Colored Architecture is not the same as Architectural Color

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Coloring an architecture as if it were a blank canvas is very different from arranging the color cohesively with the architecture. Color can aspire to something more, and attend to coherence with the architecture to which it belongs to, be structured with its logic, help its better understanding, and serve as an expression of itself and its inhabitants. In the light of the experiences of the Color Research Group in Architecture of the Polytechnic University of Valencia, we invite to reflect on the arguments that have accompanied us when making chromatic decisions regarding architectural environments. To do this, we first study the chromatic arguments that can be deduced from the object or architectural space, that is, from physical reality. These arguments come from the logic of the use of a certain construction technology, from the logic that derives from the form and function of spaces, and from the logic of the physical context, be it urban or landscape. Secondly, we reflect on the arguments that can be derived from the interaction of physical reality with the subjects involved, taking into account the logic of the architect or designer, the logic of the inhabitant, as well as the logic of an entire society to which an architecture belongs to. The ultimate goal is to demonstrate that color can be an effective plastic resource to structure the set of aspirations that are characteristic of architecture, and that its reflection does not have to be limited to an exclusively subjective approach.

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1 Arguments for a reasoned use of color in architecture

In September 2020, the Spanish press echoed the color intervention that the artistic group Boa Mistura had painted on the exterior facades of The Alhóndiga Sports Center (Getafe, Madrid, 2002), a building designed by the architect Miguel Fisac (1913-2006) (Riaño, 2020). An intervention that colored the building on the exterior surfaces, affecting the image of the urban environment and completely altering the formal integrity of the building (Figure 1). The architectural quality of the work by Miguel Fisac is beyond any doubt, being one of the Spanish architects of reference in the rationalist architecture developed in Spain after the Civil War, and having received the National Architecture Award in 2003. Also the quality of other urban interventions by the Madrid-based artistic group Boa Mistura is beyond doubt, having intervened in an extraordinary way in other countries and urban contexts, in which they managed to involve groups of citizens to attach them with their city. However, in the case of The Alhóndiga Sports Center, Boa Mistura's intervention was highly controversial because it threatened the formal reading of Fisac’s building and the architecture team brought a lawsuit against the City Council for the restitution of the original finishes. The incident just made it clear that architectural color is more than just coloring architecture. A truly architectural color should have a coherence with the architecture to which it belongs, it

should be perfectly structured in its logic, help its better understanding, and be useful for a better expression of itself.

Figure 1. The Alhóndiga Sports Center in Getafe, work by architect Miguel Fisac. Above: Original appearance in 2004. Below: Appearance after Boa Mistura's intervention, at the festival organized by Cultura Inquieta*. Source: El Pais Digital. https://elpais.com/cultura/2020-09-25/los-coautores-del-edificio-de-fisac-exigen-a-alcaldesa-de-getafe-que-limpie-las-pintadas-de-boa-mistura-en-un-mes.html*

For all these reasons, it is worth asking what are the reasons that allow us to qualify the color of an architecture as an architectural color. Or, in other words, what should the color of an architectural environment attend to, be it an urban or natural outdoor space, or an interior space, to ensure that its layout is appropriate. Obviously there can be many aspects to attend to, but ultimately they refer to the two realities that are the protagonists of every architecture: the object and the subject. The building, understood as an architectural object, which must contain the subject, understood as an inhabitant. Also the built space, understood as an urban place, which must serve the individual, understood as a citizen. The architecture with quality is the one that is capable of ordering and orchestrating the entire set of requirements and aspirations that correspond to it: shelter and protection needs, functional needs to allow the correct performance of activities, and with the ultimate desire to improve the quality of life, and to crystallize the aesthetic, even spiritual, aspirations of the individual and society. The environmental color will be all the more architectural the better it helps to structure these aspirations, which are the ones that genuinely correspond to architecture.

Sometimes it may seem that the limits between colored architecture and architectural color are blurred, but we resist considering architecture and urban space as a simple blank canvas to be painted. If the canvas for the painter is the necessary support for true expression, which is that of color, in architecture the opposite occurs. Color is a necessary vehicle for the expression of what truly matters to architecture, which is form and space. Although it may seem paradoxical, color is rather the canvas of the architectural form and not the other way around, it is the means, not the end. Architecture is not interested in expressing color, but rather in using color to express itself.

In a way, architectural color, unlike merely pictorial color, is a reasoned, intellectualized color that is at the service of other requirements that go beyond mere artistic expression. The same can be said of the architectural form, which is much more than a simple large-scale sculpture: its full meaning is given by the possibilities it offers to shelter spaces in which the activities of life take place. Within the pictorial tradition, there have been different ways of artistic creation that have opted for momentarily keeping quiet the reason in order to work with the irrational and the subconscious. There are many artistic forms from the 20th Century whose generative mechanisms have emerged from the unveiling of the subconscious, with various surrealist traditions. Breaking free from the dictates of conscience is understood as a way to get rid of the stereotypes established by reason to delve into other levels of thought. Thus, André Brettón (1924) defined surrealism as “pure psychic automatism by means of which one attempts to express, verbally, in writing or in any other way, the real functioning of thought. It is a dictate of thought, without the regulatory intervention of reason, alien to any aesthetic or moral concern”.

