particularity of this experience was to develop the reverse process. Instead of naming the color, we "colored the vowel," so as not to "contaminate" a certain color with a certain semantic configuration and obtained the following results:

- A = light blue, white, light blue, red
- E = pink, orange, salmon
- I = yellow
- O = red, green, reddish brown
- U = black, dark blue, dark violet, dark gray

Subsequently, we moved on to a formal instance in which, through a previously elaborated conceptual scheme, we continued to exercise a personal identification. The proposal was based on the recognition of a series of attributes of different character, such as physical, psychological, social, temperamental for each individual that would be stated verbally and in writing, and represented by different graphic forms of iconic, abstract or symbolic character.

The next operation was to assign a color to one's own name, which gave some logical similarities and differences as an answer, since the name did not have a typological color assignment and for whom verbal combination would also be visual. The guiding suggestion for this case was to give chromatic preponderance to the phoneme, over its tonic syllable, for having an accent; what would give rise to the dominant color, there would even be possibilities to assign more than one color, when several vowel letters are involved. This happens in the Spanish language, a language in which words

are composed of a greater number of vowel letters, unlike other languages such as English or German, in which words have a greater number of consonants. Regardless, we postponed to a later phase the exercise of coloring the consonant letters so as to establish a 26-color scheme, coinciding with all the letters of our alphabet. We noted that this possibility was closer to our hypothesis concerning the number of colors distinguishable by their proper names. To test and corroborate our hypothesis, we carried out two experiences as an instrument for data collection.

The first consisted of a survey of students of the Design Workshop 1, where the instruction was to assign a color to each vowel phoneme of the phonetic paradigm (/ a /, / e /, / i /, / o /, / u /), obtaining the following results: I = yellow 100%; U = black 90%; E = salmon 75%; A = white 50%, red 50%; O = red 50%, green 50%.

The second experience was to visualize the record of the different phonemes issued by four people of different sexes, ages and with different vocal bells.

First step: Spectral tracing. Correspondences to the vowel phonemes / a /, / e /, / i /, / o /, / u /.

It was possible, through the spectrogram plot, to recognize each of the vowels with a clear correlation to the different speakers, even when considering their different vocal timbres. Starting from the empirically realized experience, we sought its theoretical validation, for which we carried out a second step.

Second step: Tracing formants.

The vibration of the vocal cords produces sound waves with a fairly distributed frequency spectrum; these are filtered by the vocal tract and some frequencies are reinforced and others are attenuated. Strongly reinforced frequencies are precisely the main formants of sound emission. Technically, these formants are frequency bands where most of the sound energy of a sound is concentrated. The vowel letters are recognized by their formants. Without knowing, we use formants and the frequency of the sound; when we listen to them, we identify the sound. Then we find that each vowel has a different pattern of formants. The frequency of the first three formants (F1, F2, F3) acoustically distinguishes the vowels from each other. The number of these and their location is also different for each voice record, although they do not vary excessively between different people in the same record. The first formant is between 250 and 700 Hz, while the second is between 700 and 2500 Hz.

Phonic Verb Chromatic Syntax (analogies between the phonic and chromatic paradigm)

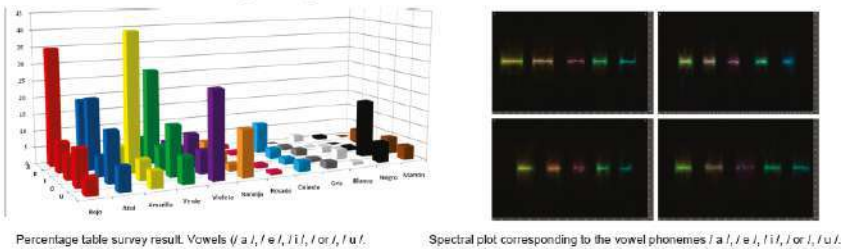


Figure 2: Table of analogies between the phonic paradigm and the chromatic paradigm.

Figure 2 shows the formants of the vowel letters. On the Y-axis, we can record the frequencies in Hz. In addition, on the X-axis the vowel sounds are ordered in correspondence to the vowels / a /, / e

/, / i /, / o /, / u /. The tracing of the formants corresponds to the previous spectral paths. In this experience, we tried to collect as much information as possible about the elements that make up the phonetic paradigm and the color paradigm.

RESULTS

To think of color as an identifier – group or individual – not mediating a convention, would be an impracticable hypothesis, but to propose a color syntax with a grammatical logic derived from the “natural” language is what underlies this work. This grammatical logic aims to establish a schematic model, associating each letter of the alphabet – vowels for their unique sound – a primary color with all the possibilities of blending to obtain the other colors. The model was shaped by assigning a primary color to the vowel letters of the alphabet, in this case to / e /, / i /, / o /, and assign white (light) to / a /, and black (dark) to / u /, so to have that color dimension and thus be able to obtain different values of the resulting colors.



Figure 3: Assignment of the vowels to primary colors: / a / to white, / u / to black, and / e /, / i /, / o / to the primary colors of the different color models: RGB (left); CMY (center); and RGB (right).

An issue to be considered is that there was no quantitative correlation between the letters and the colors, but that mismatch has been overcome from the previous results, so that / a / and / u / would be the extremes of the value dimension on a scale ranging from lightness to darkness. We continued investigating which model or color space could be related with the letters of the alphabet. We verified that our model could be related to all fundamental triadic systems such as RGB, CMY or RYB, models for light, inks, or pigments (Figure 3).

This work does not intend to create or shape a new color space different from those recognized by different color studies, it only tries to form a different way to combine them, to obtain colors based on a linguistic root by association and replacement with the colors of any triadic system.

CONCLUSION

As a partial result of the visual identity research project is the presentation of some schemes of the Color Assignment and Combination System that I called the Chromatic Alphabet (Figure 4), which is resolved by also assigning a color to the consonant letters, which form the intermediate colors produced by the combination of primary colors.



Figure 4: Chromatic alphabet: Assignment of combinations of the subtractive synthesis to the letters of the alphabet.

With the Spanish alphabet this model is possible, since linearly between each vowel letter there are 4/5 consonant letters, which coincides with the number of identifiable and nominated colors. Another of the derivations is to take advantage of the possibilities of digital technology, working the model through software that automatically produces the chromatic mixtures, so as to propose a simple but complete tool for the use in the project's design steps, with chromatic palettes established to and from semantic verbal-chromatic relationships. As a conclusion, it is possible to say that this proposed model is artificial and arbitrary, I would calmly say, as arbitrary and artificial (conventional) as the nomination of colors, so in this case I allow myself to assign color to the name. Let us also note that in the color treatment in visual communication design, we operate with three systems, since we perceive the color with Red, Green and Blue, we think paint with Red, Yellow and Blue, and we print with Cyan, Magenta and Yellow.

ACKNOWLEDGEMENTS

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Colour textile technologies for environmental design

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ABSTRACT

The aim of this paper is to show some of the interactions between the colour of textile architectural installations and the components that affect their design: 1) form, 2) function, 3) temporary colours/lighting technologies, 4) integration with the surrounding environment. The methodology of the research is based on a literature review and 28 case studies. The case studies have been investigated according to the four abovementioned criteria and a matrix was created to highlight the interactions between colour and them. The results showed that white is the most widespread colour for this type of buildings and it is widely used by designers to enhance complex and irregular forms and as a background for light projections. Multi-coloured surfaces are used in temporary installations as well as in suburban or rural contexts.

Keywords: *textile architecture, environmental design, colour design, textile materials*

INTRODUCTION

In the last decades textile materials, due to the evolution of textile composites, are more and more diffused in architectural applications (Fritz, 2011). Today, they are widely used in the construction of architectural envelopes. Current textile composites are used for the design of the whole building envelope, as well as for canopies, tensile structures, claddings and solar shading devices. The colour of architectural textile materials has always had an important role in different cultures (Gasparini and Zennaro, 2007). Without going too far back in time, in modern Western society, we may say that high-tech textiles architecture are mainly characterized by whitish colours (Chilton, 2010). Even today, a simple Google search with the keyword “textile architecture” will produce a predominant number of whitish installations. However, since textiles are filters for the daylight, white is the colour that allows a good diffused light into the building (Schock, 2001).

In the last years, like for many other types of architectural claddings (Zennaro, 2014), we have seen an increasing use of highly coloured architectural textile surfaces. These “new” colours could be permanent (e.g. with high saturation) or temporary (e.g. light projected, light emitted), as for some types of textiles (Ritter, 2013). The choice of colour could be made according to the function of the textile object and other criteria that have been identified through a literature review. The investigation tried to understand whether or not there is a relationship between the colour and the material used for the fibres’ coating.

THEORY

Textile materials are often used in temporary installations where colour is strategic for communication purposes (Figure 1), but they are also used in claddings and shading devices with the same purposes (Table 1). The colour is strongly influenced by the **form** of the object, that can be regular or irregular (Trautz, 2009). Regular forms (based on primary solids or their combinations) or irregular forms (free-forms, parametric, hypersurfaces) (Oosterhuis, 2012) can produce different interactions with colour. Another important aspect is the **function** of the object: building envelopes, claddings, solar shadings and canopies have all different needs when dealing with colour design, especially if we consider the intended use of the artefact. The literature review has highlighted three different functions for the textile envelopes: cladding, shading and shelter (Chilton, 2010). Surface texture quality can be an additional element of complexity. The colour of textiles can also be affected by the integration of lighting technologies. Often, the object becomes a screen for night **light projections** and this can be strongly related to the temporary nature of the object itself (e.g. designed for a specific event) or to the use of textiles as a screen (Figure 1, left). Furthermore, there are the chromatic relationships between the object and the surrounding environment. The communication goals of the design are strongly related to the **context**. Urban areas can be affected by saturated colours (Figure 1, right) as well as suburban areas, where the greyscale predominates (Premier, 2012). Three different types of context have been identified: urban, suburban and rural (Nguyen and Teller, 2016).



Figure 1: On the left: Soundforms pavilion, Olympic Park, London, 2012. The white cladding becomes a surface for light projections. Photo © Nick Guttridge (Courtesy of ES Global Ltd). On the right: SelgasCano pavilion, Bruges, Contemporary Art and Architecture Triennial, 2018. A temporary installation with a monochromatic envelope. Design by Lucía Cano and José Selgas. Photo © Iwan Baan (Courtesy of SelgasCano).

METHOD

The research is based on a sample of case studies collected from 2009 to 2019 for a series of articles developed for the Italian magazines *Tenda In & Out*, and *Tenda International* (*Tenda in&out*). 28 case studies of textile architecture and shading skins have been identified. The case studies were built between the years 2000 and 2018. The buildings have been studied according to a set of criteria gathered from the literature review. The criteria were: the surface colour; the form of the building; the function of the textile material; the implementation of light projections for temporary colours; and, the typology of the context. A comparison between the materials of the fibres' coating has been added. The goal was to identify a set of relationships between the surface colour and the other

abovementioned criteria in order to better identify the colour strategies adopted for environmental design.

The study of the surface colours was developed using the database of pictures provided by the designers of the case studies. The images were processed using Adobe Photoshop and the colours were sorted according to their relative Natural Colour System – NCS codes (Arbab et al., 2018) (Table 1). This process allowed us to identify three colour categories for the studied surfaces: whitish, one colour, multiple colours.

The other criteria of the research were collected in a synoptic table and studied using a MS Excel sheet. Year and location of the buildings have been considered. A comparison between the identified colours and the other criteria has been carried out. The data have been collected in charts in order to study these relationships (Figure 2).

Building	Location	Year	Form	Function	Coating	Timeframe	Colour category	RGBs	Lighting	Context
1 Chanel Mobile Art Pavilion	Paris	2007	Irregular	Cladding	PVC	Temporary	Whitish		NO	Urban
2 Burnham Pavilion	Chicago	2009	Irregular	Cladding	PVC	Temporary	Whitish		YES	Urban
3 Gardens by the Bay	Singapore	2012	Irregular	Shading	PVC	Permanent	Whitish		NO	Urban
4 One Ocean Pavilion	Yeosu	2012	Irregular	Shading	GFRP	Temporary	Whitish		YES	Suburban
5 Expo 2015 Germany Pavilion	Milan	2015	Irregular	Cladding	PVC	Temporary	Whitish		NO	Suburban
6 O2 Arena	London	2000	Regular	Cladding	PTFE	Permanent	Whitish		NO	Suburban
7 Soundforms	London	2012	Irregular	Cladding	PVC	Temporary	Whitish		YES	Urban
8 Zurich Headquarters	Milan	2009	Regular	Shading	PVC	Permanent	Whitish		NO	Urban
9 Cardiff Bay Multi Storey Car Park	Cardiff	2008	Irregular	Cladding	PVC	Permanent	Whitish		YES	Urban
10 Expo 2015 Kuwait Pavilion	Milan	2015	Irregular	Shelter	PVDF	Temporary	Whitish		YES	Suburban
11 Outdoor Room	Beijing	2013	Irregular	Shelter	PVC	Permanent	Whitish		NO	Suburban
12 Basketball Arena	London	2012	Regular	Cladding	PVC	Temporary	Whitish		YES	Suburban
13 Expo 2015 China CCUP Pavilion	Milan	2015	Regular	Cladding	PVC	Temporary	Whitish		NO	Suburban
14 London 2012 Olympic Stadium	London	2012	Regular	Shading	PVC	Permanent	Whitish		YES	Suburban
15 Polythread Knitted Pavilion	New York	2016	Irregular	Shelter	PET	Temporary	Whitish		YES	Urban
16 Prototype II	Frankfurt	2017	Regular	Shelter	PTFE	Temporary	Whitish		NO	Rural
17 Luanda Multisports Pavilion	Luanda	2013	Regular	Cladding	PVC	Permanent	Whitish		YES	Rural
18 Expo 2015 Cardo & Decumano roof	Milan	2015	Regular	Shelter	PVC	Temporary	One colour		NO	Suburban
19 Innsbruck Town Hall	Innsbruck	2002	Regular	Shading	Aluminium	Permanent	One colour		NO	Urban
20 MUSE	Trento	2013	Regular	Shading	PVC	Permanent	One colour		NO	Suburban
21 2018 Bruges Triennale Pavilion	Bruges	2018	Irregular	Shelter	PVC	Temporary	One colour		NO	Urban
22 Le Albere	Trento	2013	Regular	Shading	PVC	Permanent	One colour		NO	Suburban
23 Ark Nova	Matsushima	2013	Irregular	Shelter	PVC	Temporary	One colour		NO	Rural
24 Soft House II	Hamburg	2013	Regular	Shading	PTFE	Temporary	Multiple colours		NO	Suburban
25 Expo 2015 Mexico Pavilion	Milan	2015	Irregular	Cladding	PVC	Temporary	Multiple colours		NO	Suburban
26 Honeycomb Housing	Izola	2006	Regular	Shading	PVC	Permanent	Multiple colours		NO	Suburban
27 2015 Serpentine Pavilion	London	2015	Irregular	Shelter	ETFE	Temporary	Multiple colours		NO	Rural
28 Cressy School	Cressy	2006	Regular	Shading	PVC	Permanent	Multiple colours		NO	Suburban

Table 1: Case studies. Synoptic table by the author.

