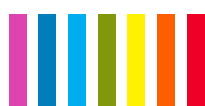




Abstracts of the International Colour Association (AIC) Conference 2018

Lisbon, PORTUGAL
25 – 29 September 2018

Sponsored by Associação Portuguesa da Cor (APC)
Published by International Colour Association (AIC)



associação portuguesa da cor





AIC LISBOA 2018
colour & human comfort



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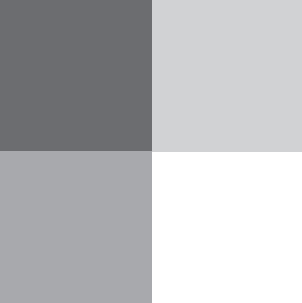
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This publication includes Abstracts of the keynote, oral and poster papers presented in the International Colour Association (AIC) Conference 2018. The theme of the conference was Colour and Human Comfort. The conference, organised by the Associação Portuguesa da Cor (APC), was held in Lisbon, Portugal on 25-29 September 2018.

More information in: www.aic2018.org.

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AIC President's Message: Tien-Rein Lee

Dear members of the AIC International Colour Association,

On the occasion of the AIC Interim Meeting in Lisbon, Portugal, the global colour community is once again getting together to celebrate the astonishing abundance of colour research and development and the substantial significance it has – in its contribution to the spheres of science, design, and arts, and to societies worldwide.

It is a great honour for me to very warmly welcome all participants and attendees from our global colour community to enthusiastically engage and indulge in a most colourful exchange of ideas throughout this event. Under the well-chosen topic of “Colour & Human Comfort”, you are cordially invited to share and discuss your fields of expertise with a multidisciplinary group of specialists from scientific, technological and artistic domains. As the conference theme aims to relate the human being with comfort through the transdisciplinary knowledge of colour, it recognizes the important impact colour may have for the human well-being, and the roles colour can play in every person's daily life experiences.

Now when the iconic crow of St. Vincent is going to spread its wings over the colourful city of Lisbon, I am sure we will all enjoy a very fascinating and inspiring conference with a program including all main topics of colour interest and R&D: ranging from Colour in the Built Environment, Colourimetry, and Colour in Arts and Design, over Colour and Lighting, Colour and Culture, Colour and Health, and Colour and Physiology, to Colour and Psychology, Digital Colour, and Colour and Landscape. Experts from many places all over the world are expected to take part in shaping this event to become another milestone in the history of the AIC International Colour Association.

Therefore, I would like to express my utmost gratitude towards the Organizing Committee and the Scientific Committee of this AIC Interim Meeting, especially to the Committee Chairs held by Prof. Dr. Margarida Gamito and Prof. Dr. Maria João Durão, the Co-Chairs held by Prof. Dr. Fernando Moreira da Silva, Prof. Dr. João Pernão and Architect MSc Zélia Simões, but as much to all presenters and the nearly 70 reviewers and all other responsible people involved, for their excellent work in preparing this remarkable conference program, and for turning the event into a colourful, radiating stage of expertise.

Wishing you a most exciting and inspiring time at the “Colour & Human Comfort” AIC Interim Meeting 2018 in Lisbon!

Prof. Dr. Tien-Rein Lee
AIC President

AIC Past President's Message: Nick Harkness

Dear Friends

I am delighted to have been invited by APCOR to write a welcome to you all to AIC 2018 in the dynamic city of Lisbon. I first visited Portugal more than forty years ago mostly in north and the area around Oporto. Fond memories of great lobsters, sardines and superb wines from the Douro valley and of course the wonderful friendly Portuguese.

Portugal was our country of choice for our last holiday in Europe before my wife and I left England in 1978 for a new adventure in Australia.

I was not invited to reminisce but to let you know what has been achieved by the AIC over the last two years which is truly remarkable. For me the four most important initiatives are the establishment of the new AIC Student Awards which will be managed by the JAIC editorial team, Stephen Westland and Vien Cheung (Vice President of AIC). The new AIC Study Group on Arts and Design which is the brain child of Maria João Durão, a very active member of the Executive Committee of the AIC, setting the wheels in motion for a much more interactive AIC website which is being managed very successfully by Leslie Harrington (Secretary/Treasurer of AIC). Log on if you have not already and experience the ease of navigation around the website. Last but not least, our application for ISSN accreditation for the JAIC and Proceedings from AIC meetings which has been the result of hard work by Vien Cheung. All these initiatives will greatly enhance the prestige of AIC and its academic excellence.

AIC 2018 is the launch pad for these initiatives, please give them your full support. The first Student Awards have been greeted with an amazing response with approximately, 30 submissions from fourteen countries. There will be a special edition of the JAIC which will feature the six best papers. If this momentum is maintained the AIC has the resources to offer more awards which could be spread across a range of disciplines.

To you all and especially my friends at APCOR have a fabulously colourful time in Lisbon.

Best regards,

Nick Harkness

Immediate Past President AIC

APCor President's Message: Margarida Gamito

Dear Friends,

It is a great pleasure to the Portuguese Colour Association to host the 2018 AIC Interim Meeting, even more because it is the first time that the AIC comes to Portugal, and more specifically to Lisbon.

Lisbon, besides being the capital of Portugal, is the westernmost capital city in continental Europe and the only one along the Atlantic coast. It is also one of the oldest cities of the world, and the oldest in Western Europe, predating by centuries other modern European capitals such as London, Paris and Rome. The omnipresence of the Tagus river, adding to the numerous hills and vegetation, provides the city with a high-quality light that enhances the colour of its buildings.

The Symbol for AIC Lisboa 2018 is a crow, which represents the guardian of Lisbon and is always present on the city shield. An ancient legend which connects the crow to St. Vincent, the patron saint of Lisbon, says that these birds had escorted the body of Saint Vincent since his death till his translation to Lisbon, on the 12th century. Also present on the Conference logo are coloured squares that represents some of the determinant elements of Lisbon's historic identity, namely its glazed tiles and cobbled stones. Simultaneously, these squares refer to the building blocks of light and colour, so characteristic of Lisbon.

The choice of the main topic – Colour and Human Comfort – embraces a very large variety of themes, because Colour is always present in all aspects of human life.

This event of great scientific relevance shall bring together an interdisciplinary group of specialists from all over the world, who use colour in both scientific research and professionally, addressing a key issue in the relationship of colour to the society: human comfort. So, this Conference has constituted a great challenge for our Association, as it reunites participants from more than thirty countries, and over than a hundred and thirty papers.

As President of the Portuguese Colour Association, I am very happy to welcome all of you to Lisbon and, specially to this colourful event, wishing that AIC Lisboa 2018 will bring more Colour into everybody's life.



Margarida Gamito
Portuguese Colour Association President

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AIC Lisboa 2018 Conference theme:

Colour and Human Comfort

This theme aims to relate the human being with comfort through the transdisciplinary knowledge of Colour.

Wellbeing is the fundamental condition to be achieved in everyone's life, and colour could play a tremendous role towards that fulfilment, from the clothes we choose every morning to the house we live in, our workspace, the environment that surrounds us, the objects we love, and so on.

But we know that there are many places, objects and environments that are not comfortable. In some cases, the reason is simple — lack of knowledge — in others, it could be the desire to impose certain aesthetic tendencies.

Colour in the Built Environment: Colour in Architecture | Colour in Urban Space | Colour in Rural Space | Interior Design | Stage Design | Museography.

Colourimetry: Colour Measuring | Colour Analysis | Technologies | Photometry | Methods | Theories and Instrumentations.

Colour in Arts and Design: Painting | Sculpture | Drawing; Theatre | Cinema | Dance | Music | Fashion Design | Communication Design | Product Design | Packaging Design | Marketing | Ergonomics | Sustainability.

Colour and Lighting: Light and Human Comfort | Light in Human Environments | Lighting Design | Lighting Technologies.

Colour and Culture: Colour in Heritage | Colour and Education | Transcultural Colour | Colour Aesthetics | Colour History | Sacred and Religious Colours | Anthropology of Colour | Philosophy of Colour | Sociology | Colour and Food; Colour and Language | Lexicology.

Colour and Health: Colour and Wellbeing | Colour in Healthcare Facilities | Colour and Neuroscience | Colour-Coded Labelling (medication, instruments, etc) | Medicine; Aesthetic Medicine | Light, Health and Wellbeing.

Colour and Physiology: Colour and the Human Being | Colour Vision | Optics | Memory | Colour Therapy.

Colour and Psychology: Colour Preferences | Colour and the Senses | Colour Perception | Perceptual Illusions | Phenomenology of Colour.

Digital Colour: Digital Colour Science | Digital Technology | Photography | Colour Image | Television and Audio-visuals | Colour Image | Virtual Reality (VR) and Augmented Reality (AR) environments | 3D Printing | Image processing | Virtual Projects.

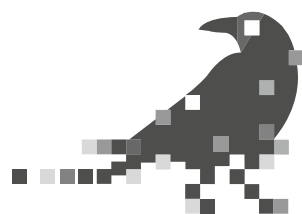
Colour and Landscape: Natural Harmony | Natural Aesthetics | Land Art | Landscape Design | Geography of Colour | Biogeography of Colour | Geology | Ecology.

Oral Papers and Posters
by Topics and alphabetic order



AIC LISBOA 2018
colour & human comfort

Keynote speakers



AIC LISBOA 2018
colour & human comfort

Colour in the historical hospitals of Cascais: *Hospital de Sant'Ana in Parede* and *Hospital Ortopédico in Alcoitão*

Luísa Arruda

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Abstract

The Sanatório de Sant'Anna (St. Anne's Sanatorium) in Parede, dating from 1904-, today called Hospital de Santa Ana (St. Anne's Hospital), is an imposing building that dominates the coastal landscape of Parede. It was designed by Rosendo Carvalheira and Álvaro Machado with the collaboration of Adolfo Marques da Silva, Manuel Joaquim Norte Júnior and António Couto Abreu. The architects brought into being the ambitious sunlight and sea air sanatorium project devised by eminent doctors Sousa Martins and José de Almeida to treat bone tuberculosis, among other illnesses rooted in malnutrition and hygiene problems, especially dedicated to children. Maria Amélia and Frederico Biester generously sponsored the project, further driven by the Mayor of Cascais, Jaime Artur da Costa Pinto. The building is made of stone from the region and has a large façade facing south over the Estoril coast, with another to the north containing the chapel and the main entrance.

The sanatorium is a remarkable example of the Neo-Romanesque taste that, in Raul Lino's eyes, is the style that best represents Portuguese architecture. The colours of the materials is defined by the architectural design and have a decisive aesthetic function in perception of the blocks of the building, the colour of the limestone, the ochre red of the tiles, the ochre yellow painted masonry and the metal or pine green-painted wood features of the towers. On the south façade, there are the stone features of the main body, the columns of the colonnade, the spouts, the sculptures depicting mussels and other shells, the colours of the band of tiles decorating the colonnade also depicting fish and algae against an ultramarine blue background. In the details of the south façade there is a desire for interaction and communication with the children staying at the sanatorium, materialised in the aesthetic creation of sea features of a type, scale and colour that encourage the playfulness of discovering and identifying things from the sea.

Another hospital building, also found in the Cascais area, Hospital de Alcoitão (Alcoitão Hospital), dating from 1968, also warrants attention thanks to the quality of its pioneering implementation of the most up-to-date physiotherapy treatments, comprising several aspects of rehabilitation in a high-quality, modern building designed by architect Formosinho Sanches.

The search for human-scale, emotional values can be seen in the noble truth of the materials, shaped with a functional and aesthetic sense. Brick, rare in Portuguese construction and even more so in hospital buildings, appears as an external covering material that introduces warm tones and interplays of light and texture to the façade. The brick walls of the main façade continue into the inside of the entrance hall, increasing the blurring of the boundaries between gardens and internal areas. In this building, the use of natural materials invading some internal areas, as stone, brick and wood – comes from the organicist architectural perspective. Even in the design of the flooring of the sculpture patio, connecting brick and stone around a pond, the chromatic and tactile qualities of the materials are exquisitely explored.

Keywords: *color, architecture, hospital, human comfort, Cascais*

Colour Experiments in my Imaginary Universes

João Brehm

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Abstract

My interest in Colour started as a Painter in 1969/70 using the cosmic universe, a theme that has always fascinated me. I used fluorescent colours, which I have never stopped using, for more light and vibrancy. They were cut shapes on flat canvas.

My work then turned to a philosophical and provocative approach, utopian classification of dreamed universes. I spent a few months experimenting various depth-enhancing techniques to increase the perception of a third dimension.

After a period working on outer space landscapes, I began to use a pictorial system based on dots, sprays (which are billions of dots), various types of paint spraying, metallic and fluorescent colours and other exploratory techniques in which ink drips are not the random result of an abstract or purely visual expression, but rather concrete objects. I have catalogued stars, galaxies and other imaginary celestial bodies in a poetic attitude of confrontation between art and science, images of a utopian photographed space, in which the universe is a pretext for another use of colour. Later I developed spectral ranges of true stars, others invented, as well as the solar spectrum.

Since everything that exists is constituted by points and it is thought that the infinitely large obeys to the same laws as the infinitely small, I dared to explore the sub-atomic world in the same way as the cosmic universe. I started using diverse colours in metallic and neutral backgrounds in a totally rigid and smooth surface (PVC), with no idea of atmosphere or vacuum, a system in which the depth of illusory space, apparent movement and light could nevertheless exist.

More recently I have returned to coloured canvas and reflective materials allowing endless associative games, contrasts, chromatisms, different perceptions of colour, always trying to create the illusion of a three-dimensional space searching for the light that sources colour as the human eye perceives it.

During the course of my work I have tried to answer several questions related to colour. Is yellow brighter on a black or neutral background? A large blue point seems closer than a small point? Do warm colours approach and cold colours move away? Can movement be suggested by the arrangement of colours in space? Is colour perception altered by scale, contrast with other colours, greater or lesser intensity of the pigment, added white or black, and/or by the combination of primary or complementary colours?

Overall, my work is based on experimentation, trial, error and correction, and using improbable chromatic combinations. A poetic approach in search of the simplicity of a certain idea of the Beautiful.

Despite all these years of searching for a different but spontaneously natural language, I feel that I am still at the beginning of the path and that the more I paint the more I learn to paint. A journey through Colour is an endless journey.

Keywords: *colour, dots, light, space, universe*

Colour from a gradualist perspective

José Luis Caivano

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Abstract

Colour and visual appearance can be studied from a gradualist perspective, which allows to explain many aspects in this field in a more appropriate way than the usual conceptions based on taxonomic divisions and categorial oppositions. We will deal with various problems associated with colour and appearance taking into account —rather than the usual oppositions, divisions, categories or taxonomies— 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.

As examples of antecedents in colour studies where a gradualist approach has produced a significant improvement or evolution in colour theory, three cases will be reviewed in order to illustrate the point: 1) colour order systems and colour notations, which have overcome the limitations of colour names for designation purposes; 2) two steps in the studies of linguistic and cognitive categorization in the domain of colour: Berlin & Kay, plus MacLaury, which are unavoidable to understand how cultures and languages incorporate basic colour terms; 3) the semantic differential scales, a method that has brought greater depth and rigor in the treatment of colour semantics. These are just a few but paradigmatic examples where we can see gradualism applied with success.

After that, and offering a brief introduction to the gradualist concept in biology and earth sciences, this perspective will be applied to other aspects of colour theory, particularly to some traditional colour topics that will be presented under a new light: a) chromatic mixtures understood as a gradation with intermediate steps, instead of the classical separate categories of additive, subtractive and partitive; b) gradations in cesia and texture, or how the scale affects the transitions between visual categories; c) chromatic vs. achromatic sensations: reductio ad absurdum of the misconception that grays, black and white are not colours.

The aim is, thus, to verify the generalization of the gradualist hypothesis, recognizing where it was applied in previous cases and extending it to other aspects of colour theory. I am convinced that methods that employ a gradualist conception have greater affinity with and are more suitable for studying visual phenomena than those approaches based on typical binary oppositions or categorial classifications, strongly anchored in verbal language.

Keywords: *colour & appearance, gradualism, colour mixtures, scale factor, cesia & texture*

50 Years of Colourful Reflections

Byron Mikellides

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Abstract

Fifty years ago, when I was first appointed to devise a course in Architectural Psychology for the Oxford School of Architecture, it was an interesting challenge to find a balance between desirable, relevant and needed material to improve the newly founded honours degree approved by the RIBA. Vitruvius wise words 40 BC were as relevant then as they are today.

In the world of colour knowledge, very little was taught to keep Vitruvius happy. One could find the odd history lecture on Ictinus and Callicrates about the painted exterior frieze of the Parthenon and in theory there was a mention of visual illusions. In First year studio, there was a design and build project of the Red and Blue chair designed in 1917 by Gerrit Rietveld. The only books in the library were Eye and Brain by Gregory and the Ishihara Colour Blindness Test

Over the next 50 years the picture changed dramatically. The intake of women studying architecture rose from 7% in 1968 to 23% in the 1980's and to over 50% in 2018! We followed both genders' psychological profiles over these years (using the Rothwell Miller Interest Blank) and noted that women recorded stronger interests in aesthetic (including colour), literary, musical and social categories.

The library was enriched by many new books on colour, from IAPS and AIC Colour Conference Proceedings, the NCS, Josef Albers Interaction of Colour, to the latest books by Swirnof, Arkill, Best and Anter, 2017. This presentation will critically evaluate the development of the subject, and how it was integrated in each year of architectural education.

One of the most critical considerations over the years was to bring the work of distinguished architectural practitioners and artists into the students' awareness and thoughts. The attitudes of local authorities and planners should also be considered. Norman Foster for example managed to get a blue building approved in the 1970s by arguing it was a greyish blue building, in an area of strict colour regulations. Similarly Bill Heine's 25ft great white shark on the roof of his house in 1980 could be given listed status now by the Oxford City Council who wanted it demolished before.

As late as 2003 Mark Major remembered that their exhibit in London on "Any Colour You Like" was the only one using lights rather than pigments. In 2009 Jean Philippe Lenclos, one of the world's leading colourists, was convinced that we are entering now a new world in which architectural colour is expressed more in new materials and illumination rather than paint.

People still like and respond to colour and as Charles Moore noted, they send postcards and photos to their friends and relatives of the places they visited to share their pleasure. This diachronic journey will consider critically the relevant issues of colour in both architectural education and practice, over the past 50 years.

Keywords: *diachronic reflections, architectural colour, gender, education*

The Architecture of Tomás Taveira: colour as the sixth sense

Tomás Taveira

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Abstract

Colour has existed in our culture, in our Architecture ever since!

Western civilization always privileged it and if it did not include it at certain moments in history it was by "individual" option or by "material" rather than by artistic circumstances. For example in Roman Architecture there is no colour, why?!!!

But there is colour in all other arts including the decorative arts and in the engravings of the books and in the paintings...

No matter how much you want to imprison colour in more or less esoteric or even chemical theories, it frees itself whenever an artist comes to the USA and comes alive!!!

The minimalist architecture derived from the 1940s, in which it was all about using materials as they were in nature, that is just as industry put them on the market, led to what has been called NEW BRUTALISM.

This idea still has very strong extensions today and even those who consider that true Architecture should not have colour!

Architects are many who think so but have not been able to materialize this architecture in a Consistent Theory... Neither Kenneth Frampton with his sense of critical realism never made it to a theory of NO COLOUR.

THE POST-MODERNISM

The Modern Movement up to the International Style was a Movement without colour, even in the interiors where at most the wood has a strong appearance and sometimes the marbles also...

The Postmodern Movement resurrects several aesthetics and various theories that came from a study more or less hibernated, such as the use of colour, the sense of the spirit of place, the joy of the gray city and still a libertarian spirit of the forms!

One of the fundamental characteristics of Postmodernism opposed to Neo-Brutalism was in fact the use of colour and the use of forms in a libertarian way and the decoration of facades: the painted materials, and this without any constraint ...

This revolution was not well accepted by fundamentalists who were partly unaware of the forms beyond the Modern Movement...

The de-characterization of the Modern Movement... was an act of courage of many Architects and Designers who introduced against everything and against all, THE COLOUR, THE FULGING IMAGINATION TRAVELING to the forms of Furniture against all tradition.

The question that can be asked:

Is it possible to live without colour?

Is it possible to live without colour in Furniture and Architecture... And in Clothing?

We do not want to enter into the more or less physical and emotional interpretations that link colour to states of soul and even studies of conviviality ... in certain groups (British aristocratic clubs).

Colours that convey joy to colours that convey sadness... Rational and irrational colours.

The question is: Can there be life without colour? Can Architecture Be Without Colour?

Keywords: *colour, architecture, postmodernism*

Colour in the Built Environment



AIC LISBOA 2018
colour & human comfort

Colour Sustainability and Authenticity in Portuguese Contemporary Architecture

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Abstract

Beyond the consolidated city, in the peripheral and residual areas, it has been built collective dwelling of cooperative housing, some awarded by their quality. These buildings are recent heritage and future legacy. Due to the present crisis, these buildings will face degradation. Given the impossibility of preserving everything, it is necessary to define colour authenticity criteria in the conservation and rehabilitation of the buildings. Also, considering that buildings are an expression of their time, most of them will not fulfil all the requirements of the present regulations to achieve sustainability without loss of their authenticity and cultural value.