Despite the fact that architectural color is always impelled by a certain level of logic or reasoning that distances it from pictorial color, in no case should that be considered a creative obstacle, but rather the establishment of rules of the game, limits to the infinite possibilities of any creative act, which allow to understand and self-understand in the decision-making process of an architecture project. The ultimate architectural color can come as a surprise in a sudden moment. That is to say, at that moment in which it seems that the different concerns that accompanied the course of a project fit into a solution that seems clean and accurate, and that is produced after a long journey envisioning possibilities and discarding the options that are less adequate. This negotiation is a reasoning that, although very intuitive, is very objective, reasonable, understandable. Much more in the field of architecture than in that of painting, the first committed to the need to respond to a function, and the second being able to be self-justified. There are numerous authors who have reflected on these mental processes involved in creativity (Pallasmaa, 2009; Berns, 2010; Huizinga, 1949).

The reflection on the limits between pictorial and architectural color has its roots in the intellectual debates that began at the beginning of the 20th century during modernity, when some of the most renowned architects on the Western scene established the intellectual foundations for a new way of understanding architecture, that was not subject to the whims of decoration and to the chance of fashionable historicisms anymore, but that, through a process of formal purification, it was getting rid of everything superfluous to become an abstract expression of itself. In this way, Le Corbusier resists color becoming a "tapestry for architecture, and the architect an upholsterer" (Le Corbusier & Rüegg, 1997). In other words, he clearly positions himself in favor of an architectural color that reinforces shaping intentions. In a similar way, other abstract avant-garde movements such as Neoplasticism

advocated a perfectly integrated color in architecture, conceived simultaneously with form. Thus, in 1923, the Dutch painter P. Mondrian came to state that "painting independent of architecture (the canvas) no longer has any right to exist" (Chipp et al., 1995). In any case, it should be noted that the positions regarding color at the beginning of the 20th century were not monolithic but very varied, so it should not be surprising to find an Expressionist architect such as B. Taut authorizing as councilor in Magdeburg (Germany), color compositions on preexisting historic façades in the city center, which definitively weakened the visual understanding of their shapes, as they could be taken as mere canvases.

This communication does not intend to reveal the intuitive processes that hide behind conscious thought to find a suitable color for the environment, but rather to describe in a humble way, what are the arguments that can be considered for a reasoned use of color in architecture. Or at least, we want to describe some of the reflections that have helped us, the members of the Color Research Group in Architecture (GICA) of the Polytechnic University of Valencia (UPV) to make decisions in the last 25 years, and which have points in common with the reflections of other color consultants such as Werner Spillmann, who studied colors “in relation to human needs and functions (psychological aspect), in correspondence to the building's surroundings (contextual aspect), and as a ´sensitive interpretation´ of the building itself (structural aspect)” (Schindler, 2005, p. 61). Our creative process has always been supported by the search for objective evidences, that is, backed by research. In addition, our works have never been interventions by an isolated artist, but by a group of people who reflect on color, so we can say that our reasons are not subjective but, at most, inter-subjective. In fact, we are somewhat critical of personalist positions that justify color based on the individual preferences of an isolated designer. We are rather in favor of teamwork that manages to orchestrate the different logics that are specified on the colored object. In short, we are always in search of reasons, arguments, logic, that guide our decisions. We are going to try to point out some arguments that have served us in our work to date and that refer to aspects related to the object and the subject.

2 The arguments of the object

In this first group of arguments to ease the reflection on the color of the environment, we are going to refer to those issues that are directly related to the material aspects of architecture. First, we will see that the color that corresponds adequately to an architecture is the one that follows the logic of the technology of the moment, so that the colors of the architecture and of the city change over time because the material resources and construction techniques also change. Second, we will study the arguments that come from the description of the form itself. We will understand that the architectural color is consistent with a certain formal composition, with the visual perception and with the functional destination of a space. Thirdly, we will reflect on the chromatic arguments provided by the physical context and the relationship with the place, whether it is an urban or a natural landscape. We will see how the environment can guide chromatic decisions and set a dialog with the surroundings, which can be more or less calm or strident.