RESULTS AND DISCUSSION

As predicted, the presence of a large number of case studies with whitish surfaces (from white to light grey) has emerged (Table 1). This is the most widespread colour range of textile membranes for architecture and, although the number of case studies is rather limited to 28, the data confirm what has already emerged from the literature review. The case studies with a whitish coloured envelope are 17, those characterized by a single colour (not in the greyscale) are 6 and those with multiple colour combinations are 5. The three colour categories were used for an easier comparison with the other criteria: form, function, lighting integration, and context.

The comparison between the three colour categories and the form of the buildings has shown that whitish surfaces seem to be the most frequent solution for complex and irregular forms. The “chiaroscuro” play of volumes and shapes is certainly enhanced by a monochromatic surface and above all as clear as white. This is also connected to the wide use of whitish surfaces in Modernist architecture (Klinkhammer, 2004). Another reason that could be related to the choice of whitish or greyish surfaces is the cost: higher request/quantity means lower prices according to economies of scale. Furthermore, whitish surfaces allow a diffused daylight into the building and the light is not affected by any coloured filter; greyish surfaces show less stains and dirt whereas white surfaces rather highlights them. Discoloration of PVC coatings is also a well-known issue (Yousif and Hasan, 2015), thus white can be also favourable for this reason. In regard to shading, greyish and dark surfaces allow a higher performance of the combination window-shading device (Giovanardi, 2019). White remains a widespread choice among designers, even if one of the major manufacturers of architectural textile materials offers a wide range of colours (Serge Ferrari, 2019).

The study of the relationships between colour and function of the textile surface shows that, although whitish colours are the most widespread for all three functions (Figure 2), they are highly preferred for cladding.

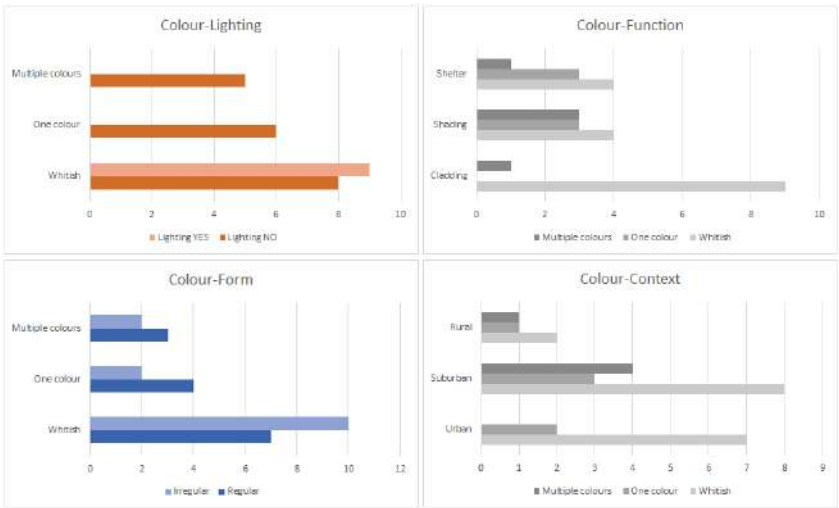


Figure 2: Results of the comparison between surface colours and form, function, lighting, context of the case studies.

In the cladding category there are no monochromatic surfaces (one colour). In addition, the substantial balance of the three colour categories for the shading function is relevant. Among the shelters there is a clear prevalence of monochromatic solutions.

The comparison between the colours and the presence of a lighting system shows that only whitish surfaces are used as screens for night light projections. It is evident that a whitish colour, or a neutral light grey, is better suited as a screen for bright chromatic projections. In fact, with these technologies and with smart-textiles technologies almost any colour is achievable and it is possible to use these colours only when it is needed (Gasparini, 2017). At certain times or in a specific place (e.g. if we talk about temporary architecture) it might not be appropriate to have a brightly coloured cladding, and with these on-off technologies the problem is easily manageable. It goes without saying that highly saturated surfaces are not the best option for colour rendering in light projections (Serge Ferrari, 2019).

The data regarding the context in which the case studies were located show that in urban areas, as city centres or historical centres, there are only monochromatic surfaces, while in the other contexts the other colour strategies are quite well distributed, even if there is a higher percentage of whitish surfaces. This data can be related to the fact that in city centres, multi coloured surfaces are often not allowed for preservation reasons, while in other areas this is possible. In city centres and historical centres, lighting technologies are widely diffused because of their provisional nature. Amongst the case studies, twenty buildings (71%) involved PVC coated textiles; only three involved PTFE coatings; individual case studies involved PTE, PVDF, ETFE, GFRP, and aluminium. The results did not show any evident relationship between the colour and the fibres' coating. Permanent and temporary buildings were equally distributed amongst the three colour categories. In regard to the location, 21 case studies were in Europe, 4 in Asia, 2 in the US and 1 in Africa. Wide literature is dedicated to the use of light colours in warm climates.

CONCLUSIONS

Twenty-eight case studies were extrapolated from a series of articles developed by the author between 2009 and 2019. Among these case studies, the following types of textile artefacts have been identified: claddings and building envelopes, solar shading devices, and tensile structures/shelters. The functions of these case studies have been classified as: cladding, shading and shelter. The colours of the textile surfaces were classified using the database of images in the possession of the author and provided by the designers. For this research the maximum colour rendering accuracy was not required, thus the colour codes were gathered from the database of pictures. This stage of the research highlighted three colour categories: whitish surfaces, one colour surfaces (monochromatic), multiple-colour surfaces. The whitish surfaces were the most widespread for all types of applications. The three colour categories were then compared with the other criteria of the research: the shape, the function, the integration with lighting technologies, and the type of context/environment. The study of these data showed that: white is more used for non-regular and complex forms; in regard to shading there is a fairly regular distribution of the three colour categories/strategies; temporary building envelopes can be adapted to various chromatic solutions; whitish surfaces are better suited to the integration of lighting technologies and light projections; multi-coloured surfaces are not particularly common in urban centres, but they can be easily integrated in other contexts. No evident relationships emerged between the fibres' coating and the colour choice, nor between the colour and the life/temporariness of the building. These results can be useful for designers in order to have a fast tool for preliminary

colour design of textile architecture as well as to develop their own strategies when using textile materials in different environments. This paper voluntarily omits some aspects related to the history of colour of textile materials presented by the author in other publications. Further research can be carried out on the choice of colour in relation to the performances of these materials in specific climate zones.

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Doll costume design: a practical exercise on color education for fashion courses

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ABSTRACT

This paper is part of a research project called Color Lab IFRJ (Laboratório de Cor – IFRJ, in Portuguese) that aims, among other things, to analyze and propose practical exercises on color education for fashion courses at the Federal Institute of Rio de Janeiro – IFRJ Campus Belford Roxo. One of the main demands of Color Lab IFRJ was to develop and to adapt teaching procedures to Campus reality, helping to increase the understanding of color theory concepts for fashion courses. In this sense, a practical exercise with doll costume design was proposed in order to explore the interaction of colors in fashion design. With this practical exercise, the teacher has taken up important questions of color theory with the students such as color dimensions, simultaneous contrast, types of chromatic harmonies. From the practical exercise, students are consciously and objectively instrumentalized and can perceive how color interaction can be applied in the composition of a look.

Keywords: *color education, fashion design, doll*

INTRODUCTION

It is known that color is a valuable tool for visual artists, stylists, fashion designers, architects, and so on. The analysis of an anonymous questionnaire applied to freshman students of the Federal Institute of Rio de Janeiro – IFRJ Campus Belford Roxo shows that they claim color theory is important for fashion projects. However, research points out that the students start attending fashion courses of IFRJ Campus Belford Roxo with very superficial knowledge regarding the color theory and have difficulty in understanding and differentiating basic concepts of the color theory and working with color spontaneously or intuitively (Quattrer and Gouveia, 2018: 1). Still according to previous research, in Brazilian Elementary School and Middle School, color is treated with less importance when compared to other contents of the Art curriculum, which contributes to perpetuation of conceptual problems on color education (Quattrer, 2019: 83).

The teaching experience of the authors in agreement with Hirschler, Lopes and Oliveira (2011) and Bergström (2001) points out that the path to a successful experience on color education in Arts and Design courses at different levels – high school, graduation, and post-graduation – is to demonstrate to students the intellectual challenge of studying and working with color through practical exercises of investigation and chromatic analysis. In this sense, the act of creation is a very important factor for

color theory understanding in IFRJ Campus Belford Roxo's fashion courses and the creative process is fundamental.

Thus, a research project called Color Lab IFRJ (Laboratório de Cor – IFRJ, in Portuguese) was created in order to analyze and to propose practical exercises on color education for fashion courses of IFRJ Campus Belford Roxo and, among other things, to support the cataloging activities of Modateca IFRJ's fashion collection.

It should be noted that IFRJ has suffered over the last few years with funding cuts and this has had a negative impact on new Campi such as IFRJ Campus Belford Roxo, which is located in one of the poorest areas of the state of Rio de Janeiro. The lack of physical space and material resources for teaching color theory is a challenge. Therefore, one of the main demands of Color Lab IFRJ is to develop and adapt teaching procedures to IFRJ Campus Belford Roxo's reality, helping to increase the understanding of color theory concepts for fashion courses.

METHOD

The practical exercise with doll's costume design was structure in order to explore the interaction of colors in fashion design and to collaborate in the fixation of basic concepts of color theory like, for example, primary and secondary colors, dimensions of color (hue, value and chroma) and simultaneous contrast by means of chromatic harmony criteria.

The exercise was named "Jenifer's Look" (Look da Jenifer, in Portuguese) from the doll's label used when the exercise was first applied in 2018. At this time, an Instagram profile was created to make public on social media the students' projects (@lookdajenifer) after student's request (Figure 1). In order to expand the diversity of bodies and skin colors to reflect the diversity of the IFRJ Campus Belford Roxo students, in 2019 Barbie® dolls with different skin colors and body types were acquired with the research project funding.

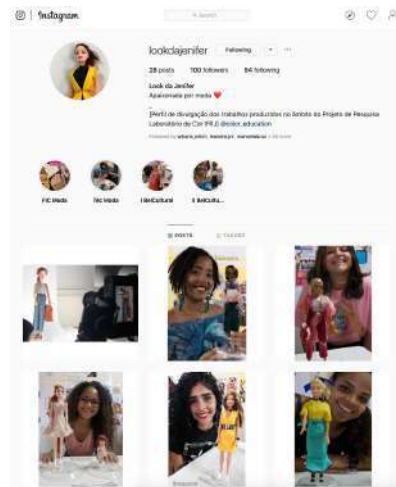


Figure 1: The Instagram profile @lookdajenifer created to make public on social media the students' projects.

“Jenifer’s Look” exercise is applied in parallel to a practical and individual exercise exploring, selecting and comparing color areas with paper and fabric flops and fashion trims, called “Color Book” (Figure 2), and after a practical exercise of color composition with paper dolls (Figure 3). For that, the research sought theoretical support in authors concerned with color education in Arts and Design: Albers (2009), Berns (2016), Frova (2008), Gage (2000), Guimarães (2004) and Monzeglio (1972).



Figure 2: Details of students’ Color Books elaborated with paper and fabric flops and fashion trims in the Color Theory class, offered in the Fashion Course of IFRJ Campus Belford in 2018. Photo: Milena Quattrer.



Figure 3: Details of students’ exercises of color composition with paper dolls elaborated with paper flops in the Color Theory class, offered in the Fashion Course of IFRJ Campus Belford in 2019. Photo: Milena Quattrer.

Carried out under the supervision of a teacher, during “Jenifer’s Look” exercise students are oriented to develop in group a color composition for doll costume design with different types of clothes, footwear and fashion accessories, just using low-cost materials like fabric flaps and fashion trims. The color palette for doll costume design should follow some criteria pre-set by the teacher such as be in line with the previously defined main theme and be based on chromatic harmonies by affinity and/or contrast (Figure 4). It is important to point out that color trends content is often previously discussed

with students through a chromatic research exercise called Moodboard, based on Fashion Moodboard commonly used by fashion professionals. Thus, students are aware of the main color trends in fashion when choosing the color palette. However, for didactic purposes, students are encouraged to investigate chromatic harmonies beyond the color palettes presented by color trend agencies and associations.



Figure 4: Students' color palettes for doll costume design developed using Color Cards in the Color Theory class, offered in the Fashion Course of IFRJ Campus Belford in 2019. Photo: Milena Quattrer.

Color harmony by affinity is the coordination of analogous hues or similar colors shades. And the opposite of affinity harmony is contrast harmony, which refers to the coordination of contrasting hues and/or color shades. Which are: (i) black and white contrast; (ii) hue contrast; and, (iii) saturation contrast. The black and white contrast occurs from the coordination of achromatic values (white, black, and their brightness variations). The hue contrast refers to the coordination of different hues (one of the strongest of its kind occurs when saturated primary hues are used). Finally, the saturation contrast can occur in two ways: (i) when a saturated hue is coordinated with white, black and/or gray (Figure 5); and (ii) when a saturated hue is coordinated with its complementary hue.