Building materials and construction techniques help to define the identity of a building and its typological characteristics. The original revetments and the architectonic surfaces are fundamental for the material and aesthetic authenticity of historical architecture, the different expressions of identity, and to the preservation of the Genius Loci. Cases as Chelas, (1975-1978), raise questions about the colour sustainability and authenticity in the context of social demographics and geographical location.

The territory is a limited resource that must be protected. The most sustainable option is the rehabilitation and renovation of the city. With this purpose different types of rehabilitation are made in Portuguese recent heritage.

This study proposes a referential grid of colour authenticity criteria, based on buildings referenced by the old National Housing Institute in Portugal (today IHRU), which can be used to assess other buildings. These authenticity criteria, defined in Nara 1994 and refined in UNESCO Operational Guidelines since 2005 (namely, concept and design, materials and substance, spirit and feeling) will be used to analyse different case studies in Portugal. To establish these criteria six case studies are analysed. In Lisbon, two urban complexes of Justino Morais, in Caselas, INH honourable mentions in 1989 and 1992, and Zambujal's Integrated Plan of Carlos Carvalho, INH award 2004. This case contrast with the former by its degradation, lack of maintenance and alteration of the original drawing. In Porto the urban complexes of Manuel Correia Fernandes, in Aldoar, and Pedro Ramalho and Luís Ramalho, in Matosinhos, are considered. The massive use of brick in these buildings contributes to a better preservation of the façades, though the graffiti is a common presence. Finally, a colour study of Tomás Taveira for Chelas. Colour is one of the most important elements of Tomás Taveira Architecture, one of the most famous architects based in Portugal. Looking through his Architecture he uses colour from the sixties to develop city life attracting people to shops façade in Cascais until big developments in housing and commercial centres in Olaias and Amoreiras (Lisbon) and in the big Stadiums of Football nowadays. These case studies are representative of an architectonic culture that differs from the North to the South of Portugal. To test and externally validate the resulting colour authentic criteria it is used the Delphi method. Taking in consideration the different interdisciplinary views in Conservation and research materials, this research aims for a consensus for the concept of colour authenticity criteria.

Keywords: *Colour, sustainability, authenticity criteria, contemporary architecture*

Historic Urban Landscape: construction of a methodology for integrated colour proposals

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Abstract

“The main argument for colour planning is that colour is there already.” (Lancaster, M., 1996, p. 82)

“(…) colour is about relationships – the relationship of one colour to those adjacent, and of all colours to those around them, which cause them to change in our perceptions according to the process described as simultaneous contrast.” (Op. cit. p.102)

Colour does not exist by itself. As documented in the literary review, colour is a variable manifestation of perception. Without material form “colour” represents a code to describe emotional and cognitive experiences - being an individual, abstract and personal concept. However, colour has patterns of repetition and tradition that represent their collective dimension. The context of the perceived colour is essential for a complete colour analysis applied to a public place.

Historical Urban Landscape is “the result of a historic layering of cultural and natural values and attributes”. The set of layers demonstrate the chromatic and material tendencies, belong to each time and culture and reflect a particular identity. However, this identity is not static. Despite the arguments from other authors, which sustained the chromatic approach in reutilization of “original local colours”, contemporary urban design also requires parameters based on current user experience.

The research project “A Cor da Ajuda” approach a methodology for colour analysis and proposals in the contemporary urban environment. Through “Calçada da Ajuda” case study, this paper aims to sustain: what are the dimensions of colour in the Historic Urban Landscape? And, how these dimensions contribute to define new colour proposals for the public place?

To achieve such goals it was assumed that chromatic proposals are a multi-conceptual and evolutionary reading of the facade, city block facade and urban landscape. To support the chromatic proposals it was consider 3 guidelines: colour morphology, colour typology and colour volumetry.

The “colour morphology” results as application of Gestal theory to unify facade perception of colour. The observation of the building includes the analysis and registration of the different colours that perform the facade: walls, roof and frames. Assuming that colour is not possible to perceive in an isolate manner but it is needed to consider the building as a whole, confirming the Gestalt idea that the whole is more than the sum of the parts.

The “colour typology” to recognize the heterogeneity between buildings, due to different times of construction and consequently the appliance of different materials as construction process although there are some patterns that can be identified and create the sense of identity.

The “colour volumetry” to escape from the buildings’ analysis based on a bi-dimensional registration considering the tri-dimensionality to offer legibility, orientation, and functionality.

Such analysis will provide information to characterise the colour of the urban landscape in its different dimensions allowing to conceive chromatic palettes’ standards to be applied. Such standards support colour functionality within urban place identity encouraging a qualified user’s experience.

Keywords: *Historic Urban Landscape; “A Cor da Ajuda”; Colour morphology; Colour typology; Colour volumetry*

S>C – Proposing a formula for Harmonic Urban Colour Composition

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Abstract

The paper presents the latest study in the ongoing project of identifying a specific colour palette for the city of Trondheim, Norway. The identities of the majority of Norwegian towns and cities are foremost associated with painted façades in traditional hues of reds, yellows and greens, in combination with façades in nuances of light to medium dark neutral colours. However, counter to the long tradition of chromatic variation, Norwegian architecture points to a dramatic change towards a perceived uniform, achromatic palette. The overall aim of the project was to identify hue and nuance similarity, and to develop a public colour guideline for the city.

As Lynch argues in *Image of the City* (1960), the overall colour gestalt is one of the most important aspects in the image of a city, and for how people perceive, inhabit and move around in the urban landscape. In *Urban design: Ornament and Decoration* (1999), Moughtin, Oc and Tiesdell points out that achieving a coherent colour gestalt of a city requires some strategic policy, which sets the basis for the colour agenda. In his paper *Strategies in Colour Choice for Architectural Built Environment* (2017), author Zennaro is seconding this, adding that the designer needs a dedicated strategy, different from case to case, specific to each place.

Traditionally, the limited access to building materials, binders and pigments naturally restricted the range of hues and nuances in the cityscape. The colours were generally variations of the same hues and nuances, managed in different ways according to style and fashion. Today, technological advances offers an almost unlimited choice of building materials and colour, of international origin and unspecific to a particular place, and the decision is often in the hands of more unexperienced consumers. Historical styles lasting decades has evolved into short-lived trends. What traditionally used to regulate itself now requires some strategies if to achieve an overall colour gestalt specific to a place.

Analyses of the registered colours of the city's façades shows a very clear tendency for the use of specific hues and nuances, thus providing a contextual base for a strategy in upholding the city's overall colour gestalt. The paper will focus on the nuances in the range of hues in the city's colour palette, i.e. the relationship between the visually perceived blackness, whiteness and chromaticness of the nuances.

The results are further compared to similar registrations the overall colour palette of Paris, Rome, Vienna, Graz and Copenhagen. We have found that most cities visited have a typical colour signature in their hues and nuances. The hues and nuances are generally not that different, but the range varies. Apart from Graz, the most typical nuance similarity is that the blackness is generally higher than the chromaticness. Despite the differences, comparisons between the registrations in the selected cities gives indications that the results are generally valid for other cities, and can be of use in identifying the key aspects in the overall colour gestalt of a place or a city.

Keywords: *Colour in Architecture, Colour in Urban Space, Colour Analysis, Chromatic Composition, NCS*

The Colours of Alvar Aalto

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Abstract

A great number of books and articles have been written about the architecture and furniture designs of Alvar Aalto (1898–1976), but very few of them mention anything about his use of colours. This paper focuses on how Alvar Aalto was influenced in his use of colours by the avant-garde and Modern art and design of his time. Colour is an integral element of Aalto's architecture, especially in his lesser-known early works and in the world-famous functionalist buildings of the late 1920s and early 1930s. Aalto was not only an architect, but also a designer of innovative furniture, lamps and glassware. Colour played a major role in also these designs.

In 1935 Alvar Aalto, Aino Marsio-Aalto, Maire Gullichsen and Nils-Gustav Hahl founded the furniture and interior design firm Artek. The main purpose of Artek was to facilitate the retail and export of Alvar Aalto's furniture, but it rapidly grew from a furniture store into a showroom for international design, tableware, textiles and art. From the start, Artek exhibited works by such artists as Ferdinand Leger and Alexander Calder, whose influence is evident in the colours of Aalto's furniture. The furniture was manufactured in a great variety of colours during the pre-Artek years of the early 1930s, but became reduced – alongside Aalto's ideas of standardization – to a few primaries plus black and white as mass production took hold.

Alvar Aalto's architecture can be divided into three main periods, each with a distinct colour palette: the Nordic Neoclassicism of the 1920s, the Functionalist period spanning from 1928 to around 1938, and the "humanistic Modernism", which Aalto develops from about 1938 onwards and which culminates in his masterpieces of the 1950s and '60s. The intense and early contacts with the most avant-garde artists of his day had a great impact on Aalto's use of colour. In this respect, perhaps the most important among his early exemplars was Le Corbusier. Although Aalto himself underplayed Le Corbusier's influence on his architecture, there are striking similarities to Corbusier's Polychromie architecturale in the way Aalto uses colour in the Turun Sanomat (1928-30) and Paimio Tuberculosis Sanatorium (1929-33) interiors. In Paimio, Aalto pays much attention to the colours of the interiors and their effect on the wellbeing of the patients. After 1938, the architectural styles of Le Corbusier and Aalto went their separate ways, but human comfort remained a guiding principle in Aalto's architecture and design to the end of his career.

Keywords: *Alvar Aalto, architecture, design, colours*

The Scales of Colour Perception in Architecture

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Abstract

This paper proposes an order in which architectural colours may be analysed. The concept has served as a tool for the author as architectural colour designer and researcher. The aim of this study is to introduce the concept of scales of colour perception in architecture as a starting point for analysis, and to underline the importance of colour selection and precision in the process of design.

In general, colour decisions for building exteriors are done empirically. Considering the effect of coloured buildings in the collective space, it is sensible that these should be grounded on a solid justification. A thorough analysis of buildings and their situation is required, as it is necessary to prioritize on the relevant aspects in each specific case. In doing so, the position and the movement of the users in exterior space should be taken into account, for they will benefit from the good practice of colour in architecture.

The first proposed scale of colour perception is the geographical scale, at the longest distance from which building fronts may be perceived by natural human vision. The view of objects in the distance is greatly affected by climate and atmospheric conditions. At this scale the analysis considers topography and soil colour, materials used in the area, vegetation and other elements of the surroundings.

It seemed necessary to divide the scale of context in two parts: the broad and the immediate. The broad context scale, for wide avenues, squares and skylines, acts as a setting to open space and as a background to other constructions. The immediate context scale comprehends narrow streets, neighbouring buildings, rows of houses, and the elements that complement the view such as trees and urban furnishing.

The core scale of perception for this study is the proper architectural scale, which regards the building as an object. Façades, although part of a collective picture, are considered as designs expressly thought for this scale.

The scale of detail includes the parts of the building made of various materials such as glass, wood, tiles and metal, and elements such as mouldings, columns and railings.

The last scale of this proposal is the scale of materials. Observed from very short distances, this scale is associated to the haptic sense and stresses on the textural qualities of material surface and coating.

A selection of examples of architectural colours set in Lima city will serve to point out the role of colour and its effects at different scales of perception.

The relation amongst the different scales of perception and the functions of colour in favour of human scale will be addressed in the discussion.

Keywords: *architectural colour, context, human scale, perception, scale*

A Study on Physical Characteristics of White Shoji Paper Used in Traditional Japanese Architecture

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Abstract

In modern architecture "white" has been used as a colour symbolizing universality and neutrality beyond regionalism. Even now white architecture is being produced repeatedly, and white has a special meaning in architecture. However, white in actual architecture is not always a stable colour, because white perception is influenced not only by the physical properties of materials but also by the relative relationship of luminance distribution and surrounding colours in a field of view. In our research, we are now investigating the transition of actual "white appearance" in modern and traditional architecture in Japan by collecting design data and measuring spectral reflectance and luminance and chromaticity distribution at actual buildings.

In traditional Japanese architecture, shoji paper has been used as a translucent screen at windows and partitions, and it is recognized as one of the typical Japanese white in traditional housing or some tea-ceremony rooms. There remains various hand-made shoji paper everywhere in Japan, however, machine-made shoji paper has much increased recently. We are now focusing on the succession and extinction of traditional white and its influence on the modern architecture. This paper aims to investigate the physical characteristics of various shoji paper as the first step of this research.

22 types of hand-made shoji paper from all over Japan and 1 type of machine-made shoji paper were collected, and their physical properties, such as a sheet formation index which shows the uniformity of the fibre distribution in paper, whiteness, haze value and transmittance were measured.

Haze values are calculated by dividing diffusive transmittance by total transmittance, and shoji paper has almost no specular transmittance component, therefore haze value is roughly determined by total transmittance. There are various thicknesses of shoji paper, and the difference of haze is thought to be greatly influenced by thickness.

The shoji paper was generally perceived as white, but the results showed that its physical value is not always typical white. Hon-Minogami, which is said to be the finest shoji paper in Japan, was located in the middle level of all samples. The machine-made shoji paper was found to be close to typical white. About sheet formation index of each shoji paper, Hon-Minogami was located in the middle level of all samples. The machine-made paper has the smallest sheet formation index value and this indicates that it is the most uniform paper. This paper examined shoji papers only from the physical point of view, however, considering that the perception on colours changes depending on the surrounding environment, further research on colour recognition of shoji paper in the actual spaces will be required in future work.

Keywords: *white, shoji paper, Japanese architecture*

Architectural Colour Design in Defense of Identity and Place; the Challenges and Potential Strategies for the Future in Urban Development

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Abstract

As Peter F. Smith notes in *The Dynamics of Colour from Colour for Architecture Today*, “There is general dissatisfaction with the uniformity of cities as so much economic growth is channeled into buildings. At the same time, there is a groundswell of concern about sustainability issues...Sustainability also encompasses the aesthetic quality of the built environment. It is the buildings and townscapes of rich diversity of form and colour within the boundaries of harmony, which endure. How to plan and design within this component of sustainability is the challenge for the twenty-first century”.

The authors have previously examined the drivers of urban colour tendencies, starting with trend production “The Greying of Norway”, presented at AIC Santiago 2016 and followed in 2017 by “The impact of the industrial surface colour palette”, presented in Naples at XIII CONFERENZA DEL COLOURE. These two papers have charted the tendencies and concur with Smith’s observation. This leads us to the identification of core problems in the implementation of colour, its decline, and how colour knowledge has deteriorated in the architectural profession. The tendency of sub-contracting material procurement in large-scale projects also plays a role in this reduction of agency. We have observed how stakeholders interact, and how the weakness of process, definition and action arise in the issue of who has the power to define, determine and legislate qualities in relation to the economies of production.

The identification of key problems and possible action that may be taken to redress the issue emerged. The issue is not “heritage” colour in existing ensembles, but colour and technological colour quality and the weakness in, or absence of, chromatic design for context in densification infill, new large scale residential and city centre developments. This in part due to the use of globalised colour products and their particular qualities that, in the absence of chromatic design thinking and understanding, produce a lack of relational and regional geographic sensitivity and erode, or fail to establish, a sense of «genus loci». Our recent findings are based on involvement in the discursive relations between the architects, developer and local authority that tend to ignore both context and end user are examined, in part, through three cases in which the authors have been involved. This is seen through a critical approach that takes its tactics and analytic form from Kenneth Frampton’s “Ten Points on an Architecture of Regionalism: A Provisional Polemic”. Ultimately, we find that mediation of the discourse founded in Frampton’s thesis raises public and professional awareness and provides a model for action in counteracting indifference, enabling resistance, correcting the erosion of the identity and aesthetics of place through actions in education, communication and mobilising political agency.

Keywords: *Colour and Place-making, Architectural Colour, Colour Design and Plan*

Sensory Experience Contours of the Natural and Built Environment: Lisboa - Sydney

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Abstract

“Without consciously looking at them, we breathe in our surroundings with all our senses.” (C. Day 1990)
This paper aims to develop the concept of mapping sensory contours of human environmental experience. The framework within which this concept is explored, is based on the ‘spectrum of senses’ as developed by Meerwein, Rodeck, Mahnke. The synthesis of human sensory experience of environment may be expressed as colour compositions that interpret the juxtaposition of contours of elements within the natural and built environment. ‘Contours’ of colour express the relationships of intangible senses that impact human experience and memory of place. This conception for the synthesis of human sensory experience of environment, enables a more holistic approach that reaches beyond the boundaries of aesthetic considerations. The aim of exploring and developing this conception is to raise awareness and to engage inhabitants and designers of spatial environments.

A question which follows asks, what is missing from current discourse that concerns the design of spatial environments, in both public and private contexts? One answer to this question may be deeply rooted in a collective, cultural context, as observes Olafur Eliasson. Where Western cultures tend to focus attention on objects within a ‘scene’ in comparison with the Japanese tendency to perceive an overall environment.

In the analysis of a site or scene, often the tendency is to interpret mostly positive elements and experiences, but in order to understand the positive, it may be viewed that the experience of negative qualities such as sharp, short sound, or bright light, or an unexpected passing of an unattractive garbage truck may also be required in order to acknowledge tension in the experience of a scene. Discordant sensory elements may actually broaden design possibilities in the context of colour palette design, synthesis and application.

A comparison of the human sensory experience of the natural and built environment of Lisbon and Sydney, presents opportunity to highlight differences in sensory experience of respective city precincts. The synthesis of sensory colour contours in support of human comfort in the design of spatial environments seems timely within the context of a rapidly changing world.

The conception of sensory experience contours provides a context for the expression of a collective sensory memory of place. In order to define this further, it is useful to consider the symbiotic relationship of indigenous people such as the Australian aboriginals, with ‘the land’ or the environment, where walking connects the human senses with people and with place. Diverse aboriginal communities once communicated their respective relationships with ‘the land’ and ancestors via drawings of marks and contours made in soft iron-rich sands or on prepared bark skin of trees native to specific regions.

The adoption of a multi-sensory approach to the experience of environment enables analysis of layers of a scene at different points in time. This enables us to consider the character of a city or precinct as a changing scene rather than as a static scene. (Santos, Datutop 29, 2007)

Keywords: *senses, architecture, environment, culture, Lisboa-Sydney*

How colour effects comfort in urban space

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Abstract

How colour effects comfort in urban space was explored in two collaborative projects by Colour Your City. As the future is increasingly urban, it is important that there is greater awareness about what constitutes good design in the built environment, of which colour is paramount.

Communicating with citizens is at the heart of Colour Your City. Both projects invited an open exchange through a #ColourChat question series posed to the public at interactive art installations. This enabled an open exploration into public perception and feelings towards urban colour.

The first project took place in Durban, South Africa in February 2018, with visual art and design label PatternNation. An installation combined #ColourChat questions with a photography exhibition which had colour mapped the city, and PatternNation's 'blob' play sculptures. The installation took place at two sites: First Thursdays on Station Drive and I Heart Market.

The second project took place in Berlin in April 2018, as part of the Museum of Colours' Colours in (Dis)Order exhibition. There were two installations including a public space activation at the Kommandoturm in Schlesischer Park, a former watchtower part of the Berlin Wall.

Responses in both Durban and Berlin were overwhelmingly positive in relation to colour in the urban environment, with a lot of pleasurable emotional value (joy, aliveness, expression, inspiration) and clear indicators of comfort (contentment and enjoyment) associated with colourful urban settings. It was also clear that colour has variable effects depending on the nature and hue of colour, and the individual's mood. This helps demonstrate that colour is a vital factor to human comfort in urban space. Conversely grey was seen as depressing and sad.

In both cities there were many calls for more colour, through forms such as street art and nature. We see that there are many practical ways in which to increase comfort by having more creative, artistic and/or nature-oriented ways to add more colour to the city.

Areas for further research include looking at refining the #ColourChat format further to gather participant data. Also to consider the effects of specific colour hues, types of colourful interventions in urban space – both general categories and site-specific studies.

We can see that colour plays a major role in our experience of life and levels of comfort. This connection between colour and human comfort in the context of urban space is a pressing and important one, and is to be explored further by Colour Your City, to help shift urban habitats from often being poorly designed and inadequately executed, to places that serve human wellbeing and enhance vitality.

Keywords: *colour, urban space, environmental colour, human comfort, placemaking*

Walkability and Colour Experience: Façade Colours and Pedestrian Walking Preferences on Urban Streets

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Abstract

This paper explores the relationship between walkability and façade colours on urban streets. Several studies have investigated the relationship between the quality of the built environment and walking behaviour of individuals in urban neighbourhoods. Various walkability indices have been developed to quantitatively measure the urban design qualities of streets and inform urban design decisions to improve walking conditions. Besides larger scale indicators such as density, diversity, and accessibility; perceptual qualities regarding the design of an urban environment have been found to influence the overall walkability of urban streets (Ewing and Clemente, 2013). In their study, Ewing et al. (2006) identified the five objectively measurable perceptual qualities of an urban environment as imageability, enclosure, human scale, transparency, and complexity.

Complexity, one of the urban design qualities, is the main focus of this paper. It refers to the visual assessment of an urban environment that has variations within its features like shape, size, material, colour, and ornamentation of buildings along with other street features like the existence of urban furniture. It is assumed that when an urban environment is more complex, it becomes more attractive, interesting, and therefore more walkable. Ewing and Clemente (2013) considered façade colours of the buildings on a street as one of the indicators of complexity.