2.1 The logic of construction technology

Throughout history, the color of architecture has been defined by the color of the materials that make up the surfaces, and these have the constructive function of closing, protecting and decorating the structural part that defines the architectural fact as such. The materials commonly used in the architecture of the Mediterranean coast were stone, marble, brick,

stucco and, in the case of more popular architecture, colored plaster. Other materials, such as mosaics and ceramics, were generally limited to areas where the tradition of these materials made them possible. And for all of them, the protective function required that the surfaces withstand the aggressions of the environment and resist the aging of the structural core.

Examining the historical architectures of the Mediterranean coast, we normally see that stone or marble are the materials to form the plinths, bases, columns, pilasters, window surrounds, cornices, etc., while what we call the “background”, or smooth plain facade, is solved either by using suitably rigged exposed brick, or by using colored plaster. Coatings, in short, that sought for the greatest durability of the masonry and were made using different finishes and materials that thus defined the image of the façade.

Traditionally, color has always been linked to a constructive reading of the language of architecture, given the nature of its use, and the aesthetic values of construction materials in their variables of color and texture. Thus, the recovery of the chromatic values of historical buildings transcends the mere role of recovering the aesthetic characteristics of the building, becoming a process of linguistic recovery of the architectural form, which makes it possible to safeguard its own formal logic. It is therefore essential to establish principles of constructive intervention that allow recovering not only the original colors, but also the very perception of color as it was produced when applying the original construction techniques (Figure 2).

Figure 2. The pigments of the territory and the traditional techniques provide the keys for the chromatic recovery

of the façade of the Church of Our Lady of the Angels in Tuéjar (Valencia). GICA-UPV together with Carmona & De la Torre Architects, 2020. Source: https://grupocolor.webs.upv.es/?page_id=2764

The traditional construction techniques, typical of each place, that remain in our cities, are part of the culture and the elaboration processes carried out by the artisan trades. It is therefore necessary to know and preserve the different traditions that have remained through time, as well as to promote their diversity, since this means a commitment to culture and its aesthetic values (García Codoñer et al., 2012).

The chromatic aspect of an architectural environment is the response to the material and technological possibilities of a certain historical and geographical context. Thus, in the historic architecture of the Valencian area, the most common building materials were lime, gypsum, and mixed lime and gypsum mortars, colored with natural mineral pigments (ochre, oxide of iron, Sienna). In the most modest buildings, the final plaster used to have a smooth appearance, without excessive ornamentation. However, in buildings whose construction typology included classical, modernist or palatial ornamentation, the use of plaster with various finishes and the imitation of wealthy materials is observed.

Thus, when in 2007 the GICA-UPV was commissioned to study the color for the recovery of the original aspect of the *Torres de Quart* (1400), the western gates belonging to the medieval wall of the city of Valencia, it was observed that the facades were plastered with three levels of lime mortar, with the colors of the previously indicated pigments of the territory, ocher and red, close to the 5.5YR hue in Munsell notation (Figure 3). The detailed study of all the remains of pigments found along the surface was carried out with the help of contact spectrophotometry, and was completed with a mineralogical study of the constructive characteristics of the mortars, which determined their composition based on lime with aggregates of silica. The remains of pigments found on facades with different orientations, from those facing south and therefore strongly isolated, to those facing north and therefore without direct sunlight at any time, allowed to carry out a comparative study between colors and sunlight, showing that the mineral pigments of the Middle Ages had turned out to be very stable to the incidence of sunlight, finding few variations in the perceptive variables of color (hue, value and chroma), between samples subject to very different amounts of hours of isolation (Towers et al., 2012).

In short, we can conclude that the logic of the construction techniques and the material resources of each historical period and geographical location reasonably determine the characteristics of the colors of an urban environment, and allow the establishment of logical criteria to preserve the formal coherence of a place.

Figura 3. Restoration of the original colors of the Torres de Quart, the gates belonging *to the medieval wall of Valencia. GICA-UPV together with Javier Benlloch Marco and Manuel Jesús Ramírez Blanco Architects, 2007. Source: Right: Rafa Esteve in Wikimedia Commons, CC BY-SA 4.0. Left: https://grupocolor.webs.upv.es/?page_id=2764*

2.2 The logic of form and function

There is a second group of chromatic arguments, which correspond to the built object, and which refer to the expression of the formal and functional logic of an architecture. We consider that the most suitable color in architectural spaces is linked to the formal composition, what happens when the color adequately expresses the laws that govern a certain design, as indicated by the Spanish architects Ana and Ricardo Bofill (Porter & Mikellides, 1976). The expression of these compositional laws that give order to the project are those that mainly worry and occupy the creative discourse.

Therefore, in this second section we propose an approach to color from its syntactic aspects, so that it serves as a strategic element to help reinforce the formal intentions of an architectural space. Reasoning is launched that refers to the logic of the form and its visual identification. Broadly speaking, and following the laws of the Gestalt School, it can be said that color interferes with the perception of the visual properties related to: the geometry of the object, its dimensions, its visual weight and its texture. In short, color can be arranged to modify the reading of the geometry of a space, or to make an excessively large space appear smaller, or to make an element appear lighter or heavier, etc. Possibilities, all of them, that are at the service of those formal intentions that architecture wishes to express (Serra Lluch, 2019).