Figure 5: Students coordinating fabrics in gray, yellow and magenta (saturation contrast) for doll costume design in the Color Theory class, offered in the Fashion Course of IFRJ Campus Belford in 2018. Photo: Milena Quattrer.

It is noteworthy that for this exercise the chromatic composition is more important than the modeling or the quality workmanship. This is because at this stage some students do not have sufficient knowledge of modeling and sewing. So, the teacher evaluates the students' progress both as a group

and individually from the pre-established criteria: (i) the application of chromatic harmonies and (ii) the adequacy of composition to the main theme.

Throughout the exercise, the teacher revisits the concepts like primary and secondary colors, dimensions of color, and simultaneous contrast. These important concepts were presented and discussed previously with features such as: (i) a color wheel of subtractive mixtures adapted from Itten (1961), in which the three primary colors magenta, yellow and cyan are used (hue variation), (ii) two scales of value (chromatic and achromatic), and (iii) a saturation scale (scale of chroma).

During the exercise, the teacher also highlights concepts of color and culture such as warm and cool colors according to the theme and color palette chosen by the students. It refers to the qualification of color in warm or cool from psychological and cultural interpretations. According to Albers (2009: 80), in the Western tradition, yellow, red, orange, as well as their respective variations are commonly accepted as warm colors. While blue, green and violet, and their respective variations are commonly considered cool.

However, such interpretations are relative and a certain color may appear warmer or cooler according to the chromatic composition. Moreover, it is important to point out that the relationship between color and meaning is not arbitrary or accidental, it is part of a cultural context that, according to Heller (2014), can be understood from the historical tradition and psychological symbolism. In this sense, according to Gage (2000: 22), “colors seem ‘warm’ or ‘cool’ only metaphorically.” Since, when it comes to the visible spectrum, already studied by the students, wavelengths for blue-violet have the highest warming capacity, while the wavelengths for red have the lowest. If necessary, the teacher can revisit this concept with the students.

Finally, after completing the exercise, students are invited to present their chromatic compositions to other students and the teacher. At this point the student group points out and justifies their choices and the dolls are photographed (Figure 6). It is a substantial moment for the whole class and a moment of reflection on color choices and on metamerism and color inconstancy.



Figure 6: Doll costume design developed by students in 2018 and 2019, in the Fashion Course of IFRJ Campus Belford. Photo: Milena Quattrer.

CONCLUSION

The application of a practical exercise like “Jenifer’s Look” proved to be an important resource for discussing important questions and concepts about color theory, such as color dimensions, simultaneous contrast, types of chromatic harmonies, in a playful way. With the help of “Jenifer’s Look”, students are consciously and objectively instrumentalized and can perceive how color is an important resource in fashion.

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Correspondences between color lightness and odor intensity: Sensorial experiments with Brazilian perfumes

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ABSTRACT

This paper presents results of experiments carried out between 2013 and 2016, in which we search for correspondences between the visual and the olfactory stimuli in perfume bottles. We start from the hypothesis that it would be possible to associate smells to colors and shapes. We conducted the research through two axes: the perception, and the representation of the fragrances. Designers and marketers used to take for granted, or at least give little consideration, to the way companies and brands use colors and shapes to sell fragrances. However, we also consider people's perception as an important factor when designing a perfume bottle. Therefore, in order to understand the perception of odors, we carried out sensorial experiments where a group of people performed a blind analysis of four Brazilian perfumes. The results obtained in part confirm some marketing practices, but they also presented different approaches. The most interesting found is the one we selected to share in this paper. Sensorial experiments pointed to a correlation between the intensity of a fragrance and the intensity of a color. Although Perfumery Industries use color hues to classify and differentiate the olfactory families, in the perception of users, to the extent that a fragrance is perceived as softer, this is related to lighter colors. Finally, this makes clear the importance of considering the color in its depth and its variety in view of the different dimensions that compose it – hue, chroma and lightness – and not just one of them.

Keywords: *perfume, color, Brazil, perception, packaging*

INTRODUCTION

The present work is the result of the inquiry into the role of design for the perfumery industry (Silva, 2017). In search of correspondences between sensory and olfactory stimuli in perfume packaging, we conducted two types of survey on the representation and the perception of smells. We know that verbalizing a smell is not an easy task, yet for those in the fragrance markets it becomes necessary. By doing a literature review in Multisensory approach we found researches on correspondences between senses that had motivated us to go further in this issue. Research in the field of experimental psychology indicates that a consonance between stimuli is capable of enhancing communication (Silva and Mazzilli, 2016). As far as perfume packaging is concerned, we expect they would translate the effects that the fragrance in question intends to evoke. In this case, the packaging designer should

better understand the effects of smells and the meanings people attribute to them in order to more effectively represent them visually and thus establish better communication with the consumer.

We chose two of what we consider the most important elements for the visual language of a perfume: colors and shapes. In this paper, we discuss part of color research results. In perfumery, colors play their role from catalogs of fragrance suppliers distinguishing the different olfactory groups and types of ingredients to the packaging of perfumes and advertising materials. By investigating the colors used by fragrance companies and suppliers, we have identified a trend in selecting a group of very close hues to represent certain fragrance families. From saved images and screen captures of such company's websites, we selected colors using the color capture tool (dropper) from Adobe Illustrator software. We then elaborated a comparative table between the colors used by the different companies as presented in Figure 1. These results were the basis for investigating people's perceptions regarding the colors and the scents of perfumes through the sensory experiments described below. What kind of colors would better represent specific smells?



Figure 1: Colors used by perfumery companies to represent some of the olfactory families.

THE COLORS AND SHAPES OF SMELLS: SENSORY EXPERIMENTS

During the months of January and March 2015, we performed sensorial experiments in the Laboratory of Sensory Analysis of the Faculty of Pharmaceutical Sciences of the University of São Paulo (FCF|USP). The experiment consisted in the investigation of the relationships that the participants would establish between a fragrance and variations of colors and forms of packaging from a blind olfactory stimulation. In order to study four different olfactory stimuli, we selected four commercially marketed perfumes belonging to the citrus, floral, woody and oriental olfactory families.

We prioritize further investigation for each of the four olfactory stimuli. For this, we divided the research into eight sessions of experiments, divided into two groups. One group (1) of research aimed to collect associations of smells with colors and the other group (2) to collect associations with perfume bottle and cap shapes. Given the exploratory nature of the research, we delimited the minimum number of 30 participants for each experiment. Given the location of the Laboratory, in the University of São Paulo's Chemistry Complex, the majority of university students from biological and exact sciences influenced the quality of the sample. We had the voluntary involvement of 345 participants, including undergraduate and graduate students, as well as USP staff and visitors. Importantly, this

research did not delimit any specific audience. There was no intention through the samples to reflect data from a specific population.

We summoned the participants through a poster placed in the building of the Faculty of Pharmaceutical Sciences, at the same day of the experiments. As inclusion criteria, we considered fit people those over eighteen and normal sense of sight (color) and smell, i.e., should not have color blindness or anosmia (complete or partial loss of smell). As exclusion criteria, we did not accept people with a clinical condition in which they had compromised the senses of smell (e.g. flu, rhinitis, and sinusitis) or vision (e.g. conjunctivitis). There were no volunteers with this picture. Regarding color vision, despite the claims of normality, we applied a Color Blindness Test before the experiment. Even if we identify abnormalities, the participant could proceed with the research. Participants who were identified as colorblind had their data computed, but did not enter the analysis. Finally, the experiments presented a minimal risk to the participants, since we used perfumes regularly marketed in Brazil.

The perfumes selected for analysis belong to the company O Boticário, because its popularity and geographical coverage. It is noteworthy to enhance, however, that the company did not have any participation in this research, having not collaborated for the development of the work presented here. All the perfumes had the same concentration of cologne deodorant. We based on the descriptions the company provides on its official website as selection criteria. We selected *Free* perfume to represent the Citrus family; *Floratta* in Rose, to represent the Floral family; *Malbec Duo*, to represent the Woody family; and *Coffee Man Seduction*, to represent the Oriental family. In order to check the participant's perception of color (Group 1), we designed a chart with 39 randomly distributed colors. Concerning shape perception (Group 2), we selected seven glass bottles from the standard *Wheaton* line and ten plastic caps from the standard line from *Incom*. We classified the bottles and caps according to pointed, rounded or intermediate shape.

In this paper, we discuss about the methods, materials and part of results obtained in the experiments of group 1, i.e., the experiments with colors and smells. In that group, each participant was asked what color would best represent the fragrance smelled (question 1). We ask the participant to state the degree of difficulty in establishing such associations (question 2) and how much this association made sense (question 3). The participant was also asked to state the degree of familiarity with the stimuli (question 4) and what the fragrance reminded him/her of if he/she was familiar (question 5). Finally, we asked them to associate the fragrance with words: question 6 allowed an open answer. In question 7 the participant should freely, select predefined words. In each of the sessions of experiments performed the participant went through four steps:

- Step 1- Initial Contact: Basic instructions on the topic of sensory analysis were provided to stakeholders who volunteered at the lab door. After agreeing to participate, we sent the candidates to one of the seven booths of the Sensory Analysis Laboratory located at FCF|USP.
- Step 2- Informed Consent (IC): Once accommodated in the booth, the participant received two copies of the IC, to read and signed it. They could choose to keep one copy with them and had to surrender the other copy.
- Step 3- Preliminary Questionnaire: The participant received a questionnaire (habits and personal data) with seven questions. In addition, those who participated in the Group 1 experiments also received a simplified vision test (6 cards) adapted from Dr. Shinobu Ishihara's original book (Ishihara, 1972: 4).

- Step 4- Sensory analysis: Participants received an olfactory strip with the fragrance to be tried and the questionnaire. In addition, for Group 1, each participant also received a color chart; in the Group 2, participants received a kit with the vials and caps to be analyzed.

Regarding to the color chart presented to the participants in Step 4, it consisted of 39 colors based on the CMYK color system. We considered the primary, secondary and tertiary colors, in total 12 colors, as the main group, which we called medium tones. Then, varying 50% toward white, we defined a second group of 12 colors in light tones. Again, varying the main group in 50% percent toward black, we defined the third group of 12 colors in dark tones. We added more three neutral colors (white, gray, black) to these 36 colors. We grouped all these in two ways: three groups of value (lightness) variations and five groups of hue variations. Finally, we assigned three-digit numbers generated in a randomization program (Table 1).

Groups of colors	Light	Medium	Dark
Group 1 - Bluish	983	681	486
	503	910	230
	638	713	576
	864	524	186
Group 2 - Pink and lilaceous	499	101	995
	321	970	459
	874	889	976
	663	307	123
Group 3 - Yellowish to reddish	764	512	624
	515	751	483
	431	425	903
	725	508	817
Group 4 - Greenish			
Group 5 - Neutrals	863	192	741

Table 1: Colors presented to the participants together with the questionnaire.

RESULTS AND DISCUSSIONS: EXPERIMENTS WITH COLORS AND SMELLS

In the experiments with colors and smells, we obtained 175 volunteer participants. The results of the simplified vision test, though, indicate the suspicion of color blindness for two participants. So, we are considering for this discussion a number N of 173 participants: N42 for citric fragrance; N42 for floral fragrance; N45 for woody fragrance; N45 for oriental fragrance.

One curious fact identified was that 74 of 173 participants attributed the mildness quality for the fragrance by responding question 6 and 7. By analyzing the color mentioned for each one of them, we can infer an existence of correspondence between color lightness and odor intensity.

Color lightness and odor intensity

In the experiment with citric fragrance, six of 12 participants who attributed the mildness quality for the fragrance also pointed a light value color as the best match (Table 2). They were N3, N4, N5, N8, N9, and N10. This result corresponds to 50% of relationships matching lightness with mildness. This

relationship is empowered when considering the four mentions (N1, N2, N6, and N7) to medium value colors, increasing to 83.33%.


Fragrance			Participant/Color Code					
	Citric							
	N1	425	N4	515	N7	681	N10	764
	N2	508	N5	515	N8	725	N11	817
	N3	515	N6	524	N9	764	N12	903

Table 2: Colors associated to citric fragrance when it was perceived as mildness.

In the experiment with floral fragrance, fifteen of 22 participants who attributed the mildness quality for the fragrance also pointed a light value color as the best match (Table 3). They were N3, N4, N6, N7, N8, N9, N10, N12, N14, N15, N16, N17, N18, N20, and N21. Moreover, one participant (N19) pointed white as best match. Despite not being a hue itself, because white represents one of the extremes of value scale, for this analysis it was considered as a color, a light color. Taking all of this into account, 72% of relationships matched lightness with mildness. This relationship is empowered when considering the four mentions (N1, N5, N11, and N22) to medium value colors, increasing to 90.90%.


Fragrance		Participant/Color Code						
	N1	101	N7	499	N13	624	N19	863
	N2	186	N8	499	N14	663	N20	864
	N3	321	N9	499	N15	663	N21	864
	N4	321	N10	503	N16	725	N22	889
	N5	425	N11	508	N17	725		
	N6	431	N12	515	N18	764		

Table 3: Colors associated to floral fragrance when it was perceived as mildness.

In the experiment with woody fragrance, eight of 16 participants who attributed the mildness quality for the fragrance also pointed a light value color as the best match (Table 4). They were N4, N5, N6, N9, N10, N12, N15, and N16. This result corresponds to 50% of relationships matching lightness with mildness. This relationship is empowered when considering the three mentions (N1, N8, and N13) to medium value colors, increasing to 68.75%.


Fragrance		Participant/Color Code							
	Woody								
	N1	101	N5	321	N9	515	N13	713	
	N2	186	N6	431	N10	515	N14	817	
	N3	230	N7	459	N11	576	N15	864	
	N4	321	N8	512	N12	663	N16	983	

Table 4: Colors associated to woody fragrance when it was perceived as mildness.

Finally, in the experiment with oriental fragrance, sixteen of 24 participants who attributed the mildness quality for the fragrance also pointed a light value color as the best match (Table 5). They were N1, N2, N3, N4, N5, N6, N8, N9, N10, N12, N14, N16, N17, N19, and N21. As occurred in the experiment with floral fragrance, one participant (N20) pointed white as best match with oriental fragrance. Taking all this into account, we had 67% of relationships matching lightness with mildness. This relationship is empowered when considering the four mentions (N13, N14, N22, and N23) to medium value colors, increasing to 83.33%.