This study seeks to explore the effect of building façade colours on the walkability of urban streets, which have been considered to affect the perceived complexity of the streetscape and thus make it more interesting and attractive to pedestrians. For our research, a part of Lapa district in Lisbon, Portugal was selected for a case study due to its rich variety in façade colours and glazed tiles. Each building façade's paint or tile colour was in-situ measured, identified by using the NCS (Natural Colour System) colour notation system and classified in order to create a colour map of the study area. Specific cases where neighbouring building façades with (1) neutral colours, (2) warm colours, and (3) diverse colours were determined and photographed. Online surveys were utilized within our study to understand people's attitudes to varying cases of façade colour combinations. The results of the study indicate that the diversity and perceived pleasantness of façade colours on an urban street has a very close association with walking preferences. This study can act as an initial step in establishing a framework based on which designers can be advised in deciding on colours of individual buildings and managing colour codes in urban neighbourhoods.

Keywords: *walkability, urban design measures, built environment, façade colour, colour experience.*

Chromatic planning for Urban Furniture - case studies for a design methodology

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Abstract

This paper aims to present, the case studies intended to test a design methodology to be applied whenever there is a need to create urban chromatic plannings to urban furniture.

This methodology was first applied in a PhD research that envisioned to demonstrate that a coherent colour application to urban furniture would improve their visibility and legibility.

The methodology procedure consists in recording all environmental colours from a chosen settlement in order to establish its dominant colours and, consequently, enable the definition of the chromatic plan that must be applied to urban furniture, which should establish a chromatic and brightness contrast with the environment. A structured and contrasting colour application to urban furniture will achieve the enlargement of urban chromatic plans perspective, and simultaneously, will enable its elements to stand out from their background, transforming them in inclusive, factors as they become more visible for people with vision difficulties. Also, the urban furniture chromatic planning, as it identifies the chosen areas with different colours, will contribute for the local identification and ameliorate the city orientation.

The applied methodology takes in account the environmental colours of the chosen area, as well as the chromatic variations of the sky, the vegetation and other elements, whose presence has enough importance to be considered as environmental colours. It also includes the chromatic variations that may occur due to climatic and seasonal alterations. All these colours are recorded on files and maps, in order to create a data base that will allow the identification of the settlement dominant colours. These colours, and the contribute of the local history and culture, lead to the establishment of a very comprehensive urban furniture chromatic plan that will fulfil the urban furniture function requirements, respect the town traditions and achieve the research objectives.

The empirical phase of the Post-doctoral research is being accomplished in two municipalities on the Lisbon (Portugal) surroundings: Loures, a municipality away from the river Tagus and constituted by traditional, modern and rural settlements, and Oeiras, a municipality that have settlements both on the interior and on the sea front, being at the same time a miscellanea of old and modern.

In each one of these were chosen three neighbourhoods with different dimensional, anthropological and topographic specifications. Samples areas have been chosen, in each locality, that encompass their most representative zones, applying there the methodology to all furniture elements, in order to increase their potentiality as relevant issues for chromatic plannings. The two groups of chosen areas have some similarities between them in order to allow the comparison between the two municipalities.

Finally, in order to validate the proposed methodology, the colour choices will be surveyed by the local population, municipality authorities and colour experts.

Keywords: Colour Methodology; Urban Furniture; Urban Chromatic Plans; Inclusivity; Identification

Colours technology for an innovative Reclamation Architecture

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Abstract

Within the broad area of landscape design and enhancement there is a growing interest in the valorisation of spaces where the reclamation architecture are built. These interests have developed in the Veneto Region and extend in to the neighbouring provinces of Trentino and Friuli, in Italy.

In a research carried out at Iuav University of Venice in collaboration with the Reclamation Consortium of these territories, it has emerged the need of enhancement and requalification of reclamation systems. Among these there are: hydraulic supports, pumping stations, water towers, and so on, all built after World War II. Reclamation architecture made during this period was conceived as only functional system within the landscape. They are built without any design approach from an appearance, technology and landscape design point of view. Often these systems degrade the landscape quality. The Reclamation Consortium Manager asked Katia Gasparini for a guideline study to improve the reclamation architecture design and enhance the surrounding landscape. This can be done using an innovative design approach conceived to low environmental impact, where the priority is the integration of the pumping construction with the landscape resulting in a good environmental quality.

The paper will report the research methodology, the case studies analysis and results linked to the surfaces treatment made with innovative coatings and colour and light technologies such as: smart materials and coloured paints, innovative surface treatment and so on.

Above all, it will deal with the issue of landscape design enhancement with light and colour technology for a low environmental impact. It is even more important the integration of the design with landscape paths, parking spaces and natural surroundings. The reclamation system design is strongly linked to the surrounding environment. In fact, in many situations, in Italy, these hydraulic constructions are situated in a natural context. In that case, what is the correct design approach? Is it more important to design chromatic integration within the natural context on taking a high colour approach increasing the visibility of the artefact? And in an urban environment, what is the correct design approach? Will it be a design with innovative and durable materials or a low visibility impact design?

During the case studies analysis, we found different technologies and colour approaches for pumping station design, in different geographical areas: in Northern Europe is different from Italy, for example, and they are different from other World cultures and latitudes.

In the paper will be described the report of these studied results and a guidelines proposal for future design of different reclamation system in different context: natural and urban environment, with traditional or innovative materials. The research carried out was made with the aim of achieving these concepts: sustainability, reversibility, usability, security and visibility. The colour role in this design context will be analysed specifically by looking at the relationship between natural landscape colour and the artefact colour; the colour surface perception in different environmental context; the surface colour durability in a pumping station, and so on.

Keywords: *colour, landscape, smart materials, reclamation architecture, environmental quality*

Naqsh-e Jahan Square Colour mapping via NCS Colourpin II

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Abstract

Documenting and characterising colours of four major monuments' façade which is on four sides of the Naqsh-e Jahan Square in Iran is the subject matter of this paper. The Naqsh-e Jahan Square is an architectural masterpiece of the beautiful capital city of Safavid dynasty (1501-1736), which comprises of Abbasi Jame Mosque, Sheikh Lotfollah Mosque, Ālī Qāpū Palace, and the main gate of the Qeysariyeh Grand Bazaar. The Safavid Empire is regarded as the golden age of Persian art because it is a period of flourishing architecture and urban planning. It took around 31 years for the Naqsh e-Jahan Square to be completed (1598 -1629), measuring 160 meters wide and 560 meters long. It was like a heart of the Safavid capital city and therefore, it was registered in the UNESCO's World Heritage list in 1979. The present research focuses on colour mapping of this historical site which will provide an objective method for developing a colour database for future decisions of Iranian chromatic physiognomy. In addition, a part of chromatic identity of Persian urban colour will be introduced as a result of this study. Moreover, Iranian designer from all fields can use this identified colour palettes as a reference in Iranian context. The Naqsh-e Jahan square's colour palettes were manually documented by Jean-Philippe Lenclos (1938-) method in the first hand, who is a pioneer in observing and sketching colours of environment. However, later digital processes were introduced for this purpose. In line with the same, the present study uniquely contributes methodologically to the research literature by using NCS COLOURPIN II to exact ID code of applied colour in the Natural Colour System. Using this colour pin, different points will be collected as morning and afternoon dots, which will be compared in order to see the effect of solar position on them. The above- stated field measurement will be followed by interviews with experts (i.e., colour experts from different fields), wherein they will be asked about their perception on characteristics of identifies colour palettes. That is "colour harmony" and "colour contrast" of the extracted colour series during the data collection. Lastly, the present study has implication for multiple stake holders: Iranian urban designers, interior designer and architecture, heritage preservation bodies, fashion designer, graphist, painters, etc.

Keywords: *Colour mapping, NCS colourpin II*

Urban Design: Colour impact in human sense of comfort and well-being

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Abstract

“The dimensions of colour are many... Colour affects environments, forming and transforming them. In towns and cities it confers magic to everyday life and experience...A vital urban environment is one in which the visual elements – light, colour, and architectonic form signify and express civic functions... Absent coherent, stimulating, and meaningful environments we risk becoming impoverished, alienated and deprived.” (Swirnoff, L., 2000, pg.IX)

Contemporary urban design illustrates a scenario oriented to property development where the functions of working, dwelling and entertainment compete to deliver user experiences. The proliferation of the car encouraged repeatedly significant distances between work and dwelling areas while disturbing the sense of relaxing walk and interaction between user and the interesting spots of the place. The awareness of this reality lead to the need to deliver the urban space to users. To accomplish such goal several policies were implemented. To the purpose of this article we highlight pedestrian areas as well as the revitalisation of streets. New and rehabilitated buildings emerge as well as the construction of areas dedicated to different user experiences. Location, dimensions, functions and equipment are introduced, however, the colour that characterise the place exposes the negligence of its dimensions. The colour of the buildings does not consider the features of coating material, geographic location and mainly surroundings. Urban furniture and street pavement harmonise colour to each other or with environ while becoming difficult to identify.

User experience is important in urban design, and the experience must contribute to user sense of comfort and well-being. What defines the sense of comfort and wellbeing for user while experiencing urban space? Which is the colour impact on the human sense of comfort and well-being? Beside health features, comfort and well-being is promoted by urban design whenever it appeals for attention, convey information, support deception and stimulate emotions and this set of guidelines embraces the functions of colour.

The awareness of colour impact in the human sense of comfort and well-being while experience urban space oblige to a new approach towards its planning: for buildings, street, urban furniture, equipment, etc... conveying its language to define functions, to orient a route, to spot a detail, to invite to stay on a place or just continue the path ...

The correct application of colour language must be a concern of academia, professionals, municipalities and individuals.

This paper aims to demonstrate that each colour applied in urban space has a direct impact in user physiological and psychological system which contributes for user sense of comfort and wellbeing. The choice of a chromatic palette, considering the building but mostly the set of elements that perform urban space is a way to humanise the places that we interact with. From literature review we expect to identify some guidelines which can be considered / applied by professionals, municipalities and individuals to change the confused colour language that overcomes in so many urban areas.

Keywords: *colour, urban design, human sense of comfort and well-being, user experience, place humanising*

A Comparative Study On Consumers' Comfort And Behaviour In Real Store

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Abstract

The influence of physical environments on users' behaviour has long been acknowledged by architects, interior designers, and environmental psychologists. In retail design, the use of colour and light are important design techniques which aim to affect customers' behaviour and increase market opportunities. It is also known that, in retail environments, the decision to buy can have a greater emotional aspect than a functional one. It is well-known that customers' comfort level measures by exploring emotions. Mehrabian and Russell suggests that Pleasure, Arousal and Dominance (PAD) scales of a person show her/his emotions. These emotions could also be changed according to customer's behaviour. In the literature, there are limited retail store studies conducted in real environment. A real furniture store was selected for experimental set-up. This study adopts Mehrabian-Russell Stimulus Response Model in order to analyse consumers' behaviour. As a method, this study uses PAD (Pleasure, Arousal, Dominance) scale questionnaire and observation method to understand behavioural intentions. Two different colour temperatures, 2700K and 6500K, were located. 2700K is known as warm white (WW) while 6500K is Daylight. These colours of lighting source are preferred since they are widely used ones in the market. General lighting conditions were kept same and LED track spots were used on specific living room furniture set and these two colour temperatures were used on these LED track spots. Colour of furniture set is kept same and this colour is the most preferred one in the furniture store of experiment. Total number of twenty people participated in this study. Participants were not informed at the beginning and they walked around with the aim of buying a living room furniture set. Each participant was evaluated in terms of the total amount of time spent in the environment, number of items touched, time spent for investigating items, and their orientation patterns in the environment. These items were found with observation method without disturbing consumers' activity. When they finished their walk, participants were asked to fill questionnaire sheet. Correlations between these scales and colour temperatures were evaluated. The results showed that colour temperature has an impact on pleasure level of consumers'. Pleasure level increased when the specific area illuminated with warm white (WW) colour temperature. It was also found that there is a correlation between time spent and colour temperature. People spent more time when the furniture set illuminated with WW. Lighting with track spot lights changed also direction path of consumers. The order of visiting illuminated furniture set is changed under different colour temperatures.

Keywords: *lighting, colour temperature, emotions, behavioural intentions, retail store*

100 Silesian colours and patterns. Project of decorative patterns and sets of colours inspired by applied art of Upper Silesia

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Abstract

“100 Silesian patterns and colours”. Project of decorative patterns and sets of colours inspired by applied art of Upper Silesia is a project created within the framework of scholarship from Foundation of promotion of work of Ministry of Culture and National Heritage of Poland.

One important reason to undertake this project is a conviction of necessity of preservation and promotion of national heritage and industrial diversity of the region. Proposed action had to do with archiving of existing patterns and accompanying sets of colours and consequently gathering and designing about 100 graphic projects inspired by original patterns. That's how the data base of graphic patterns was created in a form of vector projects (saved in digital form, ready for printing, plotting etc.) publicly available to be used for promotion activities.

There were 3 main objectives of this project: digital documentation of chosen national heritage with regard to ornamentation and colouring, project of patterns and sets of colours inspired by applied art of the region, obtaining of graphic materials (patterns of ornamentation, characteristic sets of colours) of high visual quality, possible to be applied with contemporary media (digital) employing heritage of decorative art in creative, modern, innovative approach, bringing back to social consciousness original elements of industrial design, creating art, culture and Silesian identity and promotion, building the image of the region through contemporary applied art.

While doing the project we cooperated with several museum centres (Museum of Upper Silesia in Bytom, Museum in Rybnik, Silesian Museum, Ethnographic Museum in Opole). The biggest challenge probably while vectoring patterns. Themes on porcelain were made with different techniques, among others: decalcomania, glaze, handmade decorations. Such decorations had different characteristics and while digitalization of the patterns, preservation of their uniqueness was our priority. Next stage of work was to create sets of patterns inspired by catalogued decorative elements. Each pattern was presented as: original pattern, patting pattern, pattern on a circle or oval, rapport surface of square filled with repeated elements for multiplication. Sets of colours were described in NCS and Pantone systems and CMYK.

As most important results of the project, we can number database of graphic elements, book of patterns and colours including set of patterns inspired by catalogued decorative elements and set of colours inspired by typical combination of colours used in applied art of the region.

Created elements can be used as elements in many identification projects and be element of visual culture of the region.

Keywords: *Digital documentation, ornamentation and colouring, project of patterns, sets of colours, national heritage.*

Survey on perceived façade colours using colour samples from ready-made plaster collection for southern Poland

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Abstract

The main goal of the article is to present the results of the colour survey, conducted by the authors as a part of the development of a new colour palette of finished façade plasters for the Polish manufacturer Fabryka Farb i Lakierów "Śnieżka" S.A. The palette, which consisted of 300 colours, was intended mainly for Poland. Hues were selected based on the analysis of colours typically used for façades in the region as well as local consumer preferences.

As it is well known, there exist differences in the perceived and nominal colour, which may result in improper selection of colours for the façade, especially by the inexperienced. Therefore, an experiment was carried out with an aim to examine these differences for selected 12 colours from the designed plaster collection. Another goal of the study was to compare the obtained results with the findings of similar previous studies to indicate the potential impact of local light conditions on the perception of colours.

The colours used in the survey were selected on the basis of popularity rankings developed by leading plasters and paint manufacturers, based on sales results in Poland in the last decade, as well as authors' own research in the field of architectural colour. All colour samples have been described in the NCS notation. For the purpose of the study, samples with dimensions of 1x1 meter were prepared, covered with plasters coloured in the mass.

The survey was conducted twice - in June and October 2017 in Krakow, on the campus of the Cracow University of Technology. 64 participants took part in it, mostly students of Architecture from CUT and students of Industrial Design from the Academy of Fine Arts. The plaster samples were hung 30 meters from the observation site. The task of the participants was to find in the NCS atlas colours corresponding to the presented plasters, and then enter their notations into the prepared study cards. The test method was selected based on the studies carried out by Karin Fridell Anter, as it gives the opportunity to precisely describe the results using the NCS system tools (triangle, circle). The results of the study were collected in the summary tables, and then for each of the 12 samples a graphical illustration of changes in the hue and nuance using the NCS triangle and circle was made.

The analysis of the results clearly confirmed, also emphasized by other researchers, the general tendency to reduce blackness and increase whiteness of the colour perceived in relation to the nominal one. Most of the colours showed a relative hue stability, with the exception of achromatic ones, which underwent multi-directional changes towards chromatic colours. No significant influence of the changing lighting conditions nor the observer's experience in working with colour on the sample reading has been confirmed.

The authors hope, that thanks to information about the directions of changes, the results of the survey, suitably illustrated, may facilitate the more conscious selection of façade colours from the prepared collection of finished plasters.

Keywords: *colour in built environment, colour in architecture, colour perception, façade colour, colour design*

Colour Planning in Town, a no profit colour project

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Abstract

Colour is much more than electromagnetic wavelengths. This interesting medium you can look at from many, very different view points definitely influence us – human beings – both consciously and unconsciously. Therefore, it is our duty to dedicate the maximum of our attention to these subjects and their effects on human life.

The International Association of Colour Consultants / Designers, IACC Chapter Europe, was invited in 2017 to create a new colour pallet for the City of Lanciano, Southern Italy, maintaining the character and identity of the town. A “no profit project” was offered to the community of the city. No profit means, that our knowledge and experience in practice was inserted into the project and the colour experts are working for free of charge, but for the personal expenses and materials.

In this presentation I would like to talk about the collaboration between my colleague and IACC Colour Designer, Mrs. Lee Jin Hee and myself.

In a section of the old part of Lanciano, the current colours of 11 buildings were documented by using colour fans of various colour systems or colour producers. In the studio all notes were carried out as colour samples (53 nuances in original colour quality) and carefully analysed.

For the new pallet the up-to- date colour sequence was strongly diminished and only 4 “new” tones were added to harmonise the optical impression. The aim was also to give visitors visual help for orientation while exploring this old city. Using original paint, which was provided for the realisation, finally the colour plans in form of colour collages were produced.

Not using the computer for colour projecting someone avoids the enormous difference between the appearance of colour on the monitor and the final effect of true paint on the wall. This problem seldom is considered as serious, too less taken care of or taken into consideration. And sorry to say, it is very seldom corrected or adapted to the optical impression and effect of colour sequences. We have to remember that the additive colour match, in spite of all new technical achievements, never can be the same as the subtractive colour mixture. These two colour worlds never will meet.

The IACC Colour Academy has focused its activity on education of the responsible use of colour, based on scientific researches and practical experience. The power of our seminars is the integration of interdisciplinary knowledge and research into Colour planning.

Colour is definitely more than decoration. It is an absolute necessity for a balanced surrounding. Recently a medical statement was published telling that more than 75% of all illnesses derive from stress: In this connection the stress diminishing property of colour is THE MOST EFFECTIVE one to take care of.

Keywords: *Colour-Planning, City-Identity, Colour and Human Response, Orientation*

Spatial colour design using Luminous colour images; Part 1 - how to extract Colour Contrast Images from Luminous colour images

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Abstract

It is quite difficult to estimate colour appearance in the real built environment, because colour appearance of surfaces in the environment is defined not only by their reflectance but by attribute of light illuminating them. Furthermore, there are a lot of luminous or light-emitting objects in the real built environment. For better spatial colour design, it is required to establish a method to estimate all colour appearance in real environment reasonably.

It is well known that colour appearance of object surfaces can be more or less estimated by reflectance of them, which is called Colour constancy. The authors re-examined conditions when colour constancy emerged and got suggestion that any kind of colour chips could not be seen isolated but it always had background. Thinking of colour contrast between the chip and the background, it was found that the contrast was almost constant even under different light sources like illuminant C and illuminant D65. This suggested if we imagined luminance and chromaticity distribution on a transparent screen in front of our eyes, namely luminous colour images in front of our eyes, colour appearance of the chip could be objectively estimated because luminous colour contrast could be calculated from those luminous colour images.

To make certain this implication, contrasts of Munsell hue-different colour chips with value 6 set against N5 background were calculated. In order to understand colour appearance, contrasts of tri-stimulus values X, Y and Z were translated into LC, aC and bC. LC was luminance contrast represented as $\log_{10}(Y_t/Y_b)$, aC was red-green component contrast represented as $[\log_{10}(X_t/X_b) - \log_{10}(Y_t/Y_b)]$, and bC was yellow-blue component contrast represented as $[\log_{10}(Y_t/Y_b) - \log_{10}(Z_t/Z_b)]$, with reference of CIELAB, when X_t , Y_t and Z_t were tri-stimulus values of the subject colour chip and X_b , Y_b , and Z_b were those of the background. As the result, plots on aC-bC graph of those colour chips showed circular figures and suggested this calculation could estimate colour appearance of them.

Contrast calculation can be represented as spatial filtering calculation with a contrast extraction filter like N-filter, to luminous colour images of X, Y, Z. Therefore, this filtering was applied to luminous colour images of Munsell colour circle captured by 2 dimensional luminance and chromaticity measuring device. The result showed LC, aC and bC contrast images reasonably represented colour appearance of all the colour chips of the circle. Finally, luminance colour images of real townscape were captured and analyzed in the same manner. The result suggested that three contrast images of LC, aC and bC could generally represent colour appearance of the real environment, so that colour appearance of both luminous colour and object colours could be estimate because in the luminous colour images there were no distinction of them. Absolute values of luminous colours, however, seemed to influence their appearance apparently, so that those effects would be examined in the next step.