Among the visual properties of the architectural form, we are currently investigating the ability of color to interfere with the dimensions of a space, that is, to generate contradictions between its real and perceived dimensions. Color can interfere with the proportion of the

object (height, width, length), its measurement with respect to a reference element (scale) and the separation with respect to other bodies (distance). An issue that has been dealt with by numerous color specialists, but which has scarcely been objectively demonstrated (Hayten 1960, p.22–23; Mahnke & Mahnke, 1996). We are currently investigating this in collaboration with the Munsell Color Lab at the Rochester Institute of Technology (RIT).

If we go beyond the mere visual apprehension of the shapes that make up a built environment, there is another logic to reflect on color at a formal level: its use to describe the architectural space. In this case, the observer is required to participate at a conscious level of thought, to interpret a message encoded by the designer and conveyed through color, and which refers to questions related to architecture in terms of an object with a shape and a specific function. Understood in this way, the colors that describe architecture are codified colors that allow formulating and understanding a message, which is normally related to the composition of the form, or to the function for which the building is intended. The narrative meaning of these colors helps the observer to orient through a space, and helps to understand the architectural object in some of its particularities. When color is used as a strategy to describe the architectural form, it usually communicates some aspect related to its metrics, its structural system or the logic of the formal operations used in its conception, among others.

In this way, more arguments can be added when admiring architecture as outstanding as the Berlin Pavilion at the Barcelona International Exhibition of 1929, by Mies van der Rohe and Lilly Reich (Lizondo-Sevilla & Domingo-Calabuig, 2022), observing how color helps in the perception of the geometry of the pavilion and participates in the logic of its formal composition (Figure 4). With a clear similitude to Neoplasticism, Mies arranged independent walls covered with marble of different colors, which are visually identified as parallel and perpendicular planes that do not touch each other. All of them supported on a podium, this time round, conceived as a solid volume and not as a plane, and therefore built with travertine stone of a uniform color. Mies' architecture, like Le Corbusier's, was not completely white after all (Cramer, 1999). For them, the color was useful to better describe the organization of the forms.

Figure 4. Berlin Pavilion for the Barcelona International Exhibition, Mies van der Rohe and Lilly Reich, 1929. Source: vicens, CC BY-SA 2.5 <https://creativecommons.org/licenses/by-sa/2.5>, via Wikimedia Commons

2.3 The logic of the physical context (urban or natural)

There is a third line of argument that is very important to consider when understanding the chromatic reasons related to the object, and it refers to the logic of the physical context. Each city has a color, a color that belongs to it, and that is linked to its atmosphere, which is a product of its territory, of the geological material on which the city was born and grew, something that has served some color specialists to set the colors specific to each geography (J.-P. Lenclos, 1982, 2009). The earth itself is the origin of those colors, the clays with their more or less saturated oxide component, the limes, the marbles, the quarries from which the stone is extracted, the entire territory is the raw material used for construction of the cities of the past, and that territory supporting the constructions of the city gives the anthropological range to its architecture that at the same time establishes an aesthetic relationship with the natural landscape. Colors are drawn from the land, which are the same harmonies of the landscape. The territory qualifies and explains the colors of the cities of the past, it is their origin, all the construction elements come from it, and the construction tradition is also linked to the territory, so it is linked to the constructive technology arguments set forth above. The technology and ingenuity invented by construction technologies manage raw materials, and this transformed material is what identifies and qualifies each city (Figure 5).

Figure 5. The traditional ocher colors in Valencian architecture were recovered in this eclecticist building belonging to the Rice Union in Alfafar, Valencia, 2018. GICA-UPV together with Javier Hidalgo Mora Architect. Source: https://grupocolor.webs.upv.es/?page_id=2764

The physical context can be an environment built by people, and therefore an urban environment, or it can be a natural landscape. In any of the cases, the architecture located in an environment must question what type of dialogue it wants to establish with the place, and color can be a very effective vehicle to reinforce this dialogue. From an exclusively visual point of view, which is the one that corresponds to color, the relationship between architecture and environment allows any type of dialogue between the extremes of mimicry or singularity. That is to say, the architecture may want to go unnoticed and disappear in the place, or it may want to attract attention and stand out from the environment. In general, we are in favor of calm dialectical relationships, of interventions that sew the urban fabric, but we also understand that, in degraded environments, good architecture that draws attention can be a successful solution to improve the visual quality of the whole environment.