Fragrance			Participant/Color Code					
	N1	321	N7	486	N13	713	N19	764
	N2	321	N8	499	N14	725	N20	863
	N3	321	N9	499	N15	681	N21	864
	N4	321	N10	515	N16	725	N22	889
	N5	321	N11	624	N17	725	N23	970
	N6	431	N12	663	N18	741	N24	995

Table 5: Color associated to oriental fragrance when it was perceived as a mildness fragrance.

FINAL CONSIDERATIONS

This paper is just a sample of how important it is to confront the visual representations already existing in a product category with the perception of consumers. Especially when it comes to fragrance products with complex formulations such as perfumes. It is market practice to classify perfumes into olfactory families. However, within the same olfactory family we can find different nuances of smells. In the same way, we should consider the colors. Designers should avoid a cursory look at the color field. As observed from the experiments, it is possible that the dimensions of value and chroma exert more influence on a person's perception than color itself (hue). Therefore, while dealing with the psychological effects of color, one should consider the science of color in greater depth and not just color as a set of words to which certain attributes are associated. From then on, the designer would expand the possibilities of visual expression and multisensory correspondence.

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Interpreting Beijing's theme colour

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ABSTRACT

Over the past twenty years, urban colour has received much attention in China due to the disappointing effects of increasingly homogeneous urban landscapes. More and more people are aware that a distinctive urban colour is part of a city's collective memory and a resource for urban development. Colour researchers are dealing with issues such as urban colour planning and management, as well as urban colour restoration and renewal. After many years of research and experimentation, in particular in the field of urban colour, a theory of "The Main Theme for Urban Colour" has been developed by the author in order to construct a distinctive colour identity and a specific character for a city. This paper considers Beijing as a case study to explore the methodology of analyzing urban colour identity and colour patterns. Based on an interdisciplinary approach, the author has conducted substantial research from the viewpoint of colour culture and urban planning to articulate "*Danyun Yinlyu*" (*Red Melody and Silver Rhythm*) as the main theme colour of Beijing's colourscape. A "colour palette" has been developed and integrated as a colour management tool into the Main Guidelines for Colour Planning and Design of the City of Beijing, a document that plays a significant role in managing the city's colourscape in theory and practice.

Keywords: urban colour guidelines, urban planning, *Danyun Yinlyu – Red Melody and Silver Rhythm*, colourscape of Beijing, colour palette tool

INTRODUCTION

Over the last two decades, there is probably no other country in the world than China that has been making greater efforts in urban colour planning. Although controversial in many ways, the commonality of the importance of a specific colour identity and a sense of aesthetics has become clear. Using colour as an approach to manage and reshape an increasingly modernized urbanscape is at present significant in China, because in the past hundred years Chinese cities have been developing towards modernization. In particular, in the last forty years, thousands of cities and towns, and even villages, have been involved in an unprecedented rapid urban development process. The fact that urbanscape has been changing over and over again, makes people feel more detached from the urban environment.

Colour, as an essential element of the urban landscape, has been attracting more and more attention. It is expected that this identifiable and artistic visual element could be applied in planning, guidance, and management of urban appearance. There is still space for discussion about the potential

function of colour in many ways, whether underestimated or overestimated. However, as a professional colour designer, the key issue is to respond to design concerns and to find a way to solve urban problems in a real-life context. This paper is partially extracted from the core document of the colour plan submission for Beijing Urban Authority, which is unpublished.

CREATING A WAY TO DEAL WITH URBAN COLOUR ISSUES

In China, the request for urban colour planning is generally raised by the government as it pays attention to urban planning, especially for the Development Plan included in the Five-Year Plan (Beijing, 1999). A detailed urban plan is usually described by data and text only. Without any visual input, that approach becomes problematic, especially when dealing with urban colour. Therefore, a comprehensive urban colour plan should include at least three aspects.

(1) A “road map” for investigating, evaluating, and establishing a strategy for the urban colour planning context. In the early research stage, an analytic report on the current situation and circumstances of the urban context should be provided to colour planners. The report should also identify the colour character and identity that impact the interface between urbanscape and streetscape. A “negative list” should be able to articulate the existing problems and propose a strategy and a “road map” for solutions. This requires that a colour planner understand the historical background of urban colour, distinguish colour forms, analyze colour function in the landscape, grasp principles of colour changes, construct an ideal vision, and provide the solution for the colour issues.

Professor Jean-Philippe Lenclos's theory of “The Geography of Colour” (Lenclos and Lenclos, 2007) provides an effective method for investigating urban colour. The approach helps reveal the relationship of the local natural geography, history, and the human aspects of urban colour. However, compared to Western stone-based buildings and cities, traditional Chinese cities and buildings are constructed of wood and brick that are more vulnerable to external factors and susceptible to damage. How do we reshape the colour identity of an urbanscape? My team and I have been reflecting on this question, and conducted research and experiments for the last twenty years. Based on Lenclos' theory and the Chinese context, we developed an adequate methodology and a multidisciplinary approach that includes on-site investigation, studio analysis, conceptualization, problem solving, and road mapping.

(2) A structure and a narrative about the vision of the future city. It is difficult to grasp an urban colour identity and present it in a way that the public can easily understand. As well, the decision-making process involves many parties, such as artists and designers with colour knowledge, architects with their own colour preferences, planners who know little about colour, planning managers and developers who want quick results, and the public with different levels of colour experience. To meet the expectations of all the parties requires a colour planner with the skills of a good storyteller, who is able to persuade the various audiences with a comprehensive narrative about the urban colour plan for the future city.

In my practice, I regard myself as a conductor who is directing an urban colour project as if it was the performance of a colour symphony. The “theme,” or recurring “melody,” constitutes the colour identity of specific districts, particular streets, or urban nodes, while other areas are complementary to the main theme, as if they were “countermelodies,” “background music,” or a “chorus.” I imagine inhabitants and visitors experiencing the glamorous colours when walking through the streets, alleys and other places. This approach enables me to think colour planning as a collaborative work, a synergy of urban planners, architects, artists, colour designers, and colour scientists.

A comprehensive colour plan has to clearly identify the distinctive quality of the colour character of a place. Nevertheless, it has to be able to reflect an understanding of the historical colourscape, the state-of-the-art circumstances, and the future vision. It also has to consider the architectural design trends, the architectural material development, and the construction technology. Based on these aspects, only then people can imagine the ideal colour vision for the future city, which gives the best colour to ancient cities, city centers, satellite cities, new cities, and suburbs.

(3) Guidelines for colour design of future urban projects. A design guide is a technical document for urban colour audit in project design planning and implementation that consists of three parts. (1) A city colour master plan is a document that contains an overarching colour plan for the whole city, as well as a detailed plan for the districts; a research report on similar national and international cities; a database of the urban colourscape based on fieldwork; a "positive" and a "negative" list of urban colour; an interpretation of the "main theme" of a colourscape; the positioning of colour zoning; an urban core area and major nodes with related problems and strategies; and a "road map" for urban colour management. (2) Urban colour design and management guidelines for the planning of each district as well as of important nodes. (3) Supportive colour charts including colour schemes of main building façades, roofs, decoration, ornaments, as well as classified architectural colour maps.

The guidelines should be able to reflect the core of a colour plan that directs planners, designers and constructors to follow the relevant regulations and principles. In future projects, the design guidelines are considered as an indispensable part of an integral colour plan.

THE CASE STUDY OF BEIJING'S URBAN COLOUR: RED MELODY AND SILVER RHYTHM

In 2017, I was invited by Beijing Planning and Natural Resources Committee to participate in the project "Research on Beijing City Keynote and Diversification 2016–2035" and to edit for "Beijing Urban Colour Planning and Urban Design Guidelines (2016-2035)" (Beijing, 2016). I thus started working with my team on three aspects: (1) Research and analysis: evaluation of the context and situation of Beijing's urban colour development; (2) Definition and design: compilation of a "colour palette" of Beijing's urban theme colour "*Danyun Yinlyu*"; (3) A vision for 2035: study of the future development of Chinese and global cities, and edition of technical documents. The technical content is too complex to describe therefore I have chosen an example of (2) to demonstrate our approach.

After collecting a significant number of colour samples from representative sites in Beijing, our team made the effort of quantifying and classifying the colour material in the studio. Referencing relevant historical archives and literature (Chen, 2016; Chen, 2018; Hou 2000), and from a perspective of urban colour disciplines and colour management, we create a colour palette for the city of Beijing. According to the Chinese way of interpreting things, the colour theme was named "*Danyun Yinlyu*." "*Dan*" (Red) and "*Yin*" (Silver) indicate that the main theme consists of a two-tone set: red and silver. "*Yun*" (Melody) and "*lyu*" (Rhythm) reflect an aesthetic sense of colour presentation.

"*Danyun*" (Red Melody) represents a range of reds that first symbolizes imperial power through red painted walls, pillars and doors of ancient palaces. Second, the red colour reflects the local colour preference and culture favouring shades such as maroon, dark red, scarlet, purplish red, yellowish red, and more. Third, the red colour also considers the architectural colour in the process of modernization, such as the façade colour of The Great Hall of the People, The Museum of History, The National Art Museum of China, among others. The colour trend shows that people prefer the red colour scheme. These red colours, weathered by the climate, appear uniquely mottled, vigorous and subtle, and yet with various colour patterns – "*Danyun*." In a local saying, it has the sense of being "historical."

“Danyun” also reflects the nature of the soil of Beijing. According to pedologists, the soil of Beijing contains seven different types of soil, revealing a colour range from grey-red to dark brown. The Beijing area is relatively dry, and the dust particles of these soils are easily fluttering in the wind. Over time, roads, vegetation, roofs, and even walls are covered in dust, as being dyed in brownish red and grey. Additional factors such as sunshine, seasonal changes and vegetation also have an impact, resulting in an urbanscape of warm tones – *“Danyun.”* The rich red colour scheme of *“Danyun”* is more and more being supported by local people, especially in the process of urban regeneration. Since the Beijing Olympics, that colour scheme has been continuously optimized and refined as an important colour identity of Beijing (Figure 1).

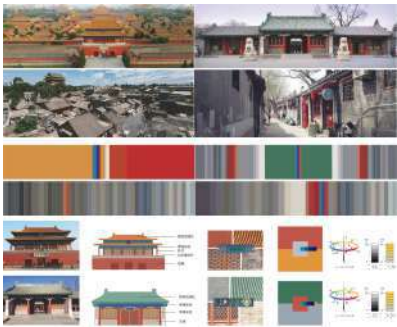


Figure 1: *“Danyun Yinlyu”* of imperial architecture (top row) and residential housing (2nd row) during the Ming and Qing Dynasties; Chromatic analysis of *“Danyun”* for traditional architecture (bottom, four rows). Concept: Jianming Song. Photo: Hangzhou Dipper Colour Research Centre.



Figure 2: Beijing colour palette of *“Danyun Yinlyu.”* Key urban nodes of different periods (top, two rows); Chromatic analysis of *“Yinlyu”* based on large-scale buildings: façade colour compositions, material texture, colour relationships (bottom, four rows). Concept: Jianming Song. Photo: Hangzhou Dipper Colour Research Centre.

Yinlyu (Silver Rhythm) represents a dynamic grey tone (Figure 2). The origins mainly are from the colour of residential dwellings. Since 1840, Western civilization and diverse architectural styles and construction techniques have been emerging in the local landscape. Various Western-style buildings have been erected since for offices, banks, hospitals, schools, railway stations. In the period of the

Republic of China, the architectural style and colour have been developed. As the capital of New China, residential buildings were predominantly using grey tones based on traditional materials. Since the 1990s, the city has undergone tremendous change. New buildings have been built using new materials, such as large-scale glass curtains and steel-framed structures. Remarkable landmarks, such as The National Stadium, The National Centre for the Performing Arts, and the The New CCTV Building, manifest a dominant colour trend towards a series of silver tones. The architectural colour scheme is highly related to the materials applied: grey bricks, grey tiles, various shades of stone, different grey paints, as well as new building materials such as steel, glass curtain, and more.

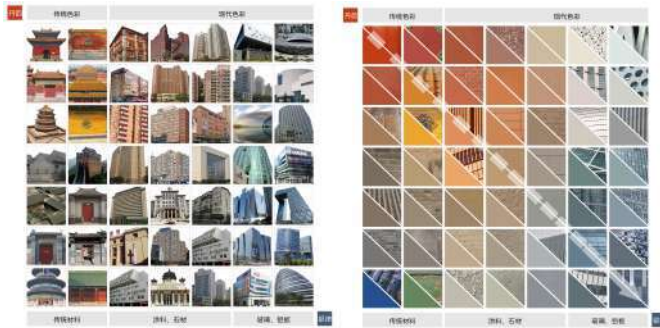


Figure 3: Colour resources of “Danyun Yinlyu” from typical buildings of various periods (left); Colour palette of “Danyun Yinlyu” (right). Concept: Jianming Song. Photo: Hangzhou Dipper Colour Research Centre.



Figure 4: Colour evolution from Ming and Qing Dynasties to present (top); Colour and material analysis and colour combinations of “Danyun Yinlyu” – Beijing’s theme colour (bottom). Concept: Jianming Song. Photo: Hangzhou Dipper Colour Research Centre.

“Danyun Yinlyu” is not only a poetic expression, but also a reflection on urban colour trends (Figure 3). The colour palette is derived from the colours of architectural prototypes and the recent development of urbanscape. From a technical viewpoint, the colour palette “Danyun Yinlyu” (Figure 4) is presented in three different layers (from bottom to top): chromatography, material, and architectural language. First, the two shades of “Dan” and “Yin” are arranged according to hue, lightness and saturation. Second, the texture associated with the colour is organized in a sequence of matte traditional building materials, shiny modern building materials, and materials with different levels of transparency. Third, the architectural language involves colour combinations and decor of traditional buildings, as well as colour structure and composition of modern building façades.