Keywords: *luminance image, luminance and chromaticity, image analysis, contrast profile*

Environmental visual literacy: Examining the roles of colour and contrast

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Abstract

The design of the built environment plays a number of roles in our lives, aside from providing shelter, comfort and social interaction. Design factors can also encourage engagement, support orientation and wayfinding strategies and signage, and facilitate the safe operation of daily activities. .

An effective interface between the built environment and users is important and architects and designers often embed passive design features into the built environment to enhance the effectiveness of this interface. However, this interface can become problematic due to issues that may occur on both sides of the equation; that is, in terms of users and the design of the built environment. Environment-behaviour research indicates that a range of design factors can either support or hinder human response and as a result, the interface between users and the built environment may become problematic for people with declining cognitive and visual capacity.

In the mid twentieth century, some architects and designers began to focus on a general aim of ensuring that design should not only be aesthetically pleasing but also usable to the greatest extent possible by all people irrespective of age and ability. As a result of this focus, a set of Universal Design principles were devised with the aim being that these can be applied to the design of the built environment to improve this interface for all users. However, there are a number of additional strategies that can enhance this interface and these relate to the mechanics of human vision and the role that colour and contrast can play in terms of environmental visual literacy.

Environmental visual literacy is the capacity to 'read' passive design features embedded in the built environment, and make sense of these in a meaningful way. This paper discusses environmental visual literacy and its importance in terms of human interactions with the built environment. The mechanics of human visual perception is discussed and in particular, the key roles that colour and contrast perform in perceiving and cognitively identifying environmental design factors. Finally, selected evidence-based colour/contrast strategies are explored in respect to the ways these facilitate effective environmental visual literacy and in particular, enhance engagement and activation of the built environment, support orientation and wayfinding strategies, improve the effectiveness of wayfinding signage, and assist with the safe operation of daily activities. In doing so, evidence-based colour/contrast strategies can enhance human comfort and wellbeing.

Evidence-based colour/contrast strategies represent an approach to environmental design that acknowledges the range and extent of visual capacity and deficiency among users and aims to improve the interface between the built environment and users, irrespective of age and visual capacity.

Keywords: *Evidence-based colour strategies, design of the built environment, environmental design, environmental visual literacy, orientation and wayfinding signage.*

Environmental colour mapping and a case study for İstanbul, Beşiktaş

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Abstract

A conscious and systematic facade colour design in a settlement depends on considering the factors and data about natural-artificial environment and visual perception, not only for a single building but also for all scales of a settlement. In other words, a successful facade colour design in settlement scale is based on the urban colour plans.

As is known, in everyday life, the colours of the building facades are usually determined by the architects, users, institutions, employers, etc. Therefore, it is not generally possible to analyse in detail the parameters and data in settlements during the determination of facade colours when the settlement has no colour-specific limitations. As a result of this process, the colour selections made are mostly subjective. This situation especially affects the appearance of buildings and the architectural identity of the regions where the historical buildings and examples of local architecture are located. In order to alleviate these drawbacks, it is clear that it will be beneficial to prepare settlement-specific "colour master plans" by the cooperation of colour designers and local governments taking into consideration the environmental parameters of the settlement.

In this context, an approach has been developed in the PhD Thesis, "An Approach for the Facade Colour Design in Settlements" including the four basic urban colour planning stages and guide the process of the creation of Urban Master Colour Plans. These stages are as follows.

- Determining the colour design priority of regions (district, neighbourhood, square, street) and buildings of the settlement
 - Performing environmental colour mapping of urban regions and buildings,
 - Identification and evaluation of urban region and building properties that affect colour perception,
 - Making colour suggestions for urban regions and buildings.

As seen in the stages of the approach, in the preparation process of urban colour plans, one of the basic study is analyzation of the environmental colours. These analyses which are called environmental colour mapping, constitute a reference for the colour planning, colour design of facades and other urban elements. Also, an archive which has all natural and artificial environment colours of the settlement is developed by environmental colour mapping.

This paper aims to introduce the basic steps of the Facade Colour Design Approach and to present the works carried out for the second stage of the approach, environmental colour mapping that is illustrated in the natural and artificial environment of Yıldız Technical University (YTU), Yıldız Campus situated in Beşiktaş, İstanbul. In the case study firstly, colour features of natural and built environment elements in the campus have been examined and documented. Later on, colour samples have been collected from natural and built environment, classified according to the Munsell Colour System. The data obtained from the performed case study can be utilized in the future colour designs of the YTU, Yıldız Campus. Similarly, environmental colour mapping studies to be carried out on successive scales of a city such as streets, neighbourhoods, districts, and the whole city will lead to colour planning for such scales.

Keywords: *Colour mapping, Environmental colour analyses, Facade colour, Colour planning, Colour master plan*

The Green in Architectural Rehabilitation

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Abstract

The green is dominant in nature, and it is the colour that is best perceived and visible to the human eye. Its dominance is due not only to species' evolutionary factors, but also to the importance of photosynthesis in our planet. This relation inherent to the natural world, as well as the exposure to nature, benefits our health. The aim of the article is to alert to the fact that architecture must comprehend Nature and bring it back again into the daily life of Man, increasing his physical and psychological comfort.

The "Green" in Architectural Rehabilitation may have various significations and approximations. In this article the "Green" is approached as Colour and Attitude, and this paper has been developed through deepening the hypothesis of the colour green in living coatings. These allow creating solutions that prevent the formalisms of architectural language, being of special relevance their use in Architectural Rehabilitation of the Heritage.

Examples of green roofs and the green façades are presented and, as a case study, we have selected the Rehabilitation of the Portalegre Cathedral.

The aesthetics of the living coatings is fundamental, making it possible to obtain completely different solutions by the option of the colour changing, according to the seasons of the year.

The plants are selected in function of the colour of the flowers, the leaves, or both, as parts of the coatings may be green, and others can be red, brown, or have different colours according to the blossom of the flowers. Even in the green zones it is possible to opt for different shades and gradations.

The living coatings, either in façades, roofs, or pavement, form proposals of quality finishes.

Nowadays, solutions begin to emerge with the use of algae and/or other green microorganisms which open the field of investigation, not only in coatings, but also in the production of renewable energy, increasing comfort, the intervention fields and their sustainability.

It is crucial to stand against the change of paradigm and to reflect about the climate changes and how they interfere in every field of architectonical creation.

The "green" as an attitude, is developed in the perspective of sustainable rehabilitation - construction, implementation, maintenance, deconstruction -, covering the whole life cycle in order to minimize the environment impact, with applications to architectural design. It increases the thermic and acoustic insulation of the buildings and allows a natural shadowing. Besides that, it improves the air quality, purifying it, increasing the comfort of its users. It is still possible to decrease water consumption through the right choice of vegetation and implementation of a management system regarding the consumption of rainwater. The green coatings can also be used to treat grey water, contributing to the innovation of the management of water and ventilation systems.

Complementarily it is necessary to think architectural rehabilitation as a form to achieve the NZEB – Nearly Zero Energy Building.

Keywords: *Architectural Rehabilitation, Green walls, Green roofs, Algae, Biological concrete*

The main elements of the colour design process of a new neighbourhood – The case Koivusaari in Helsinki

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Abstract

The case Koivusaari is a part of urban the design project, in which the focus is on the detailed plan and design guidelines, especially on guiding the colours of new architecture. This doctoral study gives practice- led information about the architectural colour design in the urban design context. Particularly, it focuses on the formulation of the architectural colour design to the detailed plan and design guidelines. This paper describes the colour design process of Koivusaari. In addition, it discusses another well-documented large- scale colour design project, Smedal's colour designing for Longyearbyen, Norway, and Lancaster's research on colour strategies in England. In their cases, the target of colour design is creating the colours and materials to the particular buildings. In the Koivusaari case, the actual construction will not happen until 10- 20 years from now. Therefore, it is impossible to only design the specific colours without knowing the architecture. The Koivusaari design consequently focuses on the atmosphere and identity of the new neighbourhood and the meaning of architectural colour.

The method is Research by Design: producing new information about the colour design process as a designer in the Koivusaari case and analysing the design process and available data as a researcher. As a designer, I have worked a colour design consultant in the urban design project of a new island and neighbourhood Koivusaari. The research data includes the sketches, the photographs, the notes, tape-recorded meetings, NCS measurements, SketchUp model and cardboard 3D model.

This study has identified eight steps in the colour design process in the Koivusaari case. The main eight elements of the case Koivusaari are (1) Introduction, (2) Analysis, (3) Sketches and colour concepts, (4) Perspective of colourscape, (5) Colour workshop, (6) Additional analysis, (7) Colour design of the neighbourhood and the blocks, (8) Detailed plan and design guidelines. Each phase has its own aims, which need to be met in order to proceed to the next phase.

The beginning of the colour design process in Koivusaari is quite similar to Smedal's and Lancaster process, as they all emphasise the importance of the analysis of the site and existing architecture. In addition, they consider the meaning of seasons and weather. However, the target in the Koivusaari case is not to create the specific colours to the facades. Instead, the target is to create the identity of the new neighbourhood with colours and connect Koivusaari to the landscape and the cityscape in all seasons. In the neighbourhood with over 5000 inhabitants, it important to have both harmony and variety and to keep the identity of the new neighbourhood clear. The colour design process of Koivusaari resonates with Böhme's concept of making the atmosphere but extends it to making the atmosphere with colour in a new neighbourhood.

Keywords: *Colour design, Urban design, Colour research, Detailed plan, Atmosphere*

Conceptualization of Colour and Light in Interior Spaces: Gelre Hospital in Zutphen and Underground Parking in Katwijk-aan-Zee

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Abstract

Colour and light are used in nature to facilitate plants, animals, and individuals to convey intended meaning and information to their surroundings, i.e. communicate and orientate. This paper aims to clarify how the author, as the interior architect of the case studies, approaches a colour and light design having the focus on functionality and the user's experience. These two distinct projects – the Gelre Hospital and the Katwijk Parking Garage – were chosen due to the architect's use of the same method in the design process. The two projects differ in size – the hospital doubles the size of the garage; in their focus group – the hospital has staff and patients who experience the space for long periods of time, while the garage has short term visitors; and of course, in functionality – the hospital has a complex programme while the parking garage is constituted, mainly, by one single area. Whereas in the hospital the design of the colour plan was used in a direct link to the well-being of patients, both projects focused on orientation and communication with a holistic aim of creating one cohesive colour scheme.

This approach to colour and light design is influenced by the system of Meerwein et al (2007) in terms of understanding how colour influences people's moods and perceptions and how to translate that approach to the client. Other influences came from the work of Steven Holl and his resonance of colour and light, Salíngaros (2016) and the biological understanding of design, and the always relevant perspective of Merleau-Ponty (1999). The light and colour schemes created focused on materialization and lighting system, in a way that helps users to easily identify their position at all times and assist them to quickly navigate the space. On the garage project, a cultural, urban, and anthropologic research created the basis for the communication elements that connect the visitors to their surroundings. While in the hospital, a nature theme was introduced to create the link with the users and each department. Three aspects of conceptualization of a light and colour scheme in interior projects are highlighted: atmosphere of the space, orientation of users, and communication of information. The end product was also optimised by working in multidisciplinary teams, where there was an open and direct communication between the different areas of the design and with the Client. Both projects have been finished and are open to the public since 2010 (hospital) and 2015 (garage), with positive reviews by their users and industry peers. The Katwijk Underground Parking received several awards, including Best Building of the Year 2016 in the Netherlands, awarded by BNA – the Royal Institute of Dutch Architects.

We can conclude that the success of both projects resides not only on a holistic design but also on the introduction of the designer on an early stage of the project and by the commitment of the client on passing the designer's vision into the final work.

Keywords: *Colour, Light, Communication, Orientation, Conceptualization*

Morphology of Contemporary Environmental Colour Design

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Abstract

Environmental colour design is a vibrant and dynamic phenomenon. Since its inception in the 1940s, it has experienced a wide range of changes and many new developments of its content, social functions and forms. Originally the concept of 'environmental design' encompassed processes of human interaction with surrounding natural (e.g., geographical, solar, climatic) factors as entailed in the course of planning and building in such fields as urban design and planning, architecture, landscape architecture, and product design, which lead to manmade impact on the natural environment. More recently, the concept implies ecological and sustainable design efforts. Lately, in terms of developments in the field of colour, environmental design is playing a key role in creating the intended atmosphere in indoor and outdoor spaces. Its aim is to improve a sense of well-being and comfort through the construction of aesthetically appealing and environmentally friendly urban and residential facilities and public infrastructures.

The main aim of this paper is to understand environmental colour design as a complex system and to find new descriptions of the variety of its morphologies using the fractal approach.

Benoit B. Mandelbrot introduced the concept of 'fractal' in his French book *Les Objets Fractals: Forme, Hasard et Dimension* (1975) for describing spatial forms which are not regular, fragmented, and include similar structures at different scales of analysis. The concept of fractal is especially helpful in allowing order to be perceived in apparent disorder. It suggests that variation and fluctuation on all scales are important, and related to each other. It allows the discovery of patterns and rules in the seemingly absolute chaos.

For studying the morphology of environmental colour design we used two types of methodological tools, which provide complementary insights on fractality of the urban patterns. Firstly, an online survey of colour professionals was carried out at the end of 2017. The total sample size was 202 respondents (86 males and 116 females) from 35 different countries. Secondly, the study used quantitative content analysis to investigate the meanings, themes and patterns of how different colour systems are applied in environmental colour design. We reviewed the AIC (Association Internationale de la Couleur) Congress and Meeting Proceedings over a 10-year period (between 2008 and 2017), treating particular elements of urban composition at different scales as integral parts of a whole sharing a common idea, examining their content regarding the goals, instrumentation, focus of environmental colour research, and traced their changes over the time and countries.

Keywords: *Environmental Colour Design, Fractals, Colour Research, Colour Systems, Morphology*

Chromatic Satiation and the Architecture of the American Diner (from “comfort food” to comfort space)

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Abstract

The diner, the timeless restaurant archetype, supplies moments of solace to drivers along the vast highways of the American landscape. “Comfortable and inviting,” diners extend pleasures of home to regulars and one-time visitors alike. Although diners offer quintessential *comfort food* – satiating, warm, and filling nourishment – that makes a chilly night, a desolate freeway, or a lonely life path seem a bit less cold, the colour design decisions in quintessential diner design drive messages of comfort long before a morsel of food is consumed. This paper explores how use of colour in relation to light and materiality in diner architecture communicates the concept of *comfort*.

Diner design offers predictability with the consistent shine of spotless surfaces in an expected visual environment. Design choices enhance the comfortable concept of diners as a “model of egalitarianism,” accessibility, and loyalty. Colour, in combination with layout, architectural form, and location, delivers this all-important message of comfort. Vibrant neon signs, glowing yellow ambiance through planes of glass, and hot reflections of car headlights off of shiny silver diner exteriors beckon weary road travelers from miles during the dark of night. Painter of diners, John Baeder, explains, “The fascination comes from all the materials and textures and colours... painted in gold and crimson and azure blue... the close-up wonders that happen with wood; shiny, mellowed caramel wood contrasting white porcelain with chrome hinges. Glimmering, shimmering stainless steel—inside, outside; wrap over and under, in and out. Mosaic inlaid tile... Colour pink. Green. Burgundy, Grey and Blue and Tan and Red and Beige Yellow... Thick Brick. Glass... Gold-flecked Formica... ruler of the table tops, and counter tops...” Materials such as Formica – the synthetic economical countertop surface – or seamless stainless steel bent into Art Deco motifs offer economical, pragmatic, and predictable surfacing that easily wipes clean within the carefully crafted environment.

Some people believe as we become more industrialized and separated from each other, there is a greater need to find the “homey comfort of a simple diner.” But, more importantly in today’s tumultuous times in the flawed political climate of an America in an increasingly conflicted world, designers can learn from the diner typology to suggest a comfort of consistent truths, acceptance, and openness in contemporary design. This paper explores colour decisions as messengers of contentment – not just to those hungry for food, but to those hungry for comfort.

Keywords: *Restaurant design, materiality, colour and era, Americana, car culture*

Defining industrial environments through colour and light

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Abstract

Colour and light produce multisensorial effects that determine the way reality is perceived by the human being. Throughout history, the technological evolution and the different socio-cultural fluxes have been creating distinct considerations regarding the design principles of industrial spaces. It has been recognised by several authors that it is important to articulate the design process and the reality of experiencing spaces however, there is still an outstanding dichotomy between the definition of industrial environments and the perception of colour and light. It is important to understand the motivations that underlie the conception of industrial spaces to create new practices of representation of light and colour, with an emphasis on human behaviour. Hence, the goal of this ongoing research is to highlight principles of intra- and interdisciplinary areas of knowledge that positively influence the social, emotional, and physical wellbeing of the users, and improve functionality in industrial spaces of low, medium, and high production. In order to accomplish this purpose four industrial complexes were selected for a purposeful analysis: Usine Claude et Duval by ATBAT / Le Corbusier; Panificadora de Chaves by Nadir Afonso; Magnum Energiecentrale van Nuon by Royal HaskoningDHV; and Manifattura Berlut by Barthélémy & Griño Architectes. Among many aspects, it was analysed how light and colour were used to reinterpret identity, legibility and harmony, as well as comfort and wellbeing. The challenge represented by this ongoing research is found mainly in cross-comparisons carried out between these case studies and a set of distinctive cultural, social, and spatial characteristics that are vital for furthering the discussion on humanization of industrial spaces. The process of questioning principles and techniques led to identification of differences and particularities, in an international context, so as to enable the development of new methodological directions. These new methodological approaches may aid professionals of diverse fields to design with excellence, meeting the needs and expectations of users. For the creation of this analysis, the following tasks were carried out: literature review; diagrams and drawings that systematize materiality (texture, pattern, colour) on particular spatial arrangements of the environments; observation sections focused on the features that contribute to the qualification of the physical space; aspects of presence and appreciation of place as expressed by the users of those environments; and interpretation and critical discussion of the results. Colour and light connect the human being to the interplay between space, form, texture, pattern, and time in the representation of architecture. These current challenges combined with an effective management, allow for the creation of industrial spaces to provide the comfort required by their intended functions.

Keywords: *colour-light-senses; comfort; wellbeing; industrial spaces*

Light, colour and (im) materiality: the scenic space as mean of urban regeneration

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Abstract

The architecture of a city always mirrors the collective consciousness of a people through the use of space. In a society experiencing moments of great transformation, triggered by the challenges of the technological and digital world, which changes the way people, culture and economies relate, the importance of architecture stands out, namely through its materiality and colours, in creating real spaces that facilitate communication between individuals and restore meaning to communities. On the other hand, despite the fact that economies and cultures have become global, which impact the materiality of places, the historical city, in its multi-sensoriality, continues to offer the parameters and foundations for creating living spaces, capable of triggering new sensations and ideas in the body that creates and experiences.

This research aims at analyzing precisely these parameters and foundations for the present urban space, searching for reflect on the scenographic potentialities of the city, through the concepts of materiality and authenticity. The city with heritage status is undoubtedly a potential scenographic stage, but acquiring an awareness of how the urban scenario works in a perspective of authenticity will help to understand the mechanisms that will rehabilitate the city. According to Merleau-Ponty, the body is a creative entity, which changes its configuration. Thus, in sense that everything is consciousness, we analyze the relationship of architecture with the body that experiences, through the (i) materiality of light and colour in the city of Porto.

The materiality and colours of architecture, as active constituents of the city space and determine the lived experience and potential of learning.

However, nowadays the body is experiencing moments of great transformation, undergoing technological experiments whose purpose is overcoming its limits, and we see that, in contemporary society, two types of trans-humanism are being triggered, which increasingly explore the frontiers of the human. An intellectual trans-humanism that seeks to analyze and improve the human condition thanks to the use of science and technology, in a categorical affirmation of the irrelevance of the body against cybernetic potentialities; and a "spiritual" Trans-humanism, based on overcoming the human by the expansion of consciousness.

Therefore, the historic city emerges as a way in where one's own thought is formulated, a scenario in which the individual is related to architecture, architecture relates to the individual and the individual relates to himself and to the other (and in the limit, relates to the whole). And it is in the quality of this relationship that our consciousness is illuminated and everything becomes clearer.