There are particularly sensitive situations such as those of historical areas, in which the dialogue with the place of a building with a new style can become very problematic, when its

logic does not match that of the environment. This is the case of a series of five high-rise buildings that are located in the surroundings of the *Torres de Serranos* (1392), an historical city gate that was part of the medieval wall of the city of Valencia. Due to their excess height and because they do not respond to the formal logic of the historical site, the local regulations state that these five buildings must be demolished and replaced by others of lower height. At GICA-UPV we developed a study to find solutions for alternative façades so that, without the need to demolish the buildings but rather by updating their external façades, their visual integration and the quality of the urban landscape might be improved (Figure 6). Based on previous studies (O'connor, 2011; O'Connor et al., 2008), we experimented how facades with different materials and colors were able to reduce the perception of height of a building, or how colors introduced a certain coherence in the urban space, visually unifying buildings that are currently unconnected and without a unitary formal logic. Citizens considered that some of the proposed solutions were a good alternative to substitution (Serra, Iñarra, et al., 2021).

Figure 6. Photograph of two of the buildings located in the historic site of the Torres de Serranos *in the city of Valencia. Left: Current status. Right: Intervention proposal to improve the visual integration of such buildings, replacing the existing facades with new panels of varied colors.*

3 The arguments of the subject

In this second group of arguments, we are going to reflect on those aspects that are directly related to the subjects, that is, to people, and that can help reason about color. Firstly, we will see that the color of an architecture responds to the concerns of an architect or designer, who carries his own life experiences, but above all his own aesthetic and intellectual concerns. Secondly, we will see that the color of an environment must necessarily be argued from the logic of the inhabitant, that is, from the personal circumstances of who is going to live in said space, attending to their particular needs. Thirdly, we will reflect on the chromatic arguments related to society, that is, with a whole group of people who inhabit a territory and have their own cultural specificities.

3.1 The logic of the architect or designer

The color designer can be understood as an orchestra conductor, capable of organizing the different requirements of an architecture so that they are harmonious, translating through its colors the concerns of the inhabitants and of society, making them consistent with the logic of the object and using the aesthetic parameters that are characteristic of their culture. But it is evident that architects or designers project the colors from their own personal experiences and style. There is still a certain personal attachment in the work of art, and for this reason,

some architects identify themselves not only by the way they design, but also by an association with a particular color or color palette. Thus, for example, we could say that minimalist architecture is identified with concise color schemes linked in the collective imagination with the myth of white in the modern movement and its desire to purify the gaze (Wigley, 1995); Or we could say that Dutch architecture is characterized by the use of highly saturated primary colors that refer to Neoplasticist work. It should not be forgotten that the cultural meanings of color evolve over time and may be specific to a certain group or professional sector (Priluck Grossman & Wisenblit, 1999). Not without a certain irony, there are those who have tried to discover why architects always dress in black (Rau, 2009).

However, the environment in which we live cannot be exclusively subject to the personal whim of an artist, but must follow a logic that, in addition to being based on subjective aspects of the designer, considers the aesthetic coherence of the different elements that make up an architecture. In this sense, the reflection on color in the work of Le Corbusier seems exemplary to us, and we have dedicated a large part of our research to it. We think that a graphic (historiographical) reconstruction of the most emblematic works of modernity with their original colors is still necessary, which can provide us with a broader look at the role of color for current architecture and improve the lack of training on color in the curricula of architecture schools (Hirschler et al., 2018). Although Le Corbusier's work has been misunderstood as exclusively white and with the colors of the materials, the truth is that he established his own architectural color palettes, and reflected extensively on the role of color in architecture. Le Corbusier's proposals were based on his own personal experiences and aesthetic taste as a painter, but they went beyond subjectivism. The logic of color in his work can be traced perfectly following his own reflections and coherence with his formal concerns (Le Corbusier & Rüegg, 1997).

As colors are useful to formulate and understand a message within a specific context, the narrative potential of color can help the inhabitant to understand a space or architectural object in some of its peculiarities, as has already been mentioned. In the case of Le Corbusier, the architect assigned universal meanings to some colors when he gave names to his Salubra Color Pianos in 1931: “sky” (blue ranges), “earth” (brown ranges), “landscape” (green ranges), etc. (Heer, 2009). Therefore, we can understand that when Le Corbusier chooses green to paint the parapets of the terrace in his own studio in Paris or in the houses of the *Weissenhofsiedlung*, he is emphasizing the idea of a green roof, one of his five key-points for the new architecture. Once again, color is significant as a reinforcement of an architectural principle, beyond the aesthetic and subjective nature of such a selection. In fact, we have recently been able to see how the taste criteria of current architects and designers have shifted regarding Le Corbusier's color combinations, and how these taste criteria for interior spaces change between cultures and genders (Serra, Manav, et al., 2021). Indeed, taste is mutable, so we continue to think that the most appropriate reflection regarding architectural color must lie in other more solid arguments, such as the ones we are trying to identify (Figure 7).