In terms of the visual experience, the warmth of “*Danyun*” and the coolness of “*Yinlyu*” are harmonious and complementary to each other and constitute the colour structure, or “theme colour” of Beijing. As the colour schemes cover about seventy to eighty per cent of the architectural colour tone of the city, it leads to the construction of a distinctive colour identity of Beijing. The theme colour “*Danyun Yinlyu*” defines the urban colourscape and the character that advises urban planners. On the other hand, it provides a tool for managing and solving colour issues in the urban development. Although the colour may change over time, the range of colours and the city's colour appearance at a large scale will still be manageable and under control.

Colour planning for such a megacity with an area of 16.41 million square kilometers is a challenge for us as colour planners. We follow four principles to guide our practice: (1) natural and geographical colour resources; (2) human and historical colour contexts; (3) current circumstances of urban colourscape and future trends for the next thirty years; and, (4) straightforward urban colour management. Looking back, my feeling is that urban colour reflects both the history of urban development and the milestones of Chinese and global architecture. As a practitioner, the essential goal is to trace the historical movement to find solutions to sustain the inherited oriental meaning of the colourscape, and at the same time, to find a way for colour construction and management that accommodates development in a new era.

CONCLUSION

The Beijing urban colour project is one of our many social experiments. It mainly intends to answer the question: How do we inherit the ancient cultural context? How do we facilitate the process of organic urbanization through colour? How do we construct a prominent colour identity for old and new built environments? “*Danyun Yinlyu*” seems to provide a solution that forms a system for colour management, a coordination tool for suppliers and developers, a discussion basis for architects and urban planners, an important persuasive colour document for city managers to work together towards a future colour vision with a unified goal. As urbanization is an ongoing process in China, the work of urban colour planners will continue. Cities across the country will continuously raise new questions, and demands will emerge based on their own situation. How do we avoid the stereotypes of urban colourscape under the impact of globalization, and how do we construct distinctive colour identities for cities? How do we refine, upgrade and consolidate the theories and the colour research design practice as a discipline? These questions are very important for the urban colour designer.

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Colour, colour fastness and chemical constitution of anionic azo dyes: Chemoinformatics analysis

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ABSTRACT

The research is devoted to chemoinformatics analysis of the relationships between colour, colour fastness and chemical constitution of large families of acid and direct azo dyes in solution and on fibres of different nature. Analysis displays substructural fragments responsible for maximum absorption wavelength, light fastness, sensitivity to oxygen bleaching and wash fastness of dyes.

Keywords: azo dyes, maximum absorption wavelength, colour, colour fastness, chemoinformatics

INTRODUCTION

Since the discovery of the first synthetic dye by W. H. Perkin in 1856 analysis of the relationships between chemical structure and colour of dyes is a key point to the progress of colour chemistry. Dyes for textile coloration played a crucial role in the development of the organic chemical industry (Travis, 1990).

The problem of colour and constitution of organic dyes has been studied for more than a hundred years (Dähne, 1978). Colour theory has reached a deep understanding of the relationships between the chemical structure of dyes and their spectral properties reflecting colour characteristics (Allen, 1971; Griffiths, 1981; Christie, 2015; Bamfield and Hutchings, 2018). Modern requirements for high functionality of textiles put forward new and advanced methods for the development of new chromophores with high colour fastness characteristics. One of them is based on methods of chemoinformatics, which became a principal direction of the development of materials science and finally emerged as a new science in the past two decades.

Recently an advanced tool of QSPR analysis of organic substances was proposed on the basis of fragment approach (Baskin et al., 1997; Zhokhova et al., 2005). Those publications deal with the application of this method for the analysis of spectral behaviour of cyanine dyes and affinity of anionic dyes to cellulose fibres. According to this method, the descriptors are calculated on the basis of the chemical structure of the molecule by the use of defragmentation of the molecule into substructures of chains, branches, and cycles of atoms. This method was applied for different physicochemical problems of organic chemistry.

The idea of fragment approach was used in our research (Telegin et al., 2016) for analysis of light fastness of azo benzothiazole disperse dyes, light fastness of indigoid dyes and some other problems of dye chemistry. Fragment substructures are shown to be very suitable for analysis of relationships

between chemical structure and technical properties of dyes for applied research. Some other efforts (Telegin, Priazhnikova, and Ran, 2016; Ran, Pryazhnikova, and Telegin, 2018) were focused on systematic analysis of fastness properties of acid and direct dyes on cellulose and cotton fabrics.

The current study is aiming at the collection of several databases and chemoinformatics analysis of the relationships between colour, colour fastness and chemical constitution of large families of acid and direct dyes in solution and on fibres of different nature.

METHOD

Collected and analyzed properties include wavelength maximum of dyes in solution, light fastness of acid dyes on wool and polyamide fibres, light fastness of direct dyes on cotton, the sensitivity of acid dyes on wool for oxygen bleaching, wash fastness of acid azo dyes on wool and adsorption of direct dyes on cotton.

The database was collected from the literature and arranged by the use of JChem software ("ChemAxon") implementing tools for drawing dye molecules, checking their chemical structure and preparation an sdf-file. Further analysis of the database by chemometric software NASAWIN (Baskin et al., 1997) makes it possible to decompose the whole database of dyes into substructural fragments without calculation any special physicochemical parameters of the molecules.

Mathematical models are built on the basis of multiple regression analysis, the robustness of the models and regression coefficients are estimated by the methods of mathematical statistics. Each model describes a certain indicator of colour and colour fastness as a function of several substructural fragments of molecules within large families of water-soluble azonaphthalene derivatives.

RESULTS AND DISCUSSION

Application of fragment approach is very much suitable for chemoinformatics analysis and understanding colour and constitution relationships because conjugated chains of different length explaining the origin of colour could be taken as an example of substructural molecular fragments of the chromophore.

A dataset for the wavelength of absorption for 83 azonaphthalene acid azo dyes (Dinner, 1928; Griffith and Brode, 1939) was taken as an example. The resulted 5-descriptor model is demonstrating the correlation between experimental and calculated wavelength shown in Figure 1. Substructural fragments and correspondent regression coefficients are shown in Table 1.

The results display that maximum absorption wavelength is controlled by the following substructural fragments:

- ✓ Total count of non-hydrogen atoms of any dye molecule (according to Student number T-stat for Coeff1, correlation with this descriptor is extremely high);
- ✓ Conjugated chain, which does not include azo-bond, exhibits negative contribution;
- ✓ Conjugated chain including two azo-bonds displays positive impact;
- ✓ Azo-bond connecting two conjugated chains demonstrates a negative impact, while sulphonic acid group as a terminal group of such a fragment increases maximum absorption wavelength.

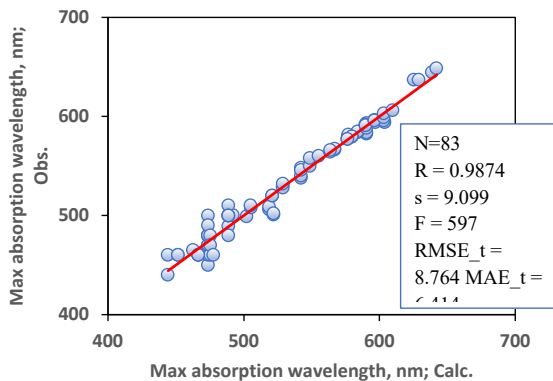


Figure 1. Correlation between calculated and observed values of the maximum absorption wavelength.

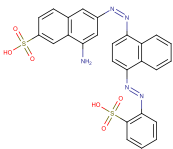
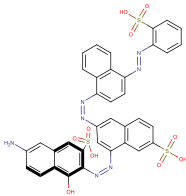
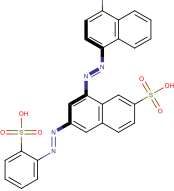
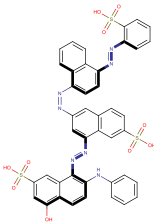
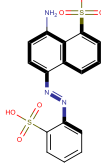
<p>Coeff0= 398.9057 T-stat= 124.4198</p>	<p>Coeff1= 3.3344, T-stat= 44.6383 Total count of non-hydrogen atoms</p> 	<p>Coeff2= -14.9355, T-stat= -6.7346</p> 
<p>Coeff3= 6.654, T-stat= 4.708</p> 	<p>Coeff4= -11.1398, T-stat= -10.2294</p> 	<p>Coeff5= 16.1618, T-stat= 5.0611</p> 

Table 1: Substructural fragments responsible for the wavelength maximum of absorption.

The efficiency of chemoinformatics methods based on fragment approach for analysis of the relationships between the chemical structure of textile dyes and colour fastness of dyings have been shown by examining a large set of properties mentioned above and data collected in previous research (Telegin, Priazhnikova, and Ran, 2016; Ran, Pryazhnikova, and Telegin, 2018). The analysis of the developed regression models reveals the contribution of several substructural fragments of the molecules on each indicator of colour and colour fastness of acid and direct azo dyes on textile materials.

The regression models display high robustness and practical applicability for describing structure – property relationships of collected datasets for azo dyes, as well as for predicting the properties of new dyes due to a large number of descriptors (about 10), considerable amount of dyes of one chemical group included into the datasets (from 83 to 225 for each property), statistically representative accuracy for predicting wavelength maximum of absorption (standard deviation 9 nm) and colour fastness (standard deviation 0.4-0.5 units according to ISO scale).

Comparison of the results of several models has shown similarity of 1-3 from about 10 individual multiatomic fragments for acid and direct azo dyes in case of wool, polyamide and cotton fibres, which indicates uniformity of the mechanisms of physicochemical processes accompanying the destruction of dyes in the tests of light fastness and sensitivity of dyeings to oxygen bleaching. Several examples of similar fragments are provided below.

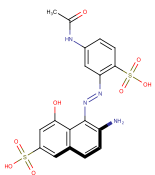
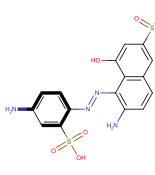
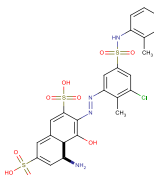
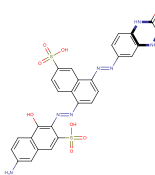
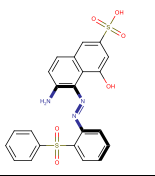
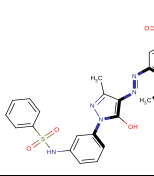
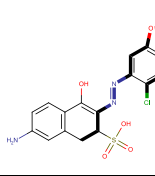
Light fastness - wool	Sensitivity to oxygen bleaching - wool	Light fastness - polyamide	Light fastness - cotton
Fragments containing primary or substituted amino group			
Coeff3= -1.037494, T-stat= -6.3766	Coeff3= 1.477873, T-stat= 4.8356	Coeff2= -2.4247, T-stat= -17.7498	Coeff2 = -0.683325; T-stat = -4.3331
			
Fragments containing azo-bond and primary or substituted amino group			
	Coeff4= 2.706476, T-stat= 7.3958	Coeff8= -0.42405, T-stat= -5.5203	Coeff5 = -0.162479, T-stat = -5.3678
			

Table 2: Comparison of fragments responsible for the destruction of dyes for light fastness and sensitivity of dyeings to oxygen bleaching tests.

Thus, the negative (destructive) effect on dye chromophore observed in the tests for light fastness of dyeings on wool, polyamide, and cotton, as well as the sensitivity of dyeings on wool for oxygen bleaching, are controlled by the following fragments shown in Table 2:

- ✓ Primary or substituted aminogroups;
- ✓ Azo-bond as a part of a chain of conjugated double bonds with primary or substituted aminogroups;
- ✓ Aromatic chain and nitrogen atom of azo-bond.

Positive (stabilizing) effect on the dye chromophore observed in the same tests is explained by the fragments (not shown):

- ✓ Azo group as a part of a chain of conjugated double bonds;
- ✓ Azo group as a part of a chain of conjugated double bonds and sulphonic group;
- ✓ Azo-bond as a part of a chain of conjugated double bonds and carbamide group.

The similarity of selected fragments for the models for wash fastness and dyeability of wool and cotton shown in Table 3 as an example also demonstrates correspondence of adsorption/desorption mechanism of dyes on fibres of different nature. Non-coinciding descriptors for each family of dyes show individual behavior of different fibres.

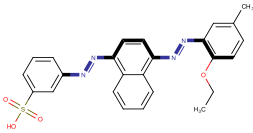
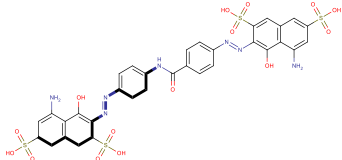
Wash fastness - wool	Adsorption - cotton
Fragments containing two azo-bonds in a chain of conjugated double bonds, negative impact	
Coeff5= 0.199498, T-stat= 3.3687	Coeff8= 0.002434, T-stat= 5.8381
	

Table 3: Comparison of fragments responsible for positive impact on wash fastness and sorption of dyes on wool and cotton.

Comparison of the models shows that wash fastness of dyeings on wool and adsorption on cotton fibres exhibit the positive influence of the following fragments:

- ✓ Two azo groups as a part of a chain of conjugated double bonds.
 - ✓ Chain of conjugated double bonds containing azo group and hydrophobic substituent.
- In contrast to the above, several similar fragments (not shown) exhibit negative impact:
- ✓ Aromatic chain with a sulfonic group as a substituent;
 - ✓ Azo group as a part of chain of conjugated double bonds with hydrophilic substituents -NH₂ or -OH.

CONCLUSION

Chemoinformatics analysis of colour, colour fatness properties and chemical constitution of a large family of water-soluble azo dyes is performed.

It is found that maximum absorption wavelength is increased with the total count of non-hydrogen atoms of any dye molecule, azo-bond connecting two conjugated chains demonstrates negative impact, while terminal sulphonic group of such a fragment displays a positive impact on that quantity.

Comparison of the results of several models shows similarity of 1-3 from about 10 individual multiatomic fragments for acid and direct azo dyes adsorbed on wool, polyamide and cotton fibres. Wash fastness and dyeability of wool and cotton also exhibit similarity of selected substructural fragments.