Keywords: *city, body, colour, materiality, rehabilitation*

The Governance of Light: Wellbeing and current practices of public lighting in Lisbon

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Abstract

Light has positive connotations with health and security. Throughout the XXth century, and up until today, we can observe that there is a tendency to overuse light, creating bright surrounding environments, even at night. Public lighting use is no exception to this. We consider that the impact of artificial light use remains to be addressed and this paper aims to make a contribution towards the topic. Our goal is to focus on public lighting, analysing the impact of light pollution on single organisms. In order to that, we will first examine several studies that focus on the impact of light on circadian rhythms – studied by chronobiology and shared by plants, animals, fungi, and cyanobacteria – providing an overview of what has been done in this area in the last couple of decades. Circadian rhythm is a 24-hour cycle that responds to the light-darkness cycle, responsible for regulating body temperature, sleep, hormone production, eating patterns and neurological stability. Artificial light, though unquestionably useful, has the ability to throw all these out of balance, affecting both our physical and mental health. Equally, artificial light can contribute to promote our health, and if it can, it should. We are particularly interested in addressing the impact of public lighting in mental health, aiming to identify the state of the art on this topic. Secondly, as a case study, we choose the city of Lisbon (Portugal) that has recently implemented the policy to replace all public lighting in the city, using LED. We aim to evaluate this decision, aware that there was a heated discussion about if LED should be used in the first place, and if so, which kind of LED (white or yellow). White LED is cheaper but yellow LED is not as ‘harsh’. Is there enough scientific information available that is able to support that, though more expensive, yellow should be the way to go because it has a more positive impact on our health? We will base our assessment, using two pairs of concepts that belong to the realm of Economics: 1) the ability to accomplish a pre-established result (effective) and to perform in the best possible manner with the least waste of time and effort (efficient) and 2) delivering results (short-term) and generating an impact (long-term). Dwelling on past and current practices we claim that when it comes to public lighting choices, good governance practices should consider health impacts above all other criteria, effectiveness should lead efficiency and impact, illuminate results.

Keywords: *public lighting, mental health, urban planning, wellbeing, light*

The role of environmental colour in the experience and identity of the city

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Abstract

In the last decades the city has become a main issue of debate in different disciplines. In fact, the city has become the best laboratory to test all the processes involved in the transformation of contemporary cities. Actually, the construction of the present city and its spaces make up a complex but appropriate performing context to reflect on the city, its spaces and the relationship with experiences in the present society. In this context, the role of environmental colour is essential since it suggests environments that promote ways of understanding and experiencing the space being this a primary element in the strengthening of urban life and the construction of the identity of the city.

The city as a collective place, public event or social life environment expresses evident changes in the urban space which reinforce the idea that this space matches the ideas of the “city” according to different times. Moreover, the idea of inhabiting keeps its meaning since the urban experience is mainly the combination of physical and mental facts not only material but imaginary as well.

The feeling of colour and the chromatic environment are part of the urban experience and take part in the everyday city life, being at the same time an aspect of its history. In the last decades, the environmental colour, that unique and general chromatic impression of the urban environment, has shared and taken part actively in the changes of societies that become evident in different ways in the city and its places.

The original function of colours is to represent concepts so as to establish a communicative relationship between the individual and the physical environment. As a consequence, the chromatic experience depends on the quantitative and qualitative interaction of the diverse components and contexts that take part in it. The environmental colour, as a psycho-physical phenomenon, is perceived together with other variables such as textures, chromatic contrasts, cesías, the material and aspect of limits, the position of the observer and the manner and speed of movement among others.

Thus, colour in the city appears as essential information that stimulates the perceptive channels that lead to action, recognition and visual tours that promote different behaviours. In the chromatic field this takes on foundation when colour is considered to serve different functions since it identifies and locates in space and time, describes the properties that define its character and possible uses and categorizes characteristics among other actions. In addition, cities are dynamic organisms which change, update and transform themselves. Moreover, their environmental colour is the reflection of a single moment and can change with time according to the different variables that influence those changes. This unique and typical dynamics is the source of its polysemy and attraction.

Within this framework, the performance of environmental colour with its iconic-linguistic potential is essential since it increases its capacity to inform, suggest and develop synaesthetic associations and create environments bringing about the experience of the city and the promotion of urban life which are vital for its identity, design and construction.

Keywords: *environmental colour, urban experience, chromatic identity, contemporary city*

Personalised Colour Palettes in Home Furnishing

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Abstract

Colour is a powerful component in daily life as it forms both natural and designed environments. Particularly in the case of home interiors, colour has influences as it is an important element of the design. Home furnishings are designed to meet a variety of human needs considering that humans seek comfort and pleasure in their homes.

Despite the existence of empirical work related to colour impact on individuals and colour emotions, the influence of colour studies does not show in the home furnishings market practices, for instance, the idea/concept of 'personalised colour palette' is not available in stores.

Based on the aforementioned and since colour impacts individuals' lives, this study investigated how home furnishing stores can provide a personalised colour palette to its consumers in the UK. The research methods framework was designed to support the exploratory nature of the study by conducting a Consumer Survey, a Designer Questionnaire, and a Colour Experiment.

The study results demonstrated that consumers can have home furnishings based on a personalised colour palette by visualising the furnishing items with the aid of Virtual Reality (VR) technology.

The results of the Consumer Survey and Designer Questionnaire combined highlighted the importance of colour to consumers in terms of purchase decisions and positive emotions associated with colours. Furthermore, a noticeable gap between consumers' views and designers' views with regards to colours was noted. The Designer Questionnaire indicated a minimal consumer involvement in the colour palette decisions and a high impact of designers' knowledge and skills. The questionnaire showed variable views of designers regarding the consumers' satisfaction with the colours currently available in the market of home furnishings. Hence, future large-scale surveys were recommended to develop a thorough understanding of the views of both UK consumers and designers.

The Colour Experiment was conducted by creating 6 VR panoramic High-definition (HD) designs of living rooms; each design included furnishings based on a personalised colour palette according to participants' colour preferences. A VR head-set was used to view the designs.

The study recommended the use of the VR technology in stores based on the positive impression expressed by the experiment participants in addition to the Consumer Survey data indicating that final purchase decisions are mostly made in stores (not online). The VR panorama HD imaging was found a powerful tool that may increase the consumers' realisation of their preferred colours as it offers a real-like view of how furnishings colours appear in a room. Additionally, the tool can provide a colour preference database for designers and retailers of the furnishing industry and improve the understanding of consumers' needs in terms of colours. Such database can lead to creating customised colour palettes which facilitate consumers' self-expression and quest for comfort and pleasure. However, a possible limitation of the VR service in stores is the price being a main motivator for consumers to favour one store over another (according to the survey results). Hence, based on the experiment's positive feedback; case studies and implementation strategies of the VR technology are highly encouraged.

Keywords: *colours, interior design, colour preference, home furnishing, virtual reality colour, urban experience, chromatic identity, contemporary city*

Colour and Spatial Comfort in Architectural Context

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Abstract

This paper tends to explore human comfort as a matter of spatial quality within architectural colour design. In architecture, colour is a design element and comprises both subjective and objective attributes within its multifaceted nature. Comfort is taken under basic needs of human in Maslow's Hierarchy of Needs and interpreted as a part of physiological accommodation. From this point of view, a built environment should provide a level of visual comfort like the other physical requirements. Such requirements lead visual comfort to some lighting standards based on quantitative references. Although colour is light, human response to colour is a subjective experience and implies more complex relations and intricate ties when the term "comfort" is comprised within the architectural context.

Rival colour theories of philosophy and science use to stress colour either in object or subject based frames parallel to their views. Sustaining their guidance, contribution and indemnity, this paper argues that 'colour and human comfort' converges qualities of light, object properties and subjective experiences at the same time, within the architectural context. Colour is not an isolated entity in architecture, it is always perceived together with the other elements of the visual environment. Theoretical knowledge about colour comes from several disciplines and arises from research mostly where colours are abstracted and simplified in to colour chips and samples. However, recent research in the field of design and architecture reveals the fact that the evaluations of contextual/applied colours and isolated/abstract colour chips are quite different. Besides the physical context in which the colour is viewed, the psychological context is also needed to be examined. In architecture, colour is not only a component of Vitruvius' Venustas, but it is also an element of his Utilitas. Some recent research show the effects of colour characteristics on occupants' productivity, self satisfaction, overall comfort, mood and their interrelation. As colour is a part of aesthetic judgement, the correspondence between harmony, pleasantness and comfort is important, too.

The aim of the study is to uncover meanings attributed to spatial comfort and to investigate predictors of colour design characteristics in this aspect. In the paper, firstly the intricate nature of architectural context and spatial colour is explained, specific to comfort. In the second part, the studies done for investigating spatial colour and comfort relations are introduced. The results indicate that pleasantness, harmony and spaciousness are determinative over comfort. Function is observed as another determinant for colour design criteria and evaluation of spatial comfort. In terms of colour and scheme characteristics; light values, warm hues, weak chromas and similar colour relations for hue and chroma are found more appropriate for a comfortable space.

Keywords: *architectural colour, spatial comfort, spaciousness, pleasantness, colour harmony*

Investigating Colour Task Performance for Occupants' Comfort in Office Environment

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Abstract

Quality of work life is highly related to personal comfort. When workspace quality assures comfort, work performance has maintained at high levels. In order to supply comfort for work-related tasks, there should be appropriate lighting conditions. This study aims to explore the effects of different colour temperatures on colour based task performance upon colour differentiation (hue, chroma, and value) performances. Although there are numerous experimental studies based on lighting conditions and task performance, there is no sufficient research regarding the effects of colour temperature on work performance of people whose instruments are colour oriented tasks in the office environment. The study was conducted with 100 participants as with-in subjects design, in a full-scale office set-up under two different colour temperature; warm white light (2700K) and cold white light (4000K). For this study three attributes of colour were the focused in the colour differentiation task and a two-dimensional colour differentiation model (ColDM) was designed based on Munsell 100 Hue Test and it was developed regarding the chroma and value attributes. ColDM was consisted of three modules; Hue Differentiation (module 1), Chroma Differentiation (module 2), and Value Differentiation (module 3). Speed and accuracy of the colour tasks were examined as the indication of the task performance. Speed of task refers to the time spent for completing each colour tasks, and accuracy of the task refers to the number of the correct arrangement of the colour chips. Since mood and feelings related to the workspace affect the task performance, self-satisfaction of occupants was assessed by Office Lighting Survey (OLS). The results of the study showed that there was a significant difference between chroma differentiation performances of red, green, yellow; hue differentiation performances of red-yellow, green-blue, and blue-purple in terms of accuracy. In terms of speed of task, it was found that there was no significant difference between chroma differentiation performances of red, green, blue, yellow; hue differentiation performances of red-yellow, yellow-green, green-blue, blue-purple, purple-red and value differentiation performances. However, there was a significant difference between purple chroma differentiation performances. When colour tasks were analysed based on the attributes of colour; whereas colour temperatures did not affect value differentiation task performance significantly, total hue differentiation tasks performance and total chroma differentiation tasks performance were significantly better under 4000K compared to 2700K colour temperature. In terms of time spent for completing colour tasks, there was no significant difference in three attributes of colour between mentioned colour temperatures. Moreover, the total colour differentiation performance in terms of accuracy of the task was statistically better under 4000K, compared to 2700K but the time spent for completing all colour tasks did not change significantly between the mentioned colour temperatures. In terms of self- satisfaction, results showed that participants significantly worked more comfortable under 4000K compared to 2700K and there was a direct relationship between self-satisfaction and task performance.

Keywords: *Comfort in Office Environment, Colour Differentiation Task, Task Performance, Colour Temperature, Office Environment*

Beyond Supergraphics – a Review of the Usage of Saturated Colours in Contemporary Urban Environments

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Abstract

As the consequence of cultural movements and increasing options in colours, applying geometric patterns together with bold colours on architectural facades became popular in the late 1960s. This graphic way of using colour on a large scale on buildings is defined as Supergraphics. The colourful graphics aim to break the structures of the architectures and bring dramatic changes or even new identities to the environment. Although with the change of aesthetic tastes and design trend Supergraphics fell out of fashion after reaching the peak during the 1970s, many artists and designers still use it as an efficient way of modifying the space, space intervention or branding. Meanwhile, audiences seem to welcome the colourful stimuli that have huge contrasts to original environmental colour schemes. However, are all bold and saturated colours in a large scale appearing in urban environments should be considered and evaluated as Supergraphics? Are there other forms and reasons to justify the application of vibrant colours in urban spaces?

This paper offers a brief review of the history of Supergraphics and its development in contemporary settings. Supergraphics was initially engaged as a tool for spatial experiments in the interior designs, which generated optical effects to extend architectural spaces visually and psychologically. This graphic technique was later introduced to urban environments as a fast and cheap tool in urban renewal in America during the 1970s. After a quiet period, Supergraphics came back into sight in different variants with more clear functional emphases recently. This paper argues that there are two major branches of Supergraphics in contemporary settings. One is environmental graphic design (EGD) that focuses on the efficiency and accuracy of information communication between the environments and viewer. Another is a specific type of art installation that uses the 'form' of Supergraphics as a way of exhibiting artworks. Vibrant colours as an important part act effectively in way findings, providing new identities and attracting attention. However, due to the different focuses on the variants of Supergraphics, the colour decisions are decided by functional purposes or pre-set, which are detached from the local context. At the same time, this paper explores several current urban design projects that also engage highly saturated colours. By comparing the colour usages with that in Supergraphics, this paper finds out that there are distinct differences related to colour in those projects. In these urban design projects, vibrant colours are chosen with clear design purposes and tailored to the local context. In some occasions, the colour designs have further connections to the place in social, cultural or even economic aspects, which supports the existence of vibrant colours in that urban environment.

This paper finds that Supergraphics still acts as a major form to introduce vibrant colours in urban environments but has limitations in adapting to different urban settings. Thinking beyond the realm of Supergraphics allows us to have a better understanding of the relationship between saturated colour and urban environments, which will benefit the environmental colour design in the future.

Keywords: *Supergraphics, Saturated colours, Urban environments*

Colour and Human Comfort in Innovative Schools. The Negrar Study Case

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Abstract

In 2016 the Italian Ministry of Education organised a competition to realize 51 new “Innovative Schools” placed all along the peninsula. Selecting these schools the municipality of Negrar (neighbouring Verona) was chosen among those who would had the funds to demolish a prefabricated school built around the Seventies of last century, currently in use but with considerable maintenance problems. This building will be replaced with a new one to serve as a model for other schools in the Veneto Region. The school illustrated in the paper was taken as study case by some researchers of the University Iuav of Venice, assuming the correct use of colour and light essential for student’s wellbeing. The opportunity of the design competition, in which the researchers participated, served as a validation of the research hypotheses on colour.

The Negrar secondary school is dedicated to middle lower education for children aged between 11 and 14 years (three years). In the requirements of the competition there was specifically requested: “conception and creation of spaces from the perspective of individual wellbeing...” i.e. human comfort. It is known that human comfort is a priority issue that involves colour and light in addition to the form, orientation, exposition, and many other aspects of a building.

From many years the authors are involved in many activities and researches about schools (Zennaro, 2015); tutors in graduation thesis in architecture (Niero, 2010; Corli, 2012, Langella, 2015); public schools consultancy. These experiences were used to implement the competition project.

A precise chromatic study was designed to meet the needs of children, depending on age, adapting the public spaces to relational processes. In short, every interior space has been adequately investigated from the point of view of colour, light and orientation to respond to human comfort.

Another fundamental aspect was to understand the new teaching and research trends. In fact, the transformation of the school spaces, enriched by digital technologies, implies a rethinking of the architectural spaces. Studies and researches published by the OECD refer to aspects of cooperative learning, flipped classroom and multi-dimensional teaching units, where there are: the agorà (for common activities), the cave (for individual study), the laboratory, and other places as theorized by Nair, Fielding & Nackley (2013).

Given these assumptions the project has outlined a type of school certainly different from the traditional one, knowing that a change cannot be radical, especially for the Italian reality. Great importance has been given to the use of colour as a generator of wellbeing and definition of functions.

Keywords: *Innovative Schools, Colour of Schools, Colour for Human Comfort, Environmental Colour, Comfortable Colours*

Acceptable Size of Advertising Fascia based on Colour and Design in Historical Urban Areas in Kyoto, Japan

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Abstract

In accordance with the outdoor advertising restriction regulations during current stage, bright brand colours were forbidden with outstanding features in historical area, while there is compulsive requirement to use the historical colour of 'brown'. For restriction of outdoor advertising colour, it is mainly restriction of the background colour, or the colour used in most area. For restriction of shape, no matter what shape it is, the size is calculated based on the longest side length for restriction. There were no regulations or researches on the relation between the advertising colour, shape design and the acceptable size.

Based on this situation, aims at historic area and surrounding regions, considering both the coordination of whole city and identity of outdoor advertising, the restriction method of outdoor advertising was surveyed based on the regulations. With the historical areas in Kyoto, Japan as the research objects, an impression evaluation was conduct to clear the relationship between outdoor advertising colours, colour combination of background and text colour, design and acceptable size. Then, based on the two evaluation elements of visual attractiveness and coordination, the acceptability of outdoor advertising was analysed. The experiment was divided in 2 steps. Firstly, a questionnaires survey was conducted to evaluate reactions to advertising fascia of different colour and size. Then, based on the result of first step, a questionnaires survey was conducted to clear the relation between the shape design and colour combination of background colour and text colour of advertising.

The result showed that 1) in cases when less than 10% of fascia of individual buildings was used for advertising, changes in hue, value and chroma had a greater influence on the perceived visual impact of the area. 2) when chroma was 6, background colour of Hue R could be accepted as size of 10% of individual buildings. Thus, the Hue B was considered acceptable with size of 3%. 3) for chromatic colour, when the fascia area used was < 3%, value < 3 and chroma < 6, similar levels of hue R, Y and B were considered to be acceptable, and higher than for hue G and P. 4) using colours of hue R with low value and low chroma, and achromatic colour with a middle value for the background received the best rating for acceptability. 5) using natural wooden shape and traditional visual elements, such as wooden frames etc., can also increase acceptability. 6) advertising fascia that does not use background boards, such as channel lettering, should be avoided. 7) using the colour of hue R~Y as the base colour, low value and low chroma was easier to be accepted. For the texts, it was not recommended to use comparative B colour. 8) using the colour of hue B as the base colour, similarly base colour of low value and low chroma was easier to be accepted. In this case, achromatic colours were recommended for texts. 9) when the base colour used achromatic colour, grey was more acceptable than others.

Keywords: Advertising Fascia, Colour Acceptance, Design, Advertising Restriction

Colorimetry



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colour & human comfort

State-of-the-art Measurement and Quality Control of Colours with Special Effects towards Comfort and Aesthetics for End Users

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Abstract

Today, there is an increasing demand from consumer markets for colour-customised products. This work demonstrates that fulfilling such a desire from end users represents a market differential for all players interested in providing the right solutions to the most recurring problems in the fields of colour measurement and quality control. Many different industrial sectors are taking into consideration these all-new end users' demands when designing and developing coloured products up to their expectations, from the clothes we wear every day - through the car we drive to our working places - to the exterior and interior of the buildings and houses we work and/or live in. For instance, since the last twenty/thirty years, paints formulated with colours of special effects have been developed as to provide end users with a customised touch for their ultimate satisfaction in terms of comfort and aesthetics. Since then, a variety of state-of-the-art technologies have been employed by industry leaders as solutions for enhancing the colour measurement and colour quality control of paints with special effects. This work shows some technology approaches on how to deal with the inherent difficulties in the measurement and colour quality control of this type of paints as related to factors like: whiteness, yellowness, hue-lightness-chroma, brightness, texture, total appearance, tolerances, pearlescent effects, metallic effects, correlation with visual assessment, aesthetics, colourimetric correlation between physical and digital samples, different substrates, repeatability, reproducibility, integration of design and production systems with points of sales, among other variables that must be taken into consideration during the design, development, production, marketing and commercialization processes. Whether we are talking about satisfying the needs of an end customer, who wants a paint that matches a colour of his-her preference extracted from a piece of painted wall, or to fulfil a big paint production order for a major manufacturer from any paint-related industry sector, this work lists some of the most modern, state-of-the-art equipment and solutions for specification and design, development and formulation, as well as production and quality control of colours formulated with special effects. Industry leaders in this sector, then, will take advantage of opportunities created by these hardware and software novelties as to improve their products and services to reach an exact colour quality control, with acceleration of commercialization times, plus a necessary minimization of reworks and maximum reutilization of wastes - all this with the aim of obtaining coloured products in a consistent and reproducible manner - towards the wellbeing and full satisfaction of the modern and well-informed consumers.

Keywords: *paints, effects, quality, appearance, colourimetry*

Spectral Skies: Towards a Novel Model to Describe Temporal Variability and Spatial Distribution of Spectral Daylight Characteristics

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Abstract

Spectral power distribution (SPD) of light can play a significant role in people's comfort, visual performance, as well as their psychological and physiological health. Yet, most daylight simulations to predict or investigate these visual and non-visual effects rely only on photometric quantities. The colourimetric information is typically reduced to a global spectral irradiance or set to a correlated colour temperature (CCT) of 6500 K. This implies a uniform distribution over the entire sky-dome, even though the spectral characteristics, and the resulting CCTs, are not only varying over time, but also depend on the orientation of the analyzed sky part. In order to include spectral characteristics in the daylight studies, for example to incorporate new spectral weighting functions for non-visual responses or to assess the potential of spectrally selective fenestration materials, a differentiated colourimetric approach based on direction specific spectral data is necessary.

To allow for a data-driven inclusion of orientation depending spectral characteristics of daylight, spatially and temporally resolved spectral sky measurements are carried out since October 2014 at the Technische Universität Berlin. It is one of the few measuring sites in the world gathering this kind of data. Every second minute, a spectral sky scanner measures the SPD, between 280 nm and 980 nm, of light from 145 sky patches distributed over the entire sky-dome.