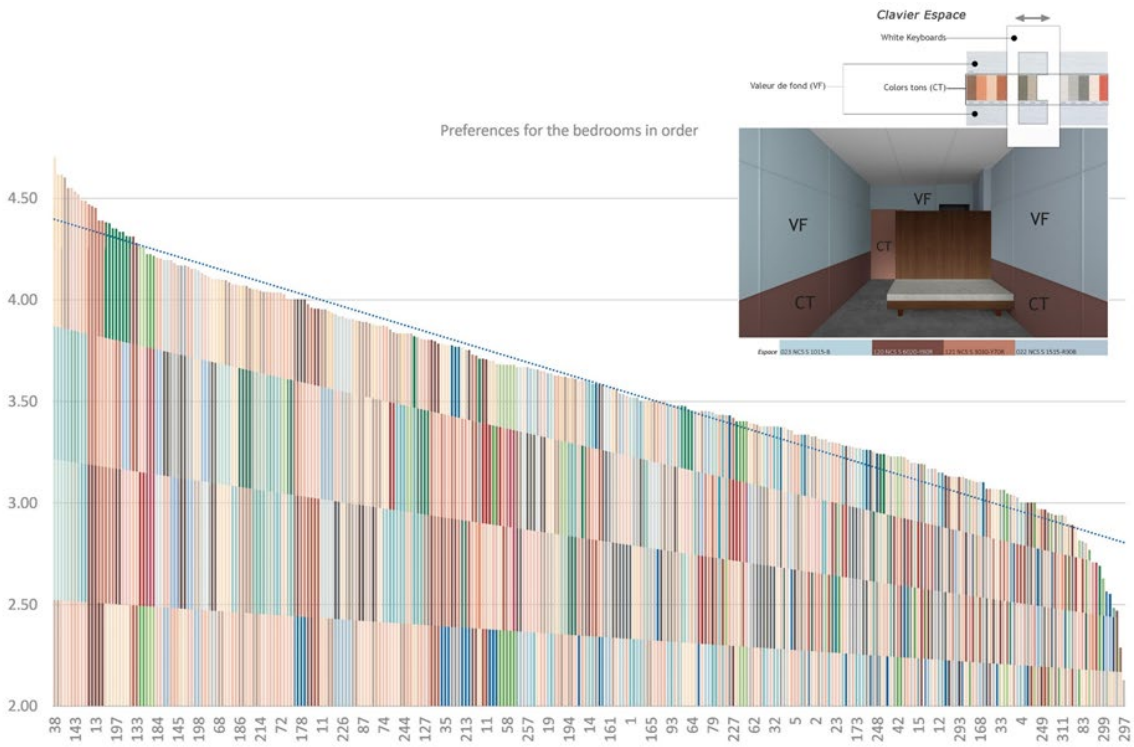

Figure 7. The 312 four-color combinations of Le Corbusier's (1931) Salubra charts, from most to least preferred, when applied to the interior space of a bedroom in the Swiss Pavilion (Le Corbusier, Paris, 1930) and evaluated by young architects and designers from Western Europe and Near East. Source: https://doi.org/10.1016/J.FOAR.2021.03.002

3.2 The logic of the inhabitant

The logic of the inhabitant is the logic of the person who is going to be the protagonist of the entire architectural event. It is important to know and integrate the concerns, needs and preferences of those who are going to live and enjoy the built spaces, also in terms of color, since color can have very different and subjective meanings for each person.

It has sometimes been pointed out that color has three essential communicative functions: attracting attention, providing information and arousing emotions (Humphrey, 2009). Evolutionary psychologists believe that humans still experience an innate, unconscious response to color, even though survival in our built environment no longer depends as much as before on our ability to identify colors. But in any case, color "does not mean the same thing in all contexts; on the contrary... different meanings can be associated with a specific color depending on the assigned case" (Meyhöfer, 2008).

The relationship between signs and their meaning is a branch of study that corresponds to semiotics, which understands every cultural phenomena as a vehicle for the communication of meanings. In the field of color and architecture, the reflections by color theorist José Luis Caivano are interesting, who recognizes three types of color signs: icon, index and symbol (Caivano, 1998). It is important to remember that the meanings attached to color may not be universal and should not limit the creative freedom of designers, since depending on its composition, color can be freed from its meaning. Such is the case of the Danish artist Per Arnoldi when he worked together with architect Norman Foster to arrange the color palette for the *Reichstag* in Berlin: “Although, in the context of a Parliament, green could be linked to an ecological policy, black with fascism, and red and blue with parties of the right and left, it

is possible to free color from such meanings and use it purely for compositional purposes" (Arnoldi, 2007: 13).