ACKNOWLEDGMENTS

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The use of Adobe Capture CC to evaluate colour schemes in Ashiya City advertisements

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ABSTRACT

This research examines the practical use of the portable smartphone app Adobe Capture CC for assessment of colour schemes in outdoor advertisements from the viewpoints of urban landscape design and colour science. The purpose is to offer an option in order to record and find conspicuous colours in easy-to-view outdoor advertisements that may not harmonize with the environment. This research attempts to apply digital colour charts produced by Adobe Capture CC to evaluate whether or not a city landscape has a harmonious colour scheme within a given environment. The reasons for using the app Adobe Capture CC are as follows. It organizes colour information of outdoor advertisements and analyzes its chromatic relationship with the surrounding environment to improve the quality of landscape design. As a sample case, four examples of hundred outdoor advertisement images taken in Ashiya City, Hyogo, Japan, are examined. This paper focuses on the “Ashiyagawa River Special Landscape District” along the Ashiyagawa River because it has been found that this district is important to Ashiya City with regard to the main landscape of the city and the citizens’ primary activity area. By comparison with the Landscape Ordinances for Outdoor Advertisement of Ashiya City, the authors assess acceptable or unacceptable cases of colour schemes of advertisements in Ashiya City. Besides, the analysis of the advantages and disadvantages of the Adobe Capture CC assessment method can improve the precision of landscape colour scheme assessments.

Keywords: *harmonious colour scheme, Adobe Capture CC, Ashiya Landscape Act, outdoor advertisement, environmental colour*

INTRODUCTION

In July 2009, Ashiya City designated the entire city as “Ashiya Landscape District” (2006) stipulated in the Landscape Act. In addition, the area along the Ashiyagawa River, which is a main scenic terrain covering 42.6 hectares and divides the city into the northern and the southern sectors, was declared “Ashiyagawa River Special Landscape District” (2012). From the perspectives of colour science and urban landscape design, this paper examines colour schemes of outdoor advertisements within “Ashiyagawa River Special Landscape District” and aims (A) to assess the colour schemes in outdoor advertisements using Adobe Capture CC photo and colour chart; and (B) to find conspicuous colours of advertisements which may not harmonize with the environment, i.e., the urban landscape

environment including buildings and greenery, according to “Design Guidelines for Advertising Signs in Ashiya City” (2017).

Among visual information, outdoor advertisements reveal to be important points of fixation holding most frequently the viewer’s attention (Higgins et al., 2014). This paper provides descriptions of outdoor advertisements with respect to their surrounding environments not only based in compliance with the landscape ordinances and the city guidelines, but also from the perspective of the authors. The purpose is to present a colour science and urban landscape design approach that can be used to fuse easy-to-view outdoor advertisements into their surroundings.

The Design Guidelines for Advertising Signs in Ashiya City were issued in April 2017 (Design Guidelines, 2017). These guidelines mainly include the city’s outdoor advertisement districts on advertisement regulation region maps and list information such as prohibited items, exceptions, and easing measures pertaining to shape, dimensions, area, quantity, height, colour (using Munsell notation) and other conditions for outdoor advertisements. Kitamura et al. (2008) have published a study on colour instructions in the environment. The reasons for using Adobe Capture CC consist of recording and organizing colour information of outdoor advertisements as an evidence of landscape colour assessment.

SCOPE

This research focuses on the “Ashiyagawa River Special Landscape District” along the Ashiyagawa River because it has been established as an important district of Ashiya City from the points of view of the main landscape of the city and the citizen’s main activity area. Four places with noteworthy colouring were selected in the Ashiyagawa River area, running from the upstream to the downstream. These places were numbered, listed, and organized according to location and assessment. The examples were divided into three categories: “Public,” “Manner” and “Commercial.”

1. “Public”

Public outdoor advertisements mainly installed by public organizations such as Ashiya City or the Police Department. Example: Sarumaru Oshotokuhi Monument and Sasameyuki Monument, Hankyu Ashiyagawa Station Northeast Side (Figure 1).

2. “Manner”

Outdoor advertisements related to public manner installed by public and private organizations as well as individuals. Example: Public manner signage displayed along Ashiyagawa River, such as exits and entrances of stairs along the river (Figure 2).

3. “Commercial”

Private outdoor advertisements including private companies with a high level of public nature. Examples: Hankyu Ashiyagawa Station South Side and commercial store advertisements (Figure 3); and, D-Parking, Hankyu Ashiyagawa Station South Side (Figure 4).

METHOD

The authors took pictures of over 100 outdoor advertisements and divided them into the above-mentioned three categories: “Public”, “Manner” and “Commercial”, and narrowed them down into four cases of significant environmental impact. The pictures were taken with an illuminance of over 30,000 lux when the weather was clear and sunny. The pictures of each category are listed along with a colour chart, Munsell value notation, and the authors’ analysis and assessment of the outdoor advertisement clarifying how the colour scheme can be improved within the surrounding environment. A colour chart was created, and RGB values were calculated from the case pictures using Adobe Capture CC. Then the RGB values were converted into Munsell values using CC Colour Converter. Five colours were extracted using a colour picker from the most prominent colours in the picture of outdoor advertisements. The order was established as follows.

- (1) Most prominent colour on outdoor advertisement surface.
- (2) Most prominent colour on advertisement text.
- (3) Second most prominent colour on outdoor advertisement surface.
- (4) Second most prominent colour on advertisement text.
- (5) Prominent outdoor advertisement surface background colours or text, structure colours

except the ones listed under the points 1 to 4. When it is difficult to determine the predominance of a colour, the colours are selected on a visual basis according to their predominance, identified with the colour picker, and recorded.

ASSESSMENT

On the pictures discussed below, a colour chart and the Munsell values are listed on the top of each picture. As well, the area which are chosen by the Adobe Capture CC is identified by numbers along with red-coloured arrows inserted onto the picture. Important was the assessment of the overall environment with focus on the overall harmonization of the advertisement with the landscape and not the exact measurement of the Munsell values of the outdoor advertisement details.

The following is a description of the markings.

City office ○ = Compliance with landscape ordinances.

City office × = Violation of landscape ordinances.

Authors ○ = Positive overall assessment of outdoor advertisement from a landscape architect point of view.

Authors × = Negative overall assessment of outdoor advertisement from a landscape architect point of view.

DATA

Assessment was carried out through taking pictures of outdoor advertisements and providing assessment and descriptions of outdoor advertisements and surrounding landscape using colour charts and Munsell values.

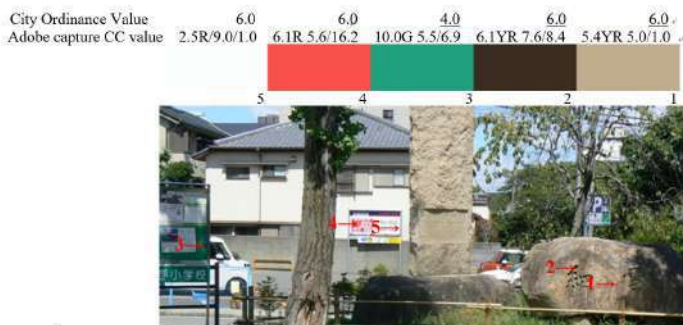


Figure 1: Sarumaru Oshotokuhi Monument and Sasameyuki Monument, Hankyu Ashiyaga-wa Station Northeast Side. City office ○ Author ×.

In Figure 1, two monuments related to important figures in Ashiya are located next to each other. There is a city public information board on the left and a private parking lot sign in the background center. The red of the parking lot sign has a high chroma level of 16.2, which devastates the harmonious balance with the colour of the stone monument and its configuration. To prevent this problem, outdoor advertisements should not be allowed at all directly in front of these important commemorative monuments.

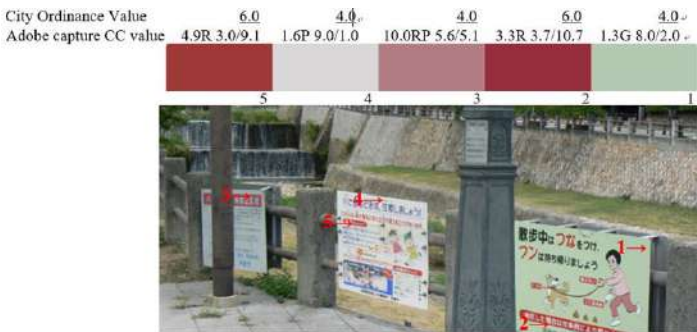


Figure 2: Public manner signages along Ashiyagawa River: exits and entrances of stairs along the river. City office ○ Author ×.

Public manner signages create a disorderly landscape at the entrances of rivers (Figure 2). These signs generally give warnings such as information about barbecues, playing in the river, and dog walking, so the red colour intensity is high at 10.7 and the panels have many colours, which together gives them an unruly appearance conversely disabling their ability to give warnings. It is necessary to decrease the size and quantity of the outdoor advertisements along with gathering them in one place and unifying the colour scheme to improve these issues.

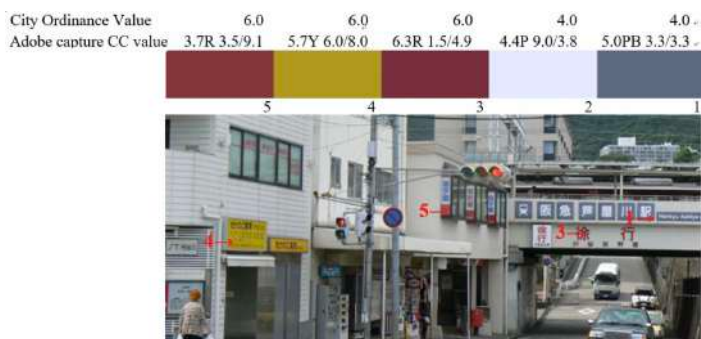


Figure 3: Hankyu Ashiyagawa Station South Side and commercial store advertisements.

City office ○ Author ×.

The quality of the outdoor advertisements on the elevated Ashiyagawa Station is not up to the level of a station which is the most important part of an area (Figure 3). The station name is limited to white text on a solid blue surface, and the “slow down” sign (with a red intensity level of 4.9) should be removed. The protruding windows adjacent to the station are classified as indoors so they are not a violation of the landscape ordinances, but the way they are perceived is the same as if they were outdoor advertisements. This is a loophole in the outdoor ordinances. The two yellow signs on the left (with yellow intensity levels of 8.0) can be improved by adjusting the size and height.

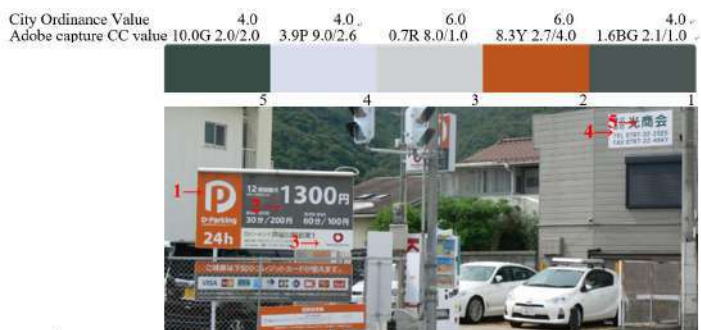


Figure 4: D-Parking, Hankyu Ashiyagawa Station South Side.

City office × Author ×.

In the Ashiyagawa River area, the orange colour value (with a yellow intensity level of 4.0) already exceeds the landscape ordinances (Figure 4). An area up to five square meters is allowed in the landscape ordinances, but in the adjacent commercial sign, the price indication on the sign display area is larger than necessary and it does not contribute to landscape improvements. There should be a greenery atmosphere with a hedge, so the cars would be hidden. The use of vending machines as a part of the landscape has been discussed in the city office. This vending machine is an outdoor advertisement which should be prohibited.

CONCLUSION: ADVANTAGES AND DISADVANTAGES

Advantages

The advantages of the Adobe Capture CC assessment method are as follows: (1) Colour effects as well as RGB values and Munsell values can be organized on a colour chart. (2) The colour chart uses numerical values to enable comprehensive landscape assessment on harmonization with the surrounding environment. (3) As a portable smartphone app, it is easy to carry and record environmental colour schemes outdoors.

Disadvantages

(1) One of the disadvantages of such a method is that colour values may differ depending on surface light reflection and shadow of selected areas by Adobe Capture CC colour picker. (2) The colour of specific points in outdoor advertisements is not determined to be compliant with landscape guidelines through only measuring colours. (3) Another disadvantage is that this evaluation method tends to be a subjective judgement.

Assessing harmony tends to be subjective since harmonious landscapes do not consist of just only colour but also of design style choices, such as typography or pattern. However, we conclude that Adobe Capture CC can be a handy tool to record and assess colour schemes, including advertisements, as to whether or not a colour disturbs the harmony of an environment.

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Emerging colours in contemporary urban environments: New demands and challenges

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ABSTRACT

The concept of colour in urban contexts has been traditionally associated with architectural colour palettes or urban colour planning. However, since the beginning of the new millennium (2000–today), colours are presented in dramatic ways and more saturated palettes have been emerging in many urban environments, contrasting with the general whitish or grey architectural environment. This paper looks into the “colourful” phenomenon occurring globally and argues that compared to the traditional environmental colour design, those emerging colours have new distinct features varying from design intentions to design impacts. Focusing on projects in urban public space, this paper positions the phenomenon in the contemporary urban context and attempts to explain the conditions and driving forces behind the appearing colours. By analyzing examples from the phenomenon, this paper argues that colour has been engaged as an active design element to respond to the shifting roles of urban public spaces and the new demands from increasing factors such as social media, commercial promotion and publicising ideas. Furthermore, these factors also accelerate the prevalence of the emerging colours which are becoming a notable tendency worldwide. From the aforementioned discussions, this paper suggests that it is time to critically review and evaluate the phenomenon as part of contemporary urban and landscape design culture. Only with a comprehensive understanding of the phenomenon can we have the updated references for environmental colour design in contemporary urban contexts, which allows colour to act effectively to serve diverse purposes in urban environments.