The aim of the research related to these measurements is to investigate whether spatially resolved spectral light distribution can be described equally to the luminance distribution of CIE Standard General Skies in accordance with the ISO / CIE standard (CIE 2003). This standard defines 15 sky types for clear, overcast and intermediate skies with standardized luminance distributions. Takagi et al. (1990), Chain et al. (1999-1,2 2004) and Rusnak (2014) suggest that the CCT of a specific sky patch corresponds to the sky patch's luminance. This relation between the CCT and the luminance differs depending on the weather conditions, and thus sky type. The spatially resolved SPD measurements collected at the TU Berlin allow to verify the accuracy of the interrelation between the luminance and the CCT of a sky patch being subject to prevalent sky conditions. The luminance distributions of CIE Standard General Skies can subsequently be linked with defined CCT distributions. The review of existing spectral sky models showed that further improvement of the models is needed. Based on a large dataset of spatially, spectrally and temporally resolved measurements gathered at the TU Berlin a comparative analysis between the predictive models and the measured data for two dominant CIE Standard Skies for Berlin was conducted. This comparison showed that the fittings for overcast condition from Chain et al, (1999-1, 2004) and Rusnak (2014) were performing comparably good, whereas the Takagi et al. model is unreliable for this sky state. For clear skies all models show relatively high MAD and RMSD values. For further refinement of the fitting more data with a shorter scan time, over a longer period of time and for more locations is needed.

Keywords: *spectral sky models; spatially resolved measurements; data-driven method; daylight characteristics; colourimetry*

Colour Discrimination Ellipses Explained by Metamer Mismatching

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Abstract

Many psychophysical experiments have shown that colour discrimination varies substantially with the region of colour space in which the colours reside. Many models of the experimental data have been proposed, and many uniform colour spaces have been developed that attempt to represent colour in a coordinate system such that equally discriminable colours are equal distances apart. All of these models and uniform colour spaces are based on fits to the experimental data. Many provide good fits to the data, but they remain data models and do not explain why colour discrimination varies in the way it does. In contrast, we propose a theory of colour discrimination based on metamer mismatching. Metamer mismatching refers to the extent to which two physically distinct reflectances that match under one light fail to match under a second light. The study by Zhang et al. (Zhang, X., Funt, B. and Mirzaei, H., "Metamer Mismatching in Practice versus Theory," *Journal of the Optical Society of America A*, Vol. 33, No. 3, pp. A238-A247, March 2016.) of metamer mismatching showed that it is most severe for grey and least severe for highly saturated colours. Our hypothesis is that in order to be able to reliably discriminate physically distinct surfaces from one another observers must be more sensitive to the differences between colours for which metamer mismatching creates significant uncertainty (i.e., when the metamer mismatch bodies are large), and least sensitive for colours for which metamer mismatch creates little uncertainty. In particular, we propose that the sensitivity of colour discrimination is inversely related to the degree of metamer mismatching. It is common to represent colour discrimination in terms of ellipsoids in colour space and ellipses in chromaticity space. One relatively recent set of experimental data on colour discrimination is that of Huang et al. (Min Huang, Haoxue Liu, Guihua Cui and M. Ronnier Luo, "Testing Uniform Colour Spaces and Colour-Difference Formulae Using Printed Samples," *Colour Research & Application* 37(5), October 2012). For discrimination ellipsoids of volume V_d measured by Huang et al. and metamer mismatch bodies of volume V_m , we find that V_d is linearly proportional to $1/V_m$ with a correlation coefficient of 0.76. This clearly supports the hypothesis that the need to overcome the uncertainty due to metamer mismatching is the reason for more precise discrimination between colours in some regions of colour space. Since Zhang et al. showed that metamer mismatching is greatest for grey, high for colours of low saturation, and decreases with increasing saturation, our hypothesis correctly predicts that colour discrimination is finest near grey and coarsest for the saturated colours near the object colour solid boundary. In other words, metamer mismatching provides an explanation for why colour discrimination varies in the way it does.

Keywords: *Colour Discrimination, metamer mismatching*

Digital Colour Management on a set of Human Skin Tones has an Irregular and Low Performance

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Abstract

The aim of the DCM (Digital Colour Management) is to ensure the best colour match between colour representations and/or between devices. Nowadays, DCM software is ubiquitous in all digital systems in order to enable automatic colour conversions and colour representations. We measured and evaluated the performance of these semi-automatic DCM colour conversions using a sample of colours similar to the variety of human skin tones, considering as qualitative assessment the human sensibility to colour differences.

In a DCM system, colour conversions are enabled by digital files, the Colour Profiles, similar to a colour catalog, encompassing the information about the colours that are possible to reproduce or to achieve in a specific device or colour space. The DCM controls the Colour Profiles with a set of commands, the tuning of the colour transformation. In these commands there are at least four different algorithms to calculate the best colours and also an important option, the BPC (Black Point Compensation), used to recalculate the darkest possible colours. In a DCM system, the combination of algorithms and BPC can produce a minimum of six different results for each Colour Profile.

We evaluated colour conversions from a colour sample to 12 CMYK ICC Colour Profiles commonly used in the printing industry. In each conversion we compared the six different algorithm combinations, a total of 72 results. The colour sample is intended to be representative of the diversity of colours of the humankind, with 156 colours from pale to dark tones, mostly from a colour palette of the brand “Pantone Skintone”. The colour deviations were calculated with the DeltaE “CIEDE2000” formula recommended for the printing industry. The results were systematized and treated quantitatively with major focus on (i) calculate a set of quantitative indicators and (ii) perform a set of statistical tests in order to impart meaning and guarantee the reliability statistical conclusions obtained, that included:

- Test Pearson Correlation Coefficient to evaluate linear relations between batches;
- Test Standard Deviation and Coefficient of Variation to evaluate data dispersion;
- Test Null Hypothesis Wilcoxon to evaluate the independence of groups of data;
- Test Null Hypothesis ANOVA to estimate the representability of closely mean values.

Our data shows that considering the human sensibility to colour difference, the results can be quite different when choosing different algorithms. Overall, in the six possible algorithm tunings evaluated, (i) none of the algorithms was always the best, (ii) two didn’t achieve any good result and (iii) the best algorithm combination only achieved good results in half of the Colour Profiles.

Restricted to the universe colours and Colour Profiles tested, we think that the mindset where the choice of a Colour Profile is enough to ensure quality needs some rethinking, because the algorithms that fine tune colour conversions have a major and unpredictable influence in the result. In sum, Digital Colour Management appears to have an overall irregular and low performance when dealing with human skin colours.

Keywords: *Colourimetry, Colour Management, Colour Conversion, Skin Tones, CIEDE2000*

Toward Colour Rendering Method of Window Glass

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Abstract

The present research started from a previous study that's aim was to expand the understanding of modern glazing materials' effects on the colour perception in interiors. Even though the qualitative and quantitative aspects of different electric light sources on colour rendering are frequently discussed topics among the researchers, one of the issues touched only sporadically is the impact of tinted glazing on colour rendering of daylight (Lynes). The present study was motivated by the following question: Is the colour rendering method of glass proposed by Joe Lynes reliable also for present-day high-tech glazing types? To find an answer an experiment was carried out in the artificial sky at Norwegian University of Science and Technology's (NTNU). This artificial sky simulator enables mimicking of skylight of the following correlated colour temperatures: 2700K, 6500K and 8000K. Three high-tech glazing types (electrochromic, photochromic and thermotropic) were used in five different transmittance scenarios. Colourimetric measurements were taken with the SpectraScan PR655 spectroradiometer. The findings indicated that the Lynes method is reliable to predict which glazing have the biggest impact on all aspects of colour but only in 6500K.

A new set of measures that together can be applied as Colour Rendering Method for Window Glass have been proposed. The method is based on the colourimetric measurements of eight CIE colour samples and the opinion that one single number, as it is in the case of Ra index for electric light, will never describe well enough HOW the various colours change. It is therefore reasonable to develop a method that refer to the three principal dimensions of colour: Hue, Chroma and Value.

The proposed method addresses the three colour dimensions in the following way. For the Chroma the gamut area on the $v' u'$ graph (behind glass). For the Hue, the average colour shift distance of the eight CIE colour samples (reference conditions vs. behind glass) on the $v' u'$ graph.

For the Value the median spectral transmittance of the glass under examination, which is to be used in the calculation according to the Value formula proposed by Valberg in the book Light vision colour, page 198, John Wiley & Sons 2007.

As the proposed method is based only on the usage of the technical specification of glass, i.e. total and spectral transmittances, and the small number of colour samples (eight samples from Munsell system which is commonly used by CIE), it should be considerably easy to use, both by industry developing new glazings and by practitioners considering to apply them in buildings.

Keywords: *colour rendering, window glass, tinted glazing, $v' u'$ graph, Munsell system*

Colour in Arts and Design



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The unexpected meeting: How to create unique colour choices for products

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Abstract

The goal of this artistic development work was to deepen the knowledge in the area of colouring for products. Our perception and ways to interpret colour are influenced by many factors, including both more slowly changing ones such as experience and social norms, as well as short-lived trends. Colour expertise from material suppliers and trend institutions are often regarded as truth and many companies rely on their forecasts. Further, the strategies and choices of colour are often made without using design methods or engaging the user, thus not making much use of all the developments in user-centred methodology otherwise influencing many areas of design.

In this series of experiments I performed, two different issues were central. The first challenge was to look into creative methods for making colour suggestions for a product/form regardless of trends and prejudice, thus looking for structured ways of challenging conventional thinking by means of a norm critical approach. Here, the starting point was to express the function and to meet the users' expectations. In order to deepen the understanding of process and method, the second issue investigated was to perform colour studies where chance played a central role, thus using the accidental and unexpected as a still structured way to challenge norms and preconceptions.

The overall objective was to see if these two different approaches would converge in some way by testing new strategies to approach colour and form. Finally, the methods developed were evaluated through exercises in teaching "colour on form" as a subject for BFA students in industrial design.

The student assignment was to use building blocks to make simple objects with generic form that were then given an imaginary function. These objects, called "form ghosts", were used as a canvas for working with colour on a form with no direct resemblance to any established product character. In this way students could focus on colour communicating values with little direct influence of other otherwise often important reasons for choosing certain colour schemes, such as trademark, trends or a given product category.

The task was to work with colour, exploring the three guiding criteria used in my own previous experimental work regarding the product characteristic, user demands and context. In their proposals, the students had to give an account for three key words answering to the following aspects:

- Product identity. What characteristics do the product express and in what way can colour enhance the function?
- Receiver. What is the recipient's expectation and in what way can you guide the user with colour to understand the product?
- Context. How does context create meaning and influence as backdrop for the chosen object colour?

In this paper, I report on these experiments, the methods developed, the output they result in, as well as reflecting on their potential relevance in design education.

Keywords: *Colouring for products, education, norm criticism, design, social norms*

Lisbon, a colour experience from sketch to illustration

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Abstract

Urban landscapes are often represented with few saturation, and an almost grey palette. In fact, skylines, building shapes and shadows can be drawn with just one pen, getting satisfactory result.

However, each city leads the observer to a different range of experience.

The Lisbon light and colour atmosphere has been an issue for visual artists, movies makers, writers, poets as Carlos Botelho, Urban Sketchers, Alain Tanner, Cardoso Pires, Frederico Lourenço, among others. Lisbon colour could be controversial and subjective, and maybe artists are the first to understand that it is depending on several variables. These interpretations can also be based on the luminosity. By drawing in Lisbon, this paper intends to share an experience of its colour perception and notation.

The experience takes place along a particular path, from some Vilas from the beginning of industrial age at Graça district to Praça do Comércio. Following the way, the places that causes a particular colour impression are drawn and painted in order to remark their chromatic composition.

It is supposed that the colours have, somehow, a kind of role for each of these places making them memorable: The colour contrast helping to highlight it, and the similar colours unifying the ensemble perception. In both cases, the colour palette as being a component of a place identity.

The experience begins when the very first colour perception of each site is registered at the sketchbook. Using watercolour set or coloured pencils, the predominant palette is tested beside the draw even before it is finished.

Drawing and painting in location is an effective way to develop the visual attention and accuracy. The main goal is not to make a naturalist representation, but to figure out a minimal palette to be used as fast as a sketch. Also, the minimal palette can be an occasion to test the possibility to portray the transitions of light and shadow by the intensity of each pigment quantity.

The minimal palette of each drawn urban landscape will help the second part of the research. The next step is about making an illustration with as few colours as possible to stress this experience. The illustration will be performed in an almost craft way of colour separation trying to compose colour by overlaying. Working with a restricted number of colours is an occasion for a didactic approach of colour mixing, beyond the usual cmyk system.

The full experience achieves at least three sorts of colour expertise: The first result must be the consciousness of the colour role as a component of a place identity; the second is the use of colour to improve drawing legibility; and the last is about decomposing colour as way to understand the chromatic harmony. Furthermore, beyond the Lisbon chosen landscapes, the experience itself can be played as a didactic dispositive in order to arouse colour sensibility, by other sketches, at other cities.

Keywords: *Sketch; illustration; city colour identity; urban colour palette; colour atmospheres*

What are the Different Uses of Colours in the Western Visual Arts?

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Abstract

Initially limited to two main colours - red and black, the chromatic palette rapidly grew to a variety of colours, culminating during the Renaissance. New pigments were incorporated with traditional ones and the influence of the Middle East on Venice rapidly spread around Europe, giving to Visual Arts an almost unlimited palette with unlimited possibilities of expression. What is the purpose of colour then?

How does the artist use colour? How does the artist manage the different meanings and the history of a given colour? Purposely breaking the rule of chronology, I will mix artists, eras and medias to highlight the variety and the complexity of colours used in Visual Art.

First, I will demonstrate the strong link between colour and symbolism. From the Middle Ages to the recent era, artists have had to navigate through the changing meaning of colours. I will explore artists as Fouquet, Yves Klein or Kandinsky.

Then I will explain how perception of colours was used to represent volume during the Modern Era. From Post-Impressionism to Fauvism, then with the more recent Kinetic Art, I will demonstrate how colour can change our perception and can be used as a constructive element of Visual Arts.

Lastly, I will embrace the materiality of colours. I will explore how colours are materialized. In contemporary art, colour has a wide variety of forms and is no longer used just for its associated symbol or to enhance an element. Colour now has a life of its own. I will see how an artist, with different materials such as light and pure pigment, can materialize the colour and bring it to life. I will explore the most recent and original expressions of colours.

From Fouquet to Anish Kapoor, investigating the experiments of Cezanne, Kandinsky or Ann Veronica Janssens and more, I will offer a wide range of examples by well established and emerging artists, combining different medias and eras. The goal of this conference is to give an artistic, original and creative insight on the topic of colours in Visual Arts.

Keywords: *Visual arts, perception, symbolism, materialization of colours*

Colour and Augmented Reality in museum fruition

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Abstract

Abstract: Among the participatory models oriented to the inclusion of the community in the process of interpreting cultural heritage is the one based on narrative technique, better known as 'storytelling'. The application of the storytelling method to the communication of cultural heritage, with its playful, captivating and stimulating approach, can help to attract new audiences, especially young people, who have hitherto been kept away from the austere and solemn image given to cultural heritage, for this reason perceived as tremendously boring. Among the techniques that best interpret this dynamic of knowledge is undoubtedly Augmented Reality.

What is proposed here is a case study of Augmented Reality applied to museum fruition with a specific function in the dynamics of perception and interpretation of chromatic space in art.

The idea is to imagine and make possible a path of approach to the work of art that, thanks to the use of new digital devices, allows, through chromatic perception, an interpretation that is unusual and oriented to both the didactic and playful aspect. The creation of an enjoyable learning environment, through which it is possible to achieve didactic objectives, making learning fun, is the basic principle of edutainment, a strategy that effectively combines education and entertainment and represents the cultural horizon in which the whole project moves.

The project presented aims to develop an interactive digital device capable of conveying in a dynamic way information on the chromatic space perceived during the fruition of a work of art with particular attention to the perceptive dynamics of the visually impaired and the daltonics.

The project draws its inspiration from the reflection around two distinct areas: the accessibility to colour in cases where it is difficult to perceive and the fruition of museum spaces through Augmented Reality. As already amply demonstrated by the vast literature on colour perception is an extremely complex and far from objective issue. Difficulties increase when you start talking about individuals who are unable to perceive certain wavelengths (protanopia, daltonia, etc.). This, of course, significantly limits the visual experience. As far as the experience of museum spaces is concerned, although many facilities have been designed that allow users to interact with the works exhibited in their galleries, none of them yet refers to the perception of colours. This consideration gave rise to the idea of proposing a 'device' capable of transporting the user into a new colour experience, regardless of the quality of their view.

The inspiring principle of the multimedia device is to simulate chromatic perception, creating the conditions under which colour, changing its appearance, but preserving its relational characteristics, can be perceived and investigated not only by a sighted user but also by visually impaired users or users suffering from discolours. The idea is to imagine and make possible a path of approach to the work of art that, thanks to the use of new digital devices, allows, through chromatic perception, an interpretation that is unusual and oriented to both the didactic and playful aspect. The creation of a relaxing, motivating and at the same time pleasant learning environment, through which it is possible to achieve didactic objectives, making learning fun, is the basic principle of edutainment, a strategy that effectively combines education and entertainment and represents the cultural horizon in which the whole project moves.

Keywords: *Augmented Reality, museum fruition, colour storytelling, colour perception*

Colour in Action: participatory paintings on residential facades

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Abstract

Even as globalization interferes with the singularities of our living spaces, various initiatives of Painting in Public Space—perhaps even in resistance to globalization’s homogenizing forces—can be seen to valorise and integrate local community participation, and in that way, to create and reflect uniqueness. Such projects, however, do not always achieve their intended results (of, e.g., giving visibility through Colour, protecting a space or community, engaging in activism), and may even hide unintended consequences such as gentrification. What are we talking about when we say Participation? What types of interventions and processes lead to successful Participation? What is beyond Participation? What benefits and Human Needs are or can be met with the realization of Participatory Painting Actions? These are the basic questions that drive this paper and the doctoral research on which it is based.

To answer the above questions, we conducted a research in situ, visiting interventions, and interviewing experts, artists and associations’ promoters, in the following locations: Tirana (Albania), “Greening and Painting” by Edi Rama; São Paulo (Brazil), “Paredes Pinturas” by Mônica Nador; and Buenos Aires (Argentina), six actions - “Calle Lanín,” “Partituras Musicales,” by Marino Santa Maria, “Pintar el Once,” by La Vereda Civil Association, “La Villa 20 es una Pinturita,” by Odisseia 20 Civil Association, “Barracas Pinta Bien,” by Mas Colour Civil Association, and “Abasto y el Fileteado Porteño,” promoted by the Association of Residents, Center of Management and Participation No. 2 South.

After researching the above projects for their processes and effects, we implemented our own action research, “Vivercor Corabitando” (Livecolour Colourinhabiting) in São Cristóvão (Portugal). We solicited Participation throughout the project, from the creation of the intervention concept through to process evaluation; this level of involvement amplified the effects seen in our previous studies. The project clearly helped foster individual and community development, and helped valorize the being, having and doing aspects of the self. The project encouraged the community’s participants to conduct personal research for meaningful objects of affective and personal historical significance, which, combined with a self-chosen phrase or saying, found colourful, painted expression on their buildings’ façades. The evaluation of the action, both subsequent to its completion and over time, confirms that Vivercor Corabitando recognized the community, its ideas, values, architecture and colours, and helped increase their visibility.

It is hoped that this paper will spark critical reflection on the transformations we see in the Public Space, and on participatory processes. We hope also that the procedural descriptions and recommendations herein may inspire and guide new actions/projects/participations.

Keywords: *Participatory Paintings, Public Space, Human Needs, ViverCor Corabitando*

The Colours of Transcendence: Mystical, Metaphysical and Spiritual Significances in Islamic Art and Architecture

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Abstract

Can colours create transcendence? The present research paper aims to shed light on this question, clarifying the various spiritual and metaphysical potentials and dimensions of colour through the analysis of Islamic Architecture and Art using the Sheikh Zayed Grand Mosque in Abu Dhabi as the core example. How colours transcend their very physical nature, allowing for a communication and embodiment of that which is divine, is thus, one of the main aspects that the paper aims to bring forth. In the theoretical section, the paper firstly defines Islamic spirituality, clarifying its founding roots and the fundamental idea of beauty as a metaphysical and archetypal essence, and clarifies the innate significances of light, geometry and colour. Because Islamic art and architecture is deeply connected to its spirituality, light, colour and geometry, as the work elucidates, act as metaphysical and spiritual essences through which the human being becomes contemplative and transcendence occurs naturally. The inner essence (batin) is exposed, the ultimate source of all existence is reflected and man reconnects himself to the divine. In the experimental section, different principles and ideas are announced that exemplify the transcendental and archetypal essence of colour (combined with geometry and light) in the mosque. The embodiment of the idea of unity, tawid, a metaphysical and spiritual principle mainly expressed through predominant use of white, and multiple colour combinations. The Reverence for Nature, and the Allusion of Paradise, where colour is used in ways that reflect the very rhythms of nature, while simultaneously, creating metaphysical links with the abundance of paradise. The idea of divine truth and of unity in the multiplicity, that occurs through the various expressions and polychromatic effects, and lastly, the idea of spiritual harmony, where 'colour' acts as a symbol of the harmony of, and with, God. The results clarify that the use of colour far surpasses its individual symbolical and metaphorical uses, permeating into deeper cosmological, metaphysical and spiritual dimensions, acting as a fundamental agent of transcendence, re-connecting the human being to the spiritual dimensions. Lastly, in the conclusions, a more universal understanding of the principles is defined, serving as a reminder that the transcendental essence can allow us to see and use colour in new and other significant ways.