In the experience of GICA-UPV, when we have faced color interventions in interior spaces, we have been interested in gathering information on the color preferences of the inhabitants and the semantic connotations that color has for them. Moreover, we have tried to identify any objective evidence to justify the preference for some colors before others, which can once again move the reflection of color one step further and distance it from simple subjectivism.

Thus, in a research project to improve the visual comfort in public nursing homes in the Valencian Community, with experiments in real buildings and virtual reality, we found that color preferences cool versus warm for interiors depended on room type and were related to the arousal level expected for the activity conducted in them. For the social rooms in nursing homes, which are places for interactions with others and require higher activation, Spanish elders for all genders preferred warm colors. This color preference fits with higher arousal levels induced by warm colors versus cool that we obtained recording physiological markers under laboratory conditions, i.e., the heart rate variance. In the case of the bedrooms in nursing homes, which are places to rest and require lower activation, elders for both genders preferred cool colors, which fits with lower arousal levels induced by cool colors in females (Figure 8). Therefore, in a certain sense, we can find physiological markers that are related to the preferences of the inhabitants. In this case, the greater or lesser activation caused by a color guided the preferences of the elderly when choosing the most suitable color for each room, according to the activity to be carried out in it (Torres et al., 2020).

Figure 8. Color intervention in a bedroom of the nursing home San Francisco de Borja *in Fontilles Sanatorium, Alicante. Left: Before the intervention. Right: After the intervention. Source: Ana Torres-Barchino, MODIFICA: Modificaciones Del Confort Visual En Centros Residenciales Para La Mejora de La Calidad de Vida de Las Personas Mayores, 1st ed. (Valencia: Editorial Universitat Politècnica de València, 2020.*

The color of an environment cannot be considered in a deterministic way depending on the use that a space is going to have, but it is true that the performance of a certain activity can be favored or hindered depending on the chromatic and lighting conditions of the environment. In the research project called Smart Classroom led by Professor María del Carmen Llinares at UPV, we studied what is the color of the classroom that is most favorable for the performance of the intellectual activities of university students, with regard to the memory and concentration. As in previous studies, using immersive virtual reality, and adding neurological markers to the physiological markers, we observed that the worst results of the students in memory and attention tasks occurred in white classrooms, something

consistent with previous studies (Birren, 1978 ; Grangaard, 1995), and the best occurred in the blue classrooms with medium saturation. Interestingly, when asked about the subjective perception of the best performance, the students believed that the white classroom was where they had worked best (Llinares et al., 2021).

In short, it is possible to find chromatic arguments that allow the logic of the inhabitant to be incorporated into the design process. This argument necessarily requires obtaining the opinion of the end users, but with the help of supporting instruments, it is possible to find neurophysiological markers that support the logic of the chromatic decisions.

3.3 The logic of society

Last but not least, it is convenient to attend to those shared color codes, with special meanings within specific cultures, and that make up a kind of metalanguage. It is well known, for example, that white is associated with weddings, purity and innocence in Western culture, while in Eastern countries it can be associated with death. The importance of color within a culture must be considered, taking into account that its meaning also depends on the context, the previous experiences of inhabitants, the state of mind and many other intangible aspects, as has already been pointed out.

In the case of architecture, we think that shared cultural meanings have sometimes few importance compared with associations deposited after long-term architectural practice: again, context is essential. For example, the red stuccowork of the Hall of the Muses in Rafael Moneo's extension to El Prado Museum in Madrid (2007) is unlikely to be interpreted as "danger", "fire" or "warmth", even though these are almost universal meanings (Figure 9). On the contrary, the red color reproduces and recalls the well-known red that appeared in the ruins of the Roman city of Pompeii, a very appropriate association for an exhibition room that houses classical sculptures.

Figure 9. Hall of the Muses in the extension of El Prado Museum, Madrid, Spain. Architect Rafael Moneo, 1996-2007. Source: Torres-Barchino, Ana (2019). Dibujando en el Museo del Prado. Valencia: UPV. https://grupocolor.webs.upv.es/?page_id=2965

Similarly, the colors of the historic centers of our cities continue the cultural logic of our territory, issues such as its climate and the available material resources. Sustained over time by an entire building tradition, the color palettes of cities are consolidated and end up being linked to the image of the city and, therefore, to the formal expression of an entire society. It is influenced by climatological parameters and shaped by natural lighting, which is a fundamental variable in the formation of cities. Northern Europe, with its special light that brings us closer to the ice, the long nights, the paler sun, is different from the southern light. The light of the Mediterranean cities, with intense colors, long summers and radiant sunshine, where cloudy days are few, and the intensity of the sun spills over the landscape, giving to it a strong brightness that can even be blinding at times.