Keywords: *colour, environmental colour design, contemporary urban environment*

INTRODUCTION

Colour has always been a controversial element along with the history of architecture in Western culture. With prejudices to colour and the uncertainty when using colour in architectural design, the general image of built environments has been whitish or grey. However, since the 2000s more colourful places are emerging in urban environments. Unlike the conservative colour palettes in traditional environmental design, the “new” colours are more vivid and bright and stick out easily from the surroundings. Apart from the colour on architectural façades, the emerging colours have also been introduced to urban environments in forms of street art, temporal installation, urban design and landscape design. To have a better understanding of how the “new” colours interact with contemporary urban contexts from a design perspective, this paper focuses on design projects in urban

public spaces in which the colour design is a collective decision and responds to certain demands in the environment. Therefore, in this paper, the emerging colours mainly refer to the growing numbers of design projects characterized by saturated colours in urban public space that are distinct from the surroundings. Through the general comparisons between the phenomenon and the traditional environmental colour design, notable differences and tendencies of colour design in contemporary urban environments can be identified.

DIFFERENCES AND TENDENCIES OF COLOUR DESIGN IN THE NEW PHENOMENON

The role and functions of colour

Architectural colour design and urban colour planning are the major branches of traditional environmental colour design in urban contexts, which have been profoundly influenced by the perspective on colour in architecture. In architectural discourses, colour has been deemed secondary to form (Braham, 2002: 2–4) and a less important element which mainly serves decorative purposes (Caivano, 2006). For many architects, colour is an intractable element that should be carefully controlled, while “safe” colour palettes are preferred in general (McLachlan et al., 2015: 16). In both academic research and practice, researchers and architects have been looking at the principles that make a colour design fit with the environment and look harmonious, which in many cases means colour being an unobtrusive element in the design. Although the potential and function of colour in environments have been revealed in many research studies (e.g., Lenclos and Lenclos, 2004; Swirnoff, 2003; Mahnke, 1996), the role of colour remains ornamental or ambiguous in many traditional environmental colour design projects.

However, instead of being used passively, the role and the function of colour have been redefined in the emerging phenomenon in which colour has been used as an active tool to achieve specific design intentions. Fresh views and open attitudes towards bold and saturated colour in art and design have been introduced to the public through several movements since the 1960s. The general acceptance and greater freedom of using colour inspired more colourful expressions in urban environments. With the recognition of colour’s potential and effects, designers have begun to endow colour with specific roles and functions in urban public space over the last few decades. Learning from former practices such as Supergraphics during the 1960s and the prevalence of billboards, colour has been applied in urban and landscape design due to its ability to catch attention, communicate visually and provide instant changes. Examples can be found in many urban intervention projects such as Superkilen Park (2012) in Copenhagen, Pink Street (2011) in Lisbon, and Garscube Landscape Link (2010) in Glasgow, where vibrant colours were introduced to urban environments to raise attention and claim the renewal of the place. Bright colour palettes applied to a large scale are believed to have positive psychological effects (McMorrough, 2007: 71–72), and the distinct characteristics of colour give the place a clear identity.

In other projects, the selection of colour palettes is more specific and allows colour to serve different intentions at one time. Delivered right after the announcement of the new Nike and Pigalle fashion collection (2017), the urban intervention project of Pigalle Basketball Court (2017) in Paris refers to the corresponding colour palette from the fashion collection. Fresh colours have been selected strategically to create a vibrant and dynamic sport place for the local community, while at the same time the colour design contains the function of promotion. The popularity of this colourful court on the web, and in reality, attracts more attention for the fashion collection which shares similar hues.

In this project, the colour palette creates connections between the urban public space and fashion products and plays a clear role in drawing attention and in branding.



figure 1: The Pigalle basketball court in Paris (left). Photo: S. Michelini, 2017, <https://www.archdaily.com/875105/pigalle-duperre-ill-studio>. And the fashion collaboration between Pigalle and NikeLab (right). Photo: Nike News, 2017, <https://news.nike.com/news/nikelab-pigalle-air-shake-ndestrukt>.

The associations between colour and cotemporary cultural icons make particular colours or colour combinations a powerful tool for communicating and publicizing ideas in urban environments. As a part of the annual summer celebration in the Gay Village of Montreal, an art installation that contained over a hundred thousand pink balls was suspended above the street to celebrate its culture between 2011 and 2016. Inspired by the rainbow flag of the LGBTQI community, the present edition of the art installation uses different colours of the rainbow (Cormier, 2019). The bright hues create an atmosphere of celebration while the symbolism of colours in this certain context expresses the intention of supporting the diversity of society. The vibrant colours with embedded meanings not only appeal to groups who share the same culture but also general audiences who enjoy the colourful scene. The abovementioned examples show that in these new projects the colour design directly responds to the contemporary urban settings, and saturated colours are selected intentionally to provide solutions for specific situations in urban environments. Instead of being an inconspicuous element in the built environment, the new colour scheme often creates a huge contrast to the original environmental colour palette on purpose to introduce instant changes to the environment. In the emerging phenomenon, the decision of colour is no longer limited by the framework for colour design in architecture and urban colour planning but open to broader options based on a better understanding of colour's role and function in urban public space.

The participants of colour design

In traditional environmental colour design, decisions on colour are made by architects and professionals from relevant backgrounds, who give preference to neutral colours and “safe” colour palettes despite the significant changes in architecture (McLachlan et al., 2015: 16). Doherty (2010: 2) also argues that there are not many voices heard from urbanists about their opinion on colour and it seems that artists are more comfortable with colour than urbanists. It is unfair to assume that most architects are less familiar with colour compared to designers and artists. However, it is notable that professionals from different disciplines may have various opinions and expertise in colour. Over the last two decades, more designers from different backgrounds began to express their ideas about colour in urban environments. The increasing numbers of interdisciplinary collaborations in urban and landscape design and the prosperity of public art encourage the appearance of new colour expressions. More

saturated colour palettes that have been frequently used in interior design, graphic design, fashion and art have been introduced in the urban settings, which blur the boundary between environmental colour design in urban contexts and other disciplines. Artists such as Carlos Cruz-Diez, Morag Myerscough and Felice Varini mark the urban landscapes with their signature colour palettes which are commonly used in their artworks. Besides expanding the range of colour selections, designers and artists also introduce the materials and skills that they are familiar with to the urban environment to generate different colour effects. Materials such as acrylic paint, PVC and fabrics allow the colour to be presented in various forms and locations rather than being limited to architectural façades. As the colour design can be a result of different disciplines, corresponding reference systems should be built to evaluate the emerging colours in urban environments.

The target groups

Lenclos (2004) considered the association between regional colour palettes with local identities with his concept of *The Geography of Colour*. Colour has been used as a way to express cultural identity and maintain a sense of place within a certain community in vernacular architectural environments. Lenclos's study implies the group who made the decisions of colour were also the audiences (the target group). Since the 1960s, studies on colour in the environment have explored the relationship between architectural colour design and elements including space, form, structure, light and function (e.g., McLachlan et al., 2015; Nemcsics, 1993), principles for urban colour planning (e.g., Brino, 2009; Spillmann, 2009) and environmental colour design in a contemporary context (e.g., Lenclos 2009; Porter and Mikellides, 2009). However, except for referring to colour preferences in practical designs, in general, no particular groups have been addressed as potential audiences in traditional environmental colour design. Nevertheless, in many cases of the emerging phenomenon, the design of colour is tailored to specific groups. Bringing into play trendy elements from popular culture among young people, sports courts around the world, especially basketball courts and skate parks, have been renovated with dramatic colour palettes, which seem to be more welcomed by young people. The colourful environments also accommodate and encourage other popular activities among the young generation such as taking selfies and making YouTube videos. Saturated colours can also be found in crossings and pathways designed for pedestrians and cyclists in many cities. The bold colours rise the attention when travelling through traffics and work as signage for wayfinding while helping to claim the territory for people in car-dominated cities.

The exaggerated colour expressions can also be found in places or exhibitions in urban environments designed for attracting tourists who are looking for photogenic scenes. The increasing flows of visitors invigorate the areas by bringing more opportunities to local business and improving the public safety according to Jacob's "eyes on street" theory (1961: 36). Last but not least, the emerging colours in urban public spaces interact with current Internet culture in an intensive way. Besides the actual users of the digital virtual space, embedded in the function of branding and promoting, the colour design is aiming to get the attention of potential audiences online. Eye-catching colours or colour palettes are selected in urban design to create an "instagrammable" scene that boosts the broadcasting of the image among social media. The bright colours create a strong and recognizable identity of a place in no time and hashtags for people to communicate online. The fast spread of the colourful images on social media, in turn, attracts people to the place. On the other hand, the popularity of certain colours or colour combinations online also influences the decisions about colour in design projects. Colours such as red, pink and rainbow colours can be spotted around the world in urban and landscape design despite their geographical location and other regional factors.

REASONS BEHIND THE EMERGING COLOURS IN URBAN ENVIRONMENTS

Based on the aforementioned discussions, this paper proposes that there are four main reasons contributing to the increase of colourful places in urban environments since the 2000s.

First, above all, the development of better technology for colour application ensures the conditions for colour expressions in outdoor environments. The availability of pigments and coloured materials that are resistant to water and sun enables the colour application to meet the design requirements. A wide range of materials available in different colour options gives designers the freedom to experiment with the performance of colour.

Second, the acceptance of, and interest in, saturated colours have increased since the 1960s, and have been reinforced through Internet culture after the 2000s. Both general audiences and designers seem to have more positive attitudes towards the new colours in urban environments. With the increasing participation of artists and designers from different backgrounds in environmental colour design, fresh perspectives and new colour palettes have been introduced to urban public spaces.

Third, the two reasons mentioned above are the preconditions for the phenomenon, while one of the driving forces behind the emerging colours is that, when used strategically, colour has the capacity to meet different demands in contemporary urban environments. Public spaces always play an important role in social and economic life in the city. Gehl and Gemzøe (2001: 10) further explain the traditional role of urban public space and state that “public space has always served as a meeting place, marketplace and traffic space.” However, in contemporary urban contexts, public spaces are endowed with more sophisticated roles and are expected to respond instantly to different requirements. Unlike the traditional public spaces which have specific functions and fixed property, the public spaces nowadays are supposed to accommodate various activities such as pop up events, art exhibitions, commercial promotions at one or different times. As a design element, colour is able to transform a place instantly and provide a new identity for the everchanging role of urban public space. Moreover, with the rapid growth of modern cities, more undefined or underutilized spaces are appearing in urban environments. Spaces including roundabouts, underpasses, parking lots and utilitarian paths sometimes become undesirable or even unpleasant for urban life. Regardless of the existing conditions, the application of vibrant colours can bring positive changes to these urban voids by creating new attractions, activities and psychological comfort. Besides being used for urban interventions, the function of colour of communicating visually has been recognized and applied in branding, wayfinding, and publicising ideas in contemporary urban environments in which the exchange of information is becoming more and more important and frequent.

Fourth, as stated above, another notable reason behind the rapid growth of the phenomenon is the increasing influence of Internet culture since the 2000s. The saturated colours in urban public spaces meet the demand of an enormous upsurge in photogenic scenes among social media. Due to fast broadcasting online, the popularity of colourful scenes inspires and encourages more similar cases worldwide. Being aware of the positive influence and potential impact, more and more designers have begun to involve popular colours in their designs in an attempt to reproduce the success in different places. The preferences and demands of saturated colours in Internet culture in a way promote the widespread presence of saturated colour in contemporary urban public spaces.

CONCLUSIONS

By looking into the contemporary colour design in urban environments, this paper argues that a design

phenomenon that characterized by saturated colours is emerging in urban public spaces since the beginning of the new millennium. Compared to the traditional environmental colour design, colour has been used as an active design element to respond to the new challenges in urban public spaces and the demands from different aspects. Although we can catch a glimpse of the importance and the potential of the phenomenon by observing and summarizing the current examples, many crucial aspects remain unknown, such as the relationship between the “emerging colours” and traditional environmental colour design, its impact on social lives and economic lives, and the future prospects of this type of colour application in urban environments. Therefore, this paper argues that systematic research on the phenomenon is required to clarify the functions and the impact of the “new” colours, which will provide references to understand and evaluate the phenomenon as part of contemporary urban and landscape design culture.

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Golden, gilded: Cultural reflections on shiny appearance in art and architecture

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ABSTRACT

The aim of this paper is to focus on the use of the colour gold in contemporary architecture. Gold has always been a precious metal used in a representative way. Its particular, vibrant yellow attracted men from prehistoric times until the present. In the case of secular use, the powerful acquired gold possessions, or a surrogate, as a symbol of an achieved status. There are not many buildings showing an envelope finish using this vibrant material. Some examples are the church domes or some exterior wall decorations in various historical periods and art movements (Renaissance, Stile Liberty, Art Nouveau, Arts and Crafts, Vienna Secession, and more). Instead of gold, many substitutes came up to imitate the metallic colour, its shininess and its reflection. The use of gold in the outer part of buildings was limited to express publicly what must be a common sentiment. But the utopia of egoism, as written by Lucretius in Book Five of *De rerum natura*, begins when men discovered gold and private property. Now the private message seems to be used as a self-reference, expressed by gold possessions. The global economic empire era moving to private what once was public and sacral, has no meaning to justify its use. The present research shows that our confused contemporary times have little idea of the meanings of gold in contemporary architecture.

Keywords: *golden architecture, gilded, shiny yellow colour, cultural history of gold, appearance*

INTRODUCTION: CULTURAL HISTORICAL REFLECTIONS ON GOLD

Gold is known since prehistoric times. It is even very likely to have been the first metal used by humans before copper. Maybe that assumption is justified by the fact that gold melts at a temperature slightly less (c. 1064°C) than copper (c. 1083°C). This record is associated with a peculiar feature: it is not attacked by the air, water, and most chemical reagents. This property makes gold a durable material and therefore greatly appreciated and also used symbolically.