Keywords: *Islamic architecture, Islamic art, Colour, Transcendence, Spirituality*

Silent colours: designing for wellbeing using smart colours

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Abstract

Nowadays, the need for peripheral information sources that are less intrusive than many of the everyday devices of the present has continuously been addressed to improve wellbeing, e.g. by making life more manageable and meaningful through the use of technology in everyday life. This research aims of increasing knowledge of the design qualities of smart colours, which is of use in relation to creating non- or less intrusive ways of displaying peripheral information. This paper focuses on the character of colour transition and discusses different colour-changing possibilities with regard to surface patterns; that is, from the perspectives of different levels of change and complexity and in relation to levels of intrusiveness and information comprehensibility. Accordingly, smart colour transition can be subdivided into three categories:

1: Fading: a graduated scale, ranging from Colour A to a lighter version of Colour A, and back again to Colour A.

2: Bridging: a graduated scale, ranging from Colour A to Colour B, and back again to Colour A. Several bridging colour mixtures can be used with the same Colour A, resulting in some areas changing from Colour A to Colour B during activation and others changing from Colour A to Colour C, and so on.

3. Continuous bridging: thermochromic inks with different activation temperatures can also be used to achieve a more continuous bridging effect. Thus, Colour A can change to Colour B and then to Colours C then D, and back again.

In examining the possibilities of using thermochromic textiles as aesthetic, ambient displays, certain design dimensions based on the attributes of the materials explored were identified.

The level of colour change refers to the contrast between the initial and end expressions of the textile. Accordingly, the level of colour change refers to the extent to which the colour is experienced to differ between the activated and non-activated states, with a greater change resulting in a greater perceived difference. This aspect can be related to the desired level of intrusiveness as a design dimension.

The level of colour complexity in the surface pattern refers to how the inks and pigment pastes are mixed (fading, bridging, and/or continuous bridging) and printed next to one another as a surface pattern. A higher complexity results in a pattern with multiple changeable elements embedding more information capacity, and a greater level of comprehensibility, e.g., by providing access to the user for additional peripheral information for without interruption.

The aspects of time and colour rhythm affect the classifications discussed above. The time required for cooling and heating depends on the ambient temperature or the type of source used. Together, these parameters affect how quickly the layers of colour change, and thus the level of intrusiveness. Variation in time spans between the colour hues and tones can create disruptions in in the central activities, but might also introduce moments of reflection and rest, e. g, allowing the users to successfully complete central tasks.

As regards the body or spatial design, this research contributes to the development of multidisciplinary design methods wherein colour transitions offer an alternative perspective on how information technology can be displayed to increase wellbeing.

Keywords: *Smart colours, textile structures, textile design, non-intrusive, interactive displays, wellbeing*

Colours of Pompeii: colour harmony palettes

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Abstract

What are the colours of Pompeii? The response to this question is attempted in ongoing research project "Colour Folds of Pompeii" developed at 'Laboratório da Cor at School of Architecture' and 'Research Group of Colour and Light' at University of Lisbon's Research Centre of Architecture, Urbanism and Design (CIAUD). The general project investigates a multiplicity of colour sources that range architectural elements, façades and reconstruction thereof, interior colours and house objects, outdoor and indoor settings, frescoes, sculptures, mosaic panels, pavements, ceilings, vaults, floorings, walls, clothes, overall culture and civilization. The present paper focuses on a thematic cluster that is inclusive and integrates architectural and pictorial colour and was distilled from the strategies implemented for the study of Pompeii remaining colours. These colour sources can be found at the archaeological site or protected in a museum. When in 79 AD the Vesuvius erupted, surrounding areas of the volcano completely submerged under ash and cinders and the 15.000 inhabitants and an area of 66 hectares disappeared from view. Pompeii excavations only began in 1748 during the reign of the Bourbon King Charles III of Naples, and have continued ever since. For conservation and restoration reasons, one third of the territory has not yet been excavated to date, but in the last 270 years, Pompeii has gradually been unveiled and the marvel of its colours revealed. Many houses covered by the eruption of the Vesuvius are dated from Pompeii's second century BC-the golden century. Romans dominated since the fourth century BC and later on, after the social fight between Roman and Italic populations (91-89BC) Sila formed a colony in Pompeii in 80 BC. Many Samnitic families fled and Pompeii was populated with Roman veterans, some becoming owners of Samnitic residences, rehabilitating and redecorating them. Research on colour materials of Pompeii bears implications on the understanding of broader Roman domains specifically those of cultural identity, authenticity and sense of place. The uncovering and discovery of the colours of Pompeii that were submerged provides testimony of a civilization that did not change in almost two millennia (1900 years). The research methodology adopted includes the analysis of Pompeii's archeological site in situ, where photos were taken and sketches made, further complemented with a record of selected collections at the Museo Archeologico Nazionale di Napoli. An inventory of colours and their systematic analysis is presented based on a wide gamut of materials and techniques used on Pompeii surfaces. Results form a foundation for the creation of harmonic palettes grounded in transversal techniques and materials such as stucco, mosaics and frescoes. These palettes highlight essential aesthetic phenomena of relationships and interactions encountered on surface material colours and take into account colour pattern, rhythm, dynamism, repetition, affinity, contrast and unity as harmonic characteristics. The analytical tools adopted for the development of colour harmony palettes indicate identity and connection to a sense of place all of which add to colour education, scholarly research, professionals of art, design, architecture, communication programmes, conservation of chromatic remains, and culture related fields of knowledge.

Keywords: *Pompeii colours, colour palettes, harmony, mosaics, frescoes*

Impact of Colour Combinations on LCD Display Legibility

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Abstract

A constant rise in technology and the expansion of the Internet are two main factors which have contributed to the decline of use of printed media and to a continuously larger circle of display readers. This has brought the evolution of high resolution displays, especially liquid crystal displays (LCD) that are among the most commonly used ones. Despite high resolutions, problems in the legibility of typefaces still occur. Many typefaces may well be readable in print, but cause more difficulties when being read on displays. For better screen legibility, the typefaces Georgia and Verdana have been designed.

A number of typographic characteristics are observed to make text more legible, for instance the distinctive character features (counter shape), x-height, ascender, descender, serifs, contrast (stroke weight), set width, type size, leading (space between lines), as well as the contrast between typography and background, and colour combination between typography and background.

The aim of this study was to examine the influence of colour combination on the legibility on LCDs to establish which type style is appropriate for a legible coloured text. Two different, specially designed typefaces for display use (one transitional and one sans-serif) were tested in a good light-dark contrast of three different colour combinations involving four colours, i.e. dark grey (#1A1A1A) on white (FFFFFF), dark blue (#142451) on white and red (#C62026) on white.

The reading speed and fixations were analysed with an eye-tracking device Tobii 120X. The texts in both typefaces at 12 pt (16 px), in 130% leading and all colour combinations were displayed on a 24-inch LCD display with the resolution of 1900 × 1200 pixels at a 120 Hz refresh rate. In each typeface and each colour combination, a different text was presented to the tested individuals. Forty tested individuals aged between 19 and 22 years were positioned 60 (+/- 1) cm from the display. The texts were set in a CSS style sheet and displayed as an HTML document. In this way, we ensured a precise display of texts in the chosen size. The texts were shown in the centre of the display.

The results showed that the selection of a particular colour combination and contrast greatly affects the speed of reading and legibility. Less visible colour combinations of text and background were read more slowly than the more contrasting or visible ones at both typefaces. At both typefaces, it was seen that at the slower reading speed, more fixations were needed and vice-versa. It might also be concluded that the transitional typeface Georgia is more legible than the sans-serif typeface Verdana. Nevertheless, it appears that different colour combinations had different reading speeds at different typefaces (transitional vs sans-serif).

The result of the study showed that a colour combination contributes to the speed of reading and better legibility. An appropriate contrast and colour combination can facilitate the legibility of displays.

Keywords: colour combination, eye-tracking technology, LCD display, legibility, typography

The Development of Methodologies for Designers Engaging with Digital Colour Inkjet Printing in Textile Design

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Abstract

Digital textile printing (DTP) offers exciting, creative potential and entrepreneurial business models in textile design. Designers are no longer restricted to a number of colours or pattern repeat. It has become possible to print fabric without large set-up costs. This relatively sustainable technology reduces water-usage and dye-wastage. DTP meets Just in Time, Concept to Consumer demand, reducing stock wastage.

However, there is a marked difference between screen-colour to print-colour and software allows a user to select colours unprintable using CMYK colourants. Colour results are further affected by factors such as structure and composition of the fabric, dye type, printer communications, fabric pre-treatments and secondary processes. A textile designer will be required to understand, and experiment with, numerous variables in order to feel colour confident.

A number of variables were tested using a Practice as Research methodology, to determine the impact on printed colour outcome. This paper presents investigations which focused on the development, and generation of, visual indicator methods and ICC profiles generated from data, accumulated through measuring printed colour differences on substrates. The aim to provide an indication of colour changes when printing on different fabric substrates, allowing designers to make adjustments to designs to obtain a better colour match, and develop their colour expectation knowledge.

A colour chart was created and printed onto four different fabrics (wool, linen, cotton and silk) and cut into swatches. The fabric swatches were compiled in a colour reference book alongside the corresponding numerical values (RGB, CMYK, HSB, Hex and LAB) and a paper print, as the closest visual match to the screen colour. This provided a broad range of colours and data for comparison, and demonstrated differences across the printed colour to the screen colour, particularly in neutral ranges such as greys, blacks and browns, as well as colours from the blue and magenta tonal ranges. The research observed hue shifts, as well as decreases in brightness and saturation values, between screen and printed colour when digitally printing on textiles. Additionally, differences were perceived between colour appearance for four different textile substrates.

Measurements from a spectrodensitometer were taken from a reduced colour set to create digitised swatches. The digital swatches were plotted onto a colour map to visualise hue, saturation and brightness (HSB) shifts from the screen colour. These digital lab dip tests became visualise clues for a designer, as to how a colour might be expected to print, depending on substrate. The differences between screen and print colour were calculated and used to produce adjusted RGB colour target. The resulting data produced output profiles which provide an indication of expected colour changes to a designer viewing their image on a computer display, allowing to make adjustments to the file to obtain a better colour match and developing colour expectation knowledge.

Keywords: *Colourimetry, Colour in the Arts and Design, Digital Colour, Digital Textile Printing*

Travel journal (in colours) of Lisbon city

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Abstract

In May 2016, the author made a two-week trip to Lisbon in the context of an internship funded by the Chilean Ministry of Education and the Faculty of Architecture and Arts of the Universidad Austral de Chile. The purposes of the trip were to visit the LabCor Lab in the Faculty of Architecture of the University of Lisbon, to know the PhD. Program on colour and to develop a colour study in three different and representative quarters of Lisbon: Alfama, Baixa and Chiado.

The artist's travel dairy format is rooted in history. The sketchbook by medieval architect and traveller Villard de Honnecourt has detailed drawings of constructions and human figures, but no mention to colour. In the 19th century, Eugene Delacroix travelled to Morocco where he created a diary with a dedicated chromatic study in the form of watercolour drawings. Le Corbusier, in his trip to the East, carried notebooks where he sketched his impressions, some of them in colour.

The onsite register of a city's architecture and public spaces has a recording language which usually involves sketches and photographs. However, the need to show colour in architecture at a later phase of the registration process broadens the graphic range to other more elaborate representation formats, among them planimetry, perspectives or collages, such as those made by Aldo Rossi, Steven Holl or Sauerbruch and Hutton. How many ways are there of representing the colour of architecture and of a city?

For the colour study, the author interviewed different people about the colour of the city, including architects, artists, the owner of a bookshop and random tourists. She also found and reviewed very interesting books about Lisbon, which helped her figure out the insights, reflections and statements made by writers, artists and experts about the colours of the city of Lisbon.

In spite of the fact that the original goal of the colour study was to develop a chromatic chart of the colours of these three districts, things didn't go as planned. The internal reflection, resulting from walking every day through the streets attempting to capture their chromatic atmosphere, reoriented the purpose of the study, which now focused on how to represent the colours of Lisbon. However, upon returning home, she began investigating the modes of representation of architecture and of the city, to cross reference them with the material collected during her internship.

Presented as a travel journal, this study is a work in progress and an account of the author's efforts to represent, through graphic schemes, impressions, diagrams, charts, collages, perspectives and drawings, the colours she found.

Keywords: *Travel Journal, Lisbon, Neighbourhood, Colour.*

Characteristics of the Tooth Crown Colours of People in Fashion Magazines

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Abstract

The demand for aesthetic dentistry focusing on the cosmetic aspects of teeth, such as crown whitening and orthodontic treatment, rather than oral treatment has been increasing. This may have been caused by the reduction in the number of patients with caries due to increasing awareness of oral hygiene and the dissemination of information on oral aesthetics by the mass media. The principal aims of the present study were to measure the tooth crown colours of individuals in photographs printed in fashion magazines and spectroscopically analyse and compare them with those of natural teeth, thereby clarifying their features.

The spectral reflectance factor of the maxillary central incisor region of portrait photographs (204 female and 64 male) published in fashion magazines sold in Japan was measured, and its diversity was analysed by principal component analysis. The crown colour of maxillary central incisors of 97 Japanese university students (48 female and 49 male) was measured and compared with that of individuals in photographs printed in fashion magazines.

Principal component analysis of the spectral reflectance factors of the tooth crown colours in fashion magazines revealed that the contribution ratios of the first, second, and third principal components were 88.04%, 6.02%, and 4.27%, respectively, and the cumulative contribution rate of the components was 98.33%. Evaluation of the relationship between the principal component score and colourimetric value of each tooth crown colour revealed a significant correlation between the first principal component score and L* value, second principal component score and yellowness index, and third principal component score and fluorescence whitening intensity of a printing paper.

The tooth crown colours of natural teeth and those of teeth in fashion magazines were compared in terms of lightness, chroma, and yellowness; the results indicated that the tooth crown colours in fashion magazine photographs had significantly higher lightness but significantly lower chroma and yellowness than those of natural teeth. The colour difference (CIEDE2000) between the mean values of the tooth crown colours of natural teeth and those in fashion magazines was 14.1.

Because readers usually accept this non-existent tooth crown colour to be true, they believe or desire that the natural tooth crown colour also has an extremely low degree of yellowness.

Keywords: *Aesthetic Dentistry, Tooth Crown Colour, Fashion Magazine, Principal Component Analysis, Natural Tooth*

A study on the proposal of personal Colour fashion material pattern

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Abstract

The 21st century is an era in which people want a customized service that is appropriate for their own needs. By this trend, various attempts have been made to apply personal Colour in the fashion and beauty industry, and studies related to it have been actively carried out. However, even though fashion is one of the most important elements of image formation, research on the personal Colour - fashion field is inadequate. Therefore, we extracted 8 kinds of language images, selected 12 patterns of fashion material based on the previous studies. To find out the difference between the expert group and the non-expert group, the questionnaire was divided into the fashion, beauty, Colour related group and the other group. F-test, t-test showed no significant difference between the two groups. In the first questionnaire to investigate the relation between the fashion material pattern and the linguistic image according to the type of personal Colour. As a result, the flower pattern and the small pattern showed the highest average value in the fashion material pattern of spring. Paisley, small droplets, gingham check and tartan check showed the highest average value in the goggles and classics, respectively. The average value of modern and chic language images shows the highest value in the fashion image of the winter, while the trend of the fashion material of the winter, Leopard, curved pattern, plain, geometry Pattern. To understand the influence of Colours on the proposal of personal Colour fashion material pattern, four patterns of seasonal fashion material extracted through the first questionnaire and previous research were converted into two Colours, respectively. The Colours were selected as yellow and blue Colours, which are representative Colours of warm tone / cool tone of personal Colour. As a result, the flower pattern showed the highest average value in the linguistic image of spring. It can be suggested that a flower pattern can be proposed as a spring pattern regardless of Colours when a personal Colour fashion material pattern is proposed. Also, silk plain, regardless of Colour, pattern of a personal Colour fashion material of summer showed the highest average value. In the case of a tartan check, the pattern of blue Colour appeared as the pattern of autumn as the result of the first survey, but the pattern of yellow Colour appeared as the pattern of winter. It can be seen that the tartan check pattern can be affected not only by the pattern but also by the Colour. In the case of the block stripe, only the influence of the pattern except for the Colour was examined. In the case of Block Strips, the first survey of the influence of the pattern except Colour showed the fashion material pattern of winter, but both blue and yellow Colour was produced by the pattern. This suggests that various suggestions can be made not only for patterns but also for Colours when suggesting fashion material patterns in personal Colours.

Keywords: *Personal Colour, fashion material pattern, material suggestion, fashion, material Colour*

The Influence of Texture and Gloss upon Colour Emotions and Colour Harmony of Three Dimensional

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Abstract

In the process of creating appearance of product, designers not only deal with colour, but also texture and gloss on the appearance of product. How to create an eye-catching appearance of product determines the success of product design. Many studies have been studied on the colour emotion and colour harmony, however, the results obtained from these studies were considered as impractical for product design. Because these studies only used 2D colour samples as experimental sample, the product designers always deal with the three-dimensional shapes, even the colour configuration appeared more complicated than those in literatures. In addition, for colour design on product appearance, designers need to understand how texture and gloss affect the colour harmony. But, the texture and gloss effect on colour harmony are ignored in the literatures.

In order to see the influence of texture and gloss upon colour emotions and colour harmony of two-colour combinations, this study conducted a psychophysical experiment. The experiment provided a series of colour-finishing combinations to collect the data of colour emotion and colour harmony by using visual assessment. Ninety participants were invited to take part in the experiment. The participants were invited to assess experimental sample on 4 scales including "active-passive", "heavy-light", "warm-cool" and "harmonious-disharmonious". The 7-step categorical judgement was used for collecting colour emotions and colour harmony data. To reduce the loading of participant, balanced incomplete block design (BIBD) was used to collect colour harmony data. The data obtained from experiment were used to see the relationship between colour harmony and appearance attributes, i.e., colour attributes and gloss value.

In terms of producing colour-finishing combinations, seven colours were used, including red, yellow, green, blue, white, grey and black colours. These 7 colours were produced in three finishing, matt, glossy and sandy. These colour-finishing appearances were applied onto a cube with side circle. The main appearance was applied onto a cube, the secondary appearance on side circle. In total, 441 colour-finishing combinations on 3D physical geometric shape were produced.

Each appearance attributes on colour-finishing combinations was measured. For colour attributes, CIELAB values were measured by using CIE1964. For gloss attributes, according to ASTM, the GU values was measured. All the appearance attributes were used to see how well correlated to colour harmony.

Mean data from experiment were used to rank colour combinations in order of colour emotion and colour harmony scales. On the base of ranking data, the results were summarized the top sample of nine finishing combinations on 4 scales. The results showed that the different finishing have different impact on different emotion scales. Such preliminary results showed that the finishing impact are existed in the phenomenon of colour harmony and colour emotion, but this has to be confirmed by further research.

Keywords: *Product design, Colour emotion, Colour harmony, Texture, Gloss*

Colour contrast in packaging and consumer product perception

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Abstract

Package appearance highly affects purchase decision. Previous research has shown that graphic design – one of the main three dimensions of package design – is one of the most influential aspects related to the decision-making process associated to the purchase of products in a marketing context (Kauppinen-Räsänen, 2014).

Colour, included in the graphic design dimension, has an impactful effect in impulsive buying (Cahyorini and Rusfian, 2011). Packaging colour has been associated to the perception of calories estimation, healthiness and purchase intention, due to its symbolic meaning (Huang and Lu, 2013). Accordingly, Singh and Srivastava (2011) stated that red conveys energy, excitement and power; orange transmits heat, desire and power; yellow is associated to the sunlight and intelligence; blue conveys tranquility and confidence; green is associated to nature and health; and, at last, purple transmits humility, wisdom and nobility. Hence, designers should consider colour symbology when creating packages, to attract the consumers' attention during purchase decisions (Mohebbi, 2014). However, the decision-making effect of specific colour contrasts (e.g., complementary vs. analogous colours) applied in a package is seldom explored.

Complementary colours are opposite to each other in the colour wheel whereas analogous colours are next to each other (Itten, 2001). Here, we aim to investigate the putative influence in purchase intention, perception of healthiness and calorie estimation of different colour combinations, in a package of cookies. We asked 344 participants to evaluate two similar packages of cookies, only differing in colour: 1) a package where complementary colours were applied (orange and blue); and 2) a package where analogous colours were applied (green and blue). The images were graphically manipulated and distributed through an online questionnaire. To avoid response bias due to the brand or the type of cookies, we chose an uncommon brand and the pictures of the cookies were also removed from the original package. The brand logo and the wording of the package were edited and coloured with a neutral colour, to avoid interferences in the perception of the image colour. Package assessment included the following dependent variables: purchase intention, healthiness and calories estimation. Findings showed that the package where complementary colours were applied was perceived to be less healthy and more caloric. However, surprisingly, these were also associated to a higher purchase intention. It thus seems that colour combinations are both associated to the consumers' perception and preference.