In this way, in historical Mediterranean cities such as Valencia, we find that the logic of the colors in specific neighborhoods is the logic of the typologies of the buildings, and so, the logic of the different social groups that inhabited each area. Urban color expresses the logic of the society. Therefore, in those areas in which there is a predominance of "artisanal buildings", which are the legacy of the medieval city, the color is characterized by its high visual and chromatic fragmentation. In these neighborhoods, the colors are juxtaposed with each other between adjoining houses, compounding a sequence of vertical stripes, as each narrow building adopts an independent chromatic solution. As has been pointed out, their colors are derived directly from the oxides of the surrounding land, as they are modest buildings that respond to simple and traditional construction technologies. This type of urban space has an outstanding presence in all the countries bordering the Mediterranean, and

they are the main reason for that sensation of urban continuity typical of this geographical area.

On the other hand, those areas of the city with predominance of buildings that we can define as "neighboring dwellings" are characterized by the presence of more complex buildings, erected later than the “artisanal buildings” and that respond to more elaborated composition criteria, which makes them likely to be bearers of a greater chromatic complexity (Figure 10). They are characterized by a greater presence of ornamental elements on their facades. In addition, the color ranges are extended, since at the time of construction (mid-19th century) the availability of materials and pigments increased considerably, surpassing the limitation on just local pigments from the immediate hinterland.

Figure 10. Proposal for the recovery of the traditional colors of the buildings at Trinquete de Caballeros *Street, Valencia. Source: García Codoñer et al., 2012.*

Finally, those areas of the city with predominance of buildings that we can define as "stately dwellings" and palace, chromatically express the wishes of a wealthy group of the society and flourishing bourgeoisie. These are buildings that respond to a greater compositional and formal complexity, and that either present a more pronounced ornamental and chromatic richness, or are characterized by the dominant presence of the stone materials characteristic of each area. The resulting image is the counterpoint to the artisan neighborhoods, and constitutes the monumental core of all our historic cities; counterpoint that stands out against the continuum of small-scale residential buildings.

Preserving the color of the city is preserving its historical image and their relationship with the material environment that feeds the city, as well as preserving the original chromatic heterogeneity of the historic city. This heterogeneity is very important, because it represents the structure of the society that inhabits it, and the structure of neighborhoods by which its inhabitants were distributed. Preserving the color of the city is, therefore, preserving the history and culture of an entire society.

4 Conclusions

In this communication we wanted to share some of the reflections that have accompanied us during our career as a research group on color in architecture, i.e. environmental color. Concerned about the color of the urban environment, particularly in the historic city, and also about the color of the interior spaces in which our lives take place, we have always wanted to take reflection on color one step further, aware that architectural color is a complex matter that can aspire to be considered more than just an issue of personal preference.

In this journey, supported by research, it has been useful for us to understand the parameters and logics that both the physical elements related to architecture and the people who are going to be their protagonists provide us. The reflection about architectural color can be set by understanding the logic of technology and the building materials available at each historical period and geography. Also by reflecting about the logic of the composition of the architectural form and its function, helping to facilitate the visual understanding of the internal logic that governs a certain architecture. And of course, there is also an argumentative logic, of extraordinary value, related to the visual relationship that a building wants to establish with the physical context. Architecture is not an autonomous element, but is integrated into an urban setting or a natural landscape with which it establishes a visual and chromatic dialogue that must be attended to with special attention.

Among the protagonists of the architectural fact, we have been interested in reflecting on three levels: that of the designer or architect, that of the inhabitant, and that of society. From the University, and aware that we are training the people who will build our cities and inhabited environments in the future, we are committed to the desire of revealing the logic of the architectural colors of those who have worked in an exemplary manner, to build a criticism that attends to architectural color in all its breadth. And of course, we have committed ourselves to the inhabitant and society, whom we try to serve with our work, making them protagonists of the chromatic decisions, and involving them in the dynamics of experiencing, admiring, and understanding the richness of architectural color, particularly in what is referred to the color of the historic city.

The environmental color, that chromatic characterization of our inhabited environment, is a basic factor in the human experience, especially in the knowledge of the environment in which our existence develops. The chromatic characteristics of the environment, the native territory, its geography and its light, characterize us throughout our personal development, connecting with our culture and collaborating in the existence of different aesthetic values in the various cities. We are what we lived, and insofar as it refers to the place we inhabit, we are intimately influenced by the territory in which our life unfolds, and which is characterized by its own geological colors, whose perception is conditioned by unique values of natural light. Thus, we live a chromatic experience nuanced by the characteristics of our own natural environment, and by the chromatic possibilities offered by the materials that constitute it. And ultimately, the preservation of this complexity of the image of the traditional city is essential to allow future generations to enjoy rich and complex spaces, made on a human scale, in which the urban culture that is in the roots of the Mediterranean cultures, was born and developed.

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