Being highly ductile, gold is usually produced in alloy with other metals to improve the aesthetic and mechanical properties. The union of gold, copper and silver forms the most common alloys. Then there are intermetallic alloys using metals such as aluminium, gallium or indium. There are also surface treatments such as polishing, coating, and all those typical finishes applied to many other metals. Gold lends itself to special surface treatments involving heating in oil and strong cooling; electroplating, which makes use of the rhodium or ruthenium; chemical vapour deposition; and controlled oxidation that occurs with chromium or cobalt. From the point of view of colour, gold can take on various colours

according to the different alloys. Gold may tend to white, pink, green, yellow, purple, blue, or black. However, in the minds of men the colour of gold is a very bright, shiny, metallic yellow. By definition 100% pure gold is 24 carats. The most common alloys are 18k (75% gold), 14k (58% gold), and 9k (38% gold). These properties have acted in the collective imagination giving rise to the use of gold for representative, metaphysical and artistic purposes. From the beginning, its main use was the creation of ornaments, jewellery and ritual objects. Jewellery, in fact, was the work of those who had the knowledge and skills to use it. Somewhere between art and technique this craftsmanship, along with the high cost of the raw material, forged the unthinkable. For its golden glare, gold has always been compared to divine prerogatives: "In ancient theological syncretism, the king was god and god was the king and this reciprocity was made explicit [...] by the use of the precious metal" (Luzzatto and Pompas, 2001: 193).

To the ancient Greeks, gold was the material related to immortality. The value of gold originated from ancient doctrines merged into Neo-Platonism that brings back to the unit the multiplicity of the universe. It was deduced that all the elements are composed of the same golden substance, identical in each element, but in different proportions.

In Roman times, there are countless innovations and gilded works. Just think of the *Domus Aurea*. The architects *Severus* and *Celeris* erected the *Domus Aurea Pavilion* on a dominant location of the southern slope of *Colle Oppio* in Rome. The size of the Palace of Nero, built after the fire of 64 CE, was enormous – in the words of Pliny the Elder, "The Domus Aurea encompassed all of Rome" (77–79 CE: 154). The profusion of colours, materials and precious stones had no limits. Rich marble, gold and gem claddings were often used in interiors; the ceilings may also be covered with ivory. Even to the Romans the golden colour constituted a sign of greatness and immortality.

In India, the colour gold represents the truth. It is an important colour for Buddhist mysticism. In fact, in Tibetan regions the statues are frequently painted with gold. In particular, the Buddha statues are often completely gilded with 24-carat gold leaves. This practice clearly reflects the talent of Tibetans to work with gold. The golden colour indicates the Sun, the sacred fires or the emotional ones. The metal gold is connected to *Surya*, which means "Sun," a deity of the Hindu pantheon. In essence, in Buddhist artworks, this colour is used to trigger emotions in the faithful, exactly as it is with other religions and philosophies.

In the Chinese alchemical treatise, "The Secret of the Golden Flower," the golden flower is a symbol of enlightenment. Here, gold is considered the metal par excellence, while being represented by white, according to Taoist Lǚ-Tzu. In Chinese tradition and Tantrism, however, the colour of gold is yellow, a colour corresponding to the Earth element.

In monotheistic religions, basically originating from previous beliefs, the meaning of gold is mainly identical to polytheistic ones. In the Old Testament, gold is interpreted as wealth, and as is typical of the contradictions found in all beliefs, it is abhorred as much as it is seen as necessary. Victorious powers aim to destroy aspects of the history and tradition of the enemy even though they do not come up with a new model but shift to imitate previous customs.

Meanwhile the gilding technique becomes more and more refined, and the meanings tend to consolidate. In the Romanesque period, Giotto and many other artists of that time painted on wooden panels with a golden background, on which the images of new religious mythologies emerged.

Similarly, in Orthodox-dominated areas, the tradition of icons takes shape, making extensive use of gold-plated backgrounds on which are painted – according to stylistic elements staying unchanged over time – images of a deity, of saints and the stories to be conveyed. With icons each colour has its own meaning that has also remained unchanged over time. Gold is not considered a colour, but a

reflection of light, taking on the meaning of royalty, which is covered by the deity. As can be seen, nothing different compared to what happens in other religions.

While the traditions of Muslims and Jews forbid the use of anthropomorphic images preferring calligraphy as a means of expression, with inscriptions often gilded, Catholics developed a world of pictures, sculptures, reliefs, and any other artistic works to celebrate their own belief often using the colour gold.

The preciousness of gold led to the use of gold leaf to demonstrate the achievement of wealth and to shock believers. Just remember the work of Lorenzo Ghiberti's golden doors of the Baptistery of Florence, but also the domes of mosques or churches. Power and religion competed to establish their authority and often exceeded their mutual boundaries of power. This conflict was not only produced by territorial conquest, but also prompted a fierce competition in the realms of culture, art and architecture.

These generally are the origins of the meaning of gold for humans. Thus far, there has been no discussion of currency, which since time immemorial is coined in gold. Money is a very important, and sometimes decisive, argument for architecture.

GOLD IN ARCHITECTURE

As mentioned above, gold is mainly used to produce furnishings, jewellery, and furniture. The interiors are the privileged spaces for the profusion of walls and decorations that make great use of gold. Above all, the power (emperors, kings, and other rulers) and the church (popes, bishops, and other religious heads) competed to demonstrate their sovereignty (Figure 1, center two). Obviously, the risk of exposing the valuable material had to be reduced, and to put gold in the outside of buildings was avoided, especially in times of absolute poverty of peoples. The only place where the ostentatiousness was allowed, and enjoyed a kind of insurance, were the places considered sacred. The fear of furious divine punishment for a theft perpetrated within a sacred place, gave these places a certain immunity. It is obvious that in the case of war the first places frequented by the enemy are churches and palaces, for the high probability of finding items of high value to take. Theft, in fact, is inherent to the presence of gold. In order to gain personal profit, theft is often planned, imagined, dreamt and even arranged with others to give satisfaction to an instinct for possession of other people's things. In fact, gold contains the seeds of the theft, the aspiration to lawful or unlawful possession.

Faced with this aspiration, men have fantasized about for a long time. The alchemists described in their treatises the search for the philosopher's stone. They practised the transmutation of cheap metals into gold through production processes with original and imaginative proposals and solutions. On the other side, more and more knowledge of procedures for gilding were developed. The casting technique, which employs a lot of material, was replaced by the use of gold leaf or foil. The thin layer of metal is applied to surfaces by hammering or by cohesion. The techniques are refined to the point that even the outside of buildings can take the resplendent golden colour without exhausting the gold reserves. Applying a great technique and talent, accompanied by a good dose of wishful thinking, even the exterior of architecture can be golden.

There are several historical examples related to both religious and civil buildings. The gilding was a technique very common in Medieval, Byzantine and Renaissance art and architecture, especially in those where the gold leaf was used in paintings on wooden panels. Gold's resistance to corrosion allowed these paintings on wooden boards to survive with undiminished splendour. But it is in architecture that the size of the buildings magnified the effect of the presence of gold by changing the

environment in which they are located. Gold applied on the buildings' exteriors becomes representative and materializes the meaning attributed to the space despite orography and weather conditions. Being the emblem par excellence of power and religiosity, the material and colour of gold have served men wishing to show their social position through golden artworks, even though art is often not present. Emperors, kings, noblemen, merchants, and patrons are the first to show off their power by the means of architecture. This is primarily performed in the presence of gold, jewels and other extremely rare objects. For its part, art, the servant who can guarantee its subsistence, adapts offering its thinking and skills. The Secession Building (1898) in Vienna designed by Joseph Maria Olbrich is an example of the shift of power from the nobility to the trade. The dome consists of thousands of laurel leaves (symbolizing the consecration of Apollo, god of the Arts) made of copper covered with gold foil (Figure 1, left two). The sponsor of the building was Karl Wittgenstein (father of philosopher Ludwig), a steel industry tycoon of the newly formed Austrian bourgeoisie. We may assume that the sense of the use of gold in architecture changed radically with the advent of the industrial revolution (1830s), and in particular with the second industrial revolution beginning in the 1870s.



Figure 1: Secession Building (1898), Vienna (left two). Photo: Thomas Ledl, and Greymouser, Creative Commons, Wikipedia; Russian Orthodox spiritual and cultural center (2016), Paris (center two). Photo: Wilmotte et Associés; Prada Foundation (2018), Milan (right). Photo: OMA Architects.

While the machines and transportation means were primarily metallic, with the transfer of power from the noble to the bourgeois, the new economy had the need to create a new ideology, which, as in the past, cannot be severed from the past. Nothing better than to use gold to prove wealth. But while the noble landowner had the political power, and also governed the minds, the merchant bought them. Consequently, the latter, in order to speculate, invents the representation, the marketing, the advertising, to appear rather than to be. In fact, golden architectures become less and less numerous, but at the same time, there is a dramatic increase of gilded surrogates. Contemporary architecture, with achieved technological perfection offering the availability of any material, does not need to make use of the valuable material, because it developed a knowledge of how to make copies more “real” than the original.

CONTEMPORARY GOLD: SHINY APPEARANCE

Collapsed ideologies forced the deletion of every symbol so important to celebrate eternity. Lifestyles have changed as well as places to spend one's life, but it seems that nothing has acquired the right to be imperishable. Consequently, any celebratory architecture has no sense anymore. These kinds of buildings are literally dismissed, because they have lost the sense of their existence. The fleeting, ephemeral buildings have changed and represent a time when nothing is longer than an instant, a distraction. Surrogates replace gold as a solid material.

The continuous variation of parameters underlying the built, as well as the perception and interpretation of architectural artefacts, meant there was no time for stabilization, replacing itself with itself. Obsolescence is the parameter that measures the duration of things. Not to get in the game becomes necessary to struggle continuously against entropy (Arnheim, 1971), as nature strives towards disorder, even in all what humans do, but entropy is indifferent to humans and to the space in which they act. Men act against entropy, knowing that entropy will destroy everything bringing equidistribution between all the parts. Architecture, in its physical manifestation, is at the highest level to challenge human making. In contemporary times, the challenge has reached the highest level of contradiction and unprecedented representation. Technology that influences architectural production, suffers a kind of delirium. The dominant present condition weakens any chance to recover the thought, which is confronted with unexpected situations, never experienced before.

Nowadays we buy the right to exist, but it is not the traditional way of representation using golden jewels or displaying property. At present, the “selfie” is the maximum expression and means of representation. The largest possible number of viewers show us that we have the right to exist. Therefore, the image seems to be the only one able to settle the questions and determine our existence. We appear therefore we exist. Otherwise we are nobody, not even worthy of a fleeting glance. The wide dissemination of Social Media is a blatant demonstration that the perception of the physical world in its daily triviality, with its distressing and fleeting happiness, has no sense, no meaning, and is not worthy of being lived. But a radical change occurs, if daily life experiences of are transmitted to the planet of voyeurs, in a world of computer bits and algorithms displayed on electronic surfaces. Known as a “window” in the *globish* language, posting selfies guarantees the veracity of content projected onto the world screen.

Even activities in the building and design domains adapt to this new trend. The continued global expansion of the Internet multiplies information and distributes some kind of knowledge to any sector of the population, similar to the advent of printing in the 15th century that played a key role in the dissemination of knowledge to the masses. As with Gerhard Schmitt, “the Internet has become the ideal site for those interested in building in the territory of information. The beholder of an architectural rendering on a computer will not be able to tell whether these buildings are proposals or exist in reality, unless the building and the city represented are known” (Schmitt, 1998: 73). Moreover, a virtual building project costs much less than a real one. The computer simulation, in addition to being a cheap, easy and bulky design tool, able to heavily influence geometric shapes, is now an essential part of the architectural imaginary. In a sense, the information architecture has forced the architectural materiality to be subordinated to digital simulation reproducing this kind of architecture in real urban landscape contexts. The radical change also applies to users. Even lay people on the street, unable to read technical drawings, prospects or *maquettes*, which have been a project communication tool for centuries, explicitly request a computer simulation to the architect. As pointed out in an earlier publication, “contemporary culture produces, transmits and stores information in a non-material way, very different than in the past. This data storage appears to represent a turning point in contemporary architectural feasibility, in its material and cultural stage. In other words, electronics is feeding continuous variation and instantaneous communication inexorably affecting all areas, including architecture, and the future being less and less solid and durable but ephemeral” (Zennaro 2009: 149). The contemporary trend is represented by the ephemeral, the speed, the market and consumption; and everything else that does not have stability, duration, permanency, is translated into the golden colour which is the new sense of no fixation. The colour gold vibrates under the sunlight, dazzles for a moment. In current fashion, wealth clamps valuables but also lies about common things. The Prada

Foundation in Milan is emblematic of this shock, typical of marketing (Figure 1, right). Gold settles as dust, anywhere, without things being so significant. The speed of events deletes previous memories, awaiting next experiences that in turn will impress new consumers.

CONCLUSION

The utopia of egoism, as written by Lucretius in Book Five of *De rerum natura*, begins when men discovered gold and private property. Possessions seem to be inherent to humans as a biological need. The modern profit is its monetary equivalent. In contemporary times, the use of gold in architecture might be included right into this trend. Individualism in which the direction of the current idea of democracy gave a strong boost, significantly lowered the quantity and quality of public interventions. The unbridled privatization of everything that has public use is given as a gained conquest. In particular, the public enjoys architecture, especially its outer part, for its physical size. While the owner takes refuge in the enclosed spaces, the outer walls do not have much to do with individualism. This contradiction plays an important role in the understanding of our present. The presence of the rare golden examples, and several surrogates, proves that there is nothing so important to be celebrated. There is no private to be worshipped as a god, no matter how rich and powerful the person may be. He/she is one of many, as with Robert Musil, *The Man without Qualities* (1930–1943).

Then the computer era gave the final blow to the sense of material actions. The ephemeral is worth more than long-lasting due to the fact that long-lasting is not easily modifiable, or adaptable to fashion and trends. From architecture to the art of big events, all has become too cumbersome and eventually disappears behind simple façades that seek, in turn, to become ephemeral. Media buildings and screen city are the necessary steps to make contemporary what is too large and immobile. “The contemporary city seems to become more and more a communicative space where signs and symbols are renewed endlessly” (Gasparini, 2012: 1). Gold can hardly compete with a screen on which images communicate even more explicitly. The cryptic language of contemporary art and architecture has chosen ways that the common man does not understand. In architecture now, the colour gold is still producing some pathetic emotional works, but nothing more.

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УЧЕНЫЕ ЗАПИСКИ
РОССИЙСКОГО ОБЩЕСТВА ЦВЕТА

Том I

**ПЕРВЫЙ ВСЕРОССИЙСКИЙ КОНГРЕСС
ПО ЦВЕТУ**

Сборник научных статей

Под редакцией В.М. Шиндлер, Ю.А. Грибер

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