In line with the reviewed literature in marketing and psychology, the noteworthy impact of colour addressed in this research points out the potential of using package colour as a marketing tool. In summary, the way colours are combined was demonstrated to be an issue that managers must pay close attention to. Despite the limitations of this research, our findings may work as a guideline for product managers.

Keywords: *Packaging, colour, food, calorie estimation, healthiness perception, purchase intention*

Chromophobia in contemporary art practices

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Abstract

Colour, a visual and expressive element with a tremendous transformative potential, simultaneously strange and seductive, unverifiable and unlimited, has meanings that are anything but universal or transversal to distinct areas of knowledge. More than interdisciplinary, colour emerges as a powerful tool with its own and autonomous value that does not allow itself to be disciplined, although centuries of cultural history tried to attribute powerful symbolic meanings to this expressive force. In the field of visual arts, specifically, perhaps the possible knowledge and understanding of colour resides in experience and in the act of doing things, experimenting and transforming.

The investigation I have been developing as a visual artist that privileges colour as a fundamental composition element that transforms spaces, questions what happened to colour after the theories that have tried to systemize it, for these have yet to provide an unequivocal and irrefutable knowledge, generating instead further possibilities of disruption and reinvention. It seems that, nowadays, colour is more associated to a fluid randomness field, to chance and intuition, than to its scientific and systematic aspect of an orderly management of principles and rules. So, today, artists themselves are writing a colour history through the artistic objects they add to the world, talking about colour in and through practice, even though this more or less privileged use of colour may not be recognized or valued.

This paper, using a personal artistic and research experience as background and context, intends to reflect on the role of colour in contemporary art, questioning if chromophobia, a concept advanced by David Batchelor, contaminates contemporary practices, as well as the critical mass and agents that influence the art world. In *Chromophobia* (2000), Batchelor argues that colour has been the object of extreme prejudice in Western culture, systematically marginalized by generations of philosophers, artists, art historians and theorists since antiquity. Batchelor tells us of a fear of being corrupted or contaminated by colour as a superficial, decorative, excessive and ornamental element and argues that we are still dealing with the often-unspoken or questioned belief that seriousness in art and culture is a black and white issue.

With an effective clear reduction of the discussion on the subject of colour after the 1960s between art historians, critics and artists, it is interesting to note, at the same time, and as Briony Fer (2008) stated, that art history was slow to recognize the importance of colour at key moments in the practice of some artists, such as the recognition of Donald Judd as one of the great colourists of the twentieth century.

As a painter who works with colour in a recidivist and assumed way, I recognize the effects of this chromophobia, in certain contexts, agents and platforms of dissemination of contemporary art. It is worth reflecting on the possibility that chromophobia influences the understanding of the place of colour in contemporary art and, on the other hand, how it is interleaved with the apology of colour, as it has been through several moments of history, often surprisingly.

Keywords: *Colour, prejudice, chromophobia, contemporary art, painting*

The diegetic colour in the Brazilian miniseries Suburbia

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Abstract

Interested to discuss the colour's role in the audio-visual creative processes, this paper presents a chromatic analysis of the Brazilian miniseries Suburbia (Globo Television, 2012), considering the conceptual relation between narrative, staging and art direction, and its visual projections in the miniseries images. The research proposes the "diegetic colour" concept by the study of the audio-visual art direction processes, considering its dialogue with the photography direction. The art direction is responsible for the material design of diegetic spaces and characters and it is one of main aesthetic base of the film and television image visual aspect. The colour should be considered the most important layer of creation in the art direction, connecting all elements of the scene.

The "diegetic colour" is a concept resulting by the study of the colour syntax in the audio-visual image and it should be understood as a perceptive frame formed for layers resulting by the interferences on the hue material bases of scenes, that is saturated or attenuated for to rear specific meanings. We do not have to think the "diegetic colour" only about the film colour palette itself, but its expression at the film universe by the colour scene components like scenarios and scenes objects, characters, costumes and makeup, considering the material shapes. Yet how this set is registered under a specific light design and the post production chromatic process.

In the miniseries Suburbia, the colour is the main visual element and it is essential to narrative development. Suburbia (2012) was directed by Luiz Fernando Carvalho and wrote by Carvalho and Paulo Lins (the Cidade de Deus book's author). The miniseries has eight chapters that presents a Rio de Janeiro's suburbs: the black and poor population's life, the violence, the social behaviours and cultural manifestations. In the Suburbia's visual narrative is presented all the colours of Brazilian black culture: dances, parties, garments, religions and buildings. The chromatic creation is one of the responsables for the visual narrative expressivity, resulted by a competent material and visual research.

This study considers that the audio-visual colour construction must be related to a research on the production's diegetic universe and not to pre-conceived colour symbologies. The "diegetic colour" reflects the scenes atmosphere and it is related to narrative concepts. The Suburbia's "diegetic colour" is resulted by an art direction's design focused on a representation of the Brazilian black population suburbs. The colour symbolism presents some of the visual identity elements of the Afro Brazilian culture. The art direction express through visual narrative the possibilities of using colours from a specific cultural background.

Keywords: *colour, art direction, audio-visual, television, Luiz Fernando Carvalho*

Colour in Children's Furniture – emotion and sustainability

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Abstract

In a product design research about children's furniture and its adaptation to the child and sustainability, the aim is to find solutions, which can follow child's growth. Namely, through a design project of a high chair, with an age target from 6 months up to 7 years of age, capable of contributing to a sustainable development, with a longer product life cycle. A study about colour, emotional response and product attachment seemed necessary in this research project.

Although the focus lays many times in form and function and how the object physically adapts to the user, chromatic properties may be relevant to a psychological appropriation and a lasting bond to the object in question. When the main target is a child, who has a sensitive and prone to change nature, the subject is more difficult to approach, when it comes to colour perception. But parents, as indirect users and consumers/buyers have also, to be taken under account.

Given the concept of affective sustainability to prevent waste, enabling a stronger bond with a product, colour preference may be an important element in the child's emotional response and product attachment. Dealing with variables such as gender, age, education and cultural background and the concepts of emotional and pleasurable design, this literary review based study searched for a relationship between colour and sustainability. Studies focused on colour perception and preference in illustration, fashion, interiors, marketing and product design, namely on household appliances, revealed some convergence of results, despite such subjective variables as personality and mood differences.

It was possible to conclude that colour seemed relevant in product attachment, being an important key in product perception and identification with a strong emotional response and therefore may lead to an affective sustainability in product design. Blue seems to be perceived as calming and peaceful, red as intense and powerful and green as perseverant and balanced, whilst black and white seem to be associated with technology and efficiency. These were mentioned in most of the reviewed studies as chromatic and achromatic preferences, regarding several variables.

This study contributed therefore, to narrow the chromatic choices for this design project, to a limited range of colours: three chromatic options – blue, red and green, along with two achromatic options - white and black. Being the natural colouring of the chosen wooden materials (beech and pine), the primary option, blue, red, green, white and black, partially or overall versions would be alternative or secondary options for the high chair' design project.

Keywords: *Children's Furniture, Product Design, Colour in Design, Emotion, Sustainability*

A Study on Lighting Control Strategies Combining Daylight with White LEDs in Museums

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Abstract

Daylight has been used as one of the major museum lightings from the past. It has high colour rendering and brings natural appearances of paintings. However, those appearances are not stable because the intensity and colour temperature of daylight always varies depending on the time and weather. Recently white LEDs have been widespread in museums, and they have an advantage in the easiness of controlling light intensity and colour while keeping high colour rendering. There is a possibility that white LEDs could be used with daylight in a new way, where the daylight fluctuation will be taken full advantage of for an appreciation of paintings. The purpose of this study is to find out the appropriate lighting control strategies using both daylight and LEDs, which bring preferable lighting environment in museums.

The experimental procedures were as follows; purple-phosphor white LEDs ($R_a > 94$) were set in a high-sidelight as an “alternative” to daylight (referred to as “daylight LEDs” in this paper). It was verified in the previous experiment that subjects could not distinguish these LEDs from daylight. To reproduce natural daylight in the evening, the CCT of daylight LEDs was gradually changed from 6500K to 3000K and its illuminance on the painting was changed from 150lx to 70lx, taking 22 minutes. A spot lighting (purple-phosphor white LEDs, $R_a > 94$) was used together, and by changing its intensity and CCT, 13 lighting conditions were prepared. The experimental room measured 3000mm in width, 3000mm in depth and 2400mm in height. There were 19 participants aged 21-28 with normal colour vision. 3 kinds of oil paintings, “Lake Como” which showed colourful scenery, “Madonna of the Meadow” whose face’s colour is conspicuous and “Red Mt.Fuji”, were used in this experiment. Subjects evaluated the appearance of the painting and the preference for the fluctuation of lighting using 9-point scales.

The results of the experiment are as follows; preferable lighting conditions for the appearance and fluctuation differed according to the paintings. As to “Lake Como” and “Madonna of the Meadow”, there was a tendency that the appearance and fluctuation was highly evaluated under the conditions that illuminance on the paintings was kept constant at around 200lx even with the fluctuation of daylight LEDs. As to “Red Mt.Fuji”, 3 types of lighting conditions shown below were highly evaluated: 1) illuminance on the paintings was kept constant at 200lx and CCT on the paintings was changed to 3000K, 2) illuminance on the paintings was lowered to 120lx and CCT on the paintings was gradually changed to 4000K, 3) lighting condition was CCT on the paintings was kept constant at 5000K. This result indicates that the paintings like “Red Mt.Fuji” with low reflectance can be highly evaluated even if the illuminance on the paintings is lower than usual if we control the spotlight properly under daylight fluctuation. In future work, we will continue to do further experiment under various lighting conditions in a wider CCT range.

Keywords: *museum lighting, daylight, white LEDs, fluctuation, control strategies*

Primary colours as emotional signs for visual design: case study

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Abstract

Colour is fundamental in our lives, likewise, in visual communication. Colours carry immense symbolic charge and, according to their use, can transmit different messages. Therefore, the knowledge about potential of communication of each colour is fundamental to the correct transmission and interpretation of visual messages, because there is an enormous possibility of colour application and each composition produces a distinct result, as a message of its own. There are researches and bibliographies to help us to use colours in visual communication, but we know that each country, region or community has cultures and beliefs that presents particularities in emotional perception. For the design field, this particularities in colour perception are fundamental to project and its success in transmission of messages. The second point that drove this research was the difficulty of students to convert bibliography information of colours in images or other visual communication. To raise afore mentioned interpretation of colours, this research was proposed. The select universe to started was students of Design in Universidade de Sorocaba, in São Paulo state, Brazil. The purpose of research, named “Primary colours as emotional signs for visual design” occurs as preliminary study during 2016/2017 and is proceeding in 2018 as Scientific Initiation Project and, also, is taking place in 2018 classes of Creative Process, of Design course. The principal focus of this bibliographic research is the emotional interpretation of primary colours and, using the design thinking methodology, convert the interpretation in illustrations and images to inspire projects of visual communication for design students. In other words, create signs of primary colours to design students, according their emotional perception about bibliographic information. A preliminary research starts in 2016 with the colour yellow. Using mind maps, the student construed signs and, to experiment the results, transformed it in stamps, to serigraphic press. As any other colour, yellow allows an immense range of possibilities to create sign, for that reason, the propose of the student were better tied her own universe. Obviously, final drawings or yellow signs will be validated, but the positive point of this preliminary research was that other students were instigated to propose their own drawings. During 2018, blue and red are being study too; yellow results are being validate and students are proposing new signs. We intend to expand the universe of research to other universities in the state of São Paulo, Brazil. The final product of this investigation will be a sign book to inspire student’s projects in visual design field. Therefore, this research corroborates the study on primary colours and its use in visual design projects, because it facilitates the students’ immersion in the universe of each primary colour and approximates the understanding of the possible messages that each one transmits, or can transmit, in visual communication.

Keywords: *Colours Signs, Primary Colours, Visual Communication, Visual Design, Emotional Perception*

Colour Cultural Study: A Comparison Case Study of Fashion Colour Between China and UK

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Abstract

This project was initiated by Colour Cultural Study Group in Tongji University as part of a colour cultural research agenda, which was funded by Shanghai High Education Academy Research Board in 2017. The research approaches consumer commodity as main focus, which framed by clothing, food, buildings and traffic. The four dimensions are involved colour design that lies upon the understanding of aesthetics and sociocultural premises in different geographical and cultural context.

As one of the important components, fashion and clothes serve communicative functions, which carries symbolic messages. The structural meanings are constructed by style, material as well as colour. Colour as a significant visible signifier reflects an individual and collective cultural identity. A specific colour tendency and propensity is determined by conventional colour culture in both temporal and geographical factors. As a result, the response to the colour choices will be different due to the local and global cultural context. Thus, a cross-cultural study is necessary to provide an empirical evidence to test and verify the hypothesis, more importantly it can be further explored the process of colour decision making in corporate with design implementation and strategies in various ways.

Based on the assumption of cultural influence on colour, the research approaches a comparison case study method to look at the difference and sameness of the fashion colour cross culture. This case study analyses the colour application of fashion consumption based on the market of China and UK. The samples is collected from 4 brands between the fashion market respectively: Uniqlo (China), Uniqlo (UK), JNBY (China) and Jigsaw (UK). By examining 10 featured SKUs of 2017 women winter collection for each brand, the online research investigated the data including colour categories, colour similarity and colour naming in both international and local fashion brands' online shops.

The results show that local brands offer less colour categories than international brand; In comparison with same brand of different market, the colour similarity is 52% in average; and the colour similarity between different local brands is 11.4%. A significant colour difference has been highlighted between local brands compared with international brand; In terms of colour naming, the local brands use more colour names with descriptive, refined tones and cultural colour than international brand.

Through analysing the distinctive characteristics of the data, this research highlights the international brand promotes a consistent fashion strategy through colour unification; whilst the local brands emphasise the diversity and individuality of colour choices, which reflects the uniqueness of the brand identity. Moreover, the local brands use more sophisticated colour and refined colour rather than conventional colour narratives. All of which are supporting the hypothesis of colour preference is influenced by colour culture, and in turn by segmenting and applying a refined and unique colour quality to clothes, it helps to create and demonstrate a local character of fashion sense.

Keywords: *Colour culture, Fashion Colour, Cross-cultural colour study, Colour category and naming*

Spotting the aesthetically dynamic properties of naturally dyed and finished textiles from a circular design point of view

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Abstract

What if an aesthetically dynamic quality of textile colours and finishing could change our perception of colour as a design element and how could this happen?

Imagine, the colour of our new pullover is achieved by natural dyes, the product is developed based on a circular design thinking in manufacturing and, therefore, has different qualities, which are only revealed while using and wearing the garment. Its colour is not permanent, as most customers would expect their clothes to be, but interacts slowly and metamorphically with influences from the environment such as light and water affecting the shine, brightness and saturation of its colour appearance. The user is informed about this novel property of the product in order not to consider its changes as a failure. If the colour characteristic is creating an added value as a specific design element, the user may find himself discovering and observing its dynamic, evolving features. As a result, he can see the beauty of natural changes and variations in the product, making it over time unique and personal. Unfortunately, this portrayed scenario has not yet become true and explains one of today's relevance of textile and material research: to outline and develop solutions on how materials and textiles could be designed in order to respect and integrate the conditions of our living environment.

The goal of this paper is to make suggestions on how the gap between today's user expectations (products should perfectly stay the way they are when we purchase them) and the above-mentioned scenario can be cultivated. We are sharing insights which we gained in the last five years in textile research in several applied research projects together with industry partners funded by the Swiss Government (Innosuisse). Between 2014 and 2017, we particularly reflected the textile and garment manufacturing process from a circular design point of view and with given criteria from the industry partner that the textiles have to be fully vegan (excluding all animal fibres) and bio degradable. After use the textiles are meant to become suitable soil to grow plants on.

To enrol the discussion more deeply about design potential of so-called aesthetically dynamic properties of naturally dyed and finished textiles, it is necessary to first define terms outlining the theoretical background. Then we present finishing experiments with natural dyestuffs, which will lead us to draw an outlook with future scenarios.

The research which has led to this paper was funded by the Swiss Government (Innosuisse) and conducted by the "Research Group Products & Textiles". The research has taken place in textile workshops and the "Studio of Colours" as well as in testing labs at our University by researchers with different backgrounds and expertise in pigments, inks, textiles, finishing and applying scientific methods and tools.

Keywords: *Dynamic colour properties, Circular design, Natural dyestuff, Natural finishing, Sustainable product strategies*

Colour and Lighting



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colour & human comfort

The Effect of Coloured Glazing on Thermal, Visual and Overall Comfort Evaluation

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Abstract

Colour, besides affecting the visual perception of people, can also influence other types of perception, such as the thermal one. The specific influence of coloured stimuli on human thermal perception is referred to as the “hue-heat-hypothesis” and has gained attention for building design and operation due to the fascinating idea of heating and cooling with colours. In the built environment, colour is an essential aspect that characterises the whole indoor ambiance, from small objects to the permeating light. The colour of the incoming daylight changes its appearance due to variations of its spectrum according to weather, time of the day and season, but also because of the window’s spectral transmittance properties. The role of glazing’s properties (in particular, its colour) becomes therefore an important factor to study for the understanding of not only the visual perception of the indoor environment, but also of the thermal perception and the overall comfort of people.

The present study is a part of a larger research project aiming to understand the interactions between visual and thermal factors on human comfort and perception. The paper intends to collect information relevant to this aim by analysing the differences in comfort votes regarding thermal and overall comfort, besides the visual comfort, of 75 people exposed to both blue and orange glazing for a short exposure time (i.e., 30 minutes). Furthermore, by analysing the results of the same experiment repeated at three temperature levels (19 °C, 22 °C and 26 °C), it aims at understating whether the aforementioned differences are affected by temperature. Finally, this study intends to learn the correlation between the three comfort evaluations.

Results illustrates that changes of coloured glazing result in changes of thermal and overall comfort, other than of foreseeable changes of visual comfort. Moreover, results show temperature-related colour effects regarding visual and thermal comfort evaluations. In particular, orange glazing leads to more comfortable thermal conditions than the blue glazing, especially at temperatures evaluated as comfortable (26 °C) or close-to-comfortable (22 °C). Orange glazing also leads to higher colour comfort compared to blue glazing at slightly uncomfortable (19 °C) and close-to-comfortable (22 °C) thermal conditions, and the percentage of participants preferring blue glazing over the orange one increases with temperature (from 12% at 19 °C to 44% at 26 °C). Despite changes in colours lead to changes in overall comfort, neither blue nor orange results in more comfortable overall conditions. Variations in thermal and overall comfort votes between the blue and the orange conditions are larger in the close-to-comfortable thermal condition (22 °C), highlighting a stronger influence of temperature in the other thermal conditions. Variations in colour comfort votes are larger at comfortable (26 °C) and close-to-comfortable (22 °C) thermal conditions, meaning that the effect of colour on a visual-related scale is lower if the temperature is slightly uncomfortable.

Overall comfort positively correlates to both visual and thermal comfort in a comparable way, due to the experimental design and the fact that colour is a strong attribute of the indoor environment.

Keywords: *colour, temperature, visual comfort, thermal comfort, overall comfort*

Visual Experience of Older Adults: Colour Preference and Colour Tuning for Health and Comfort

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Abstract

Understanding visual conditions of the aging population helps us to define major challenges faced in navigating space and living healthy lives. For older adults colour and light can be used strategically to improve quality of life. The global population aged 60 or over is growing faster than all younger age groups. According to data from World Population Prospects: the 2017 Revision, (U.N.) the number of older persons -those aged 60 years or over- is expected to more than double by 2050 and to more than triple by 2100. One of the five strategic priority areas recognized by the World Health Organization, Global strategy and action plan on aging and health 2016-2020, is Age Friendly Environments. As the population ages rapidly, we are faced with the opportunity to create living environments that promote independent healthy lives.

Biological and environmental factors influence the older adults' spatial orientation, object recognition and social behavior. Incorporation of daylight and electric light into the built environment can help compensate for the diminished visual system and lifestyle changes of the older adult.

Effective use of lighting can lessen the impact of the aging eye on task visibility; changes in balance and postural stability leading to higher risks of falls; adjust hormonal balance, behavior and mood; improve changes in the circadian system that can impact the quality of sleep. Quality lighting design that is strategically incorporated with colours and materials in interior design enhance visual ergonomics and wayfinding. Intentional use of CCT and quantity of light helps older adults experience colouration designed intentionally to create comfortable living spaces. Quantity of light and colour fidelity boosts appetite and mood. Quantity of light and spectral sensitivity is critical for the regulation of the circadian system.

Changes and developments in lighting technology present unprecedented opportunities, but there are also risks and challenges for the new technologies. One of the biggest trends in lighting is the development of colour tuning LED fixtures. Individuals have the ability to decide with one light source the quantity of light and what Kelvin temperature of light they want to experience ranging from candlelight at 1700K to daylight at 6500K. Is incorporating tunable white LED fixtures in people's homes the advisable route for aging adults? If a spectrum of the light is making colours look less attractive to them, should the source change to make colour more vivid and interesting? Or conversely, is the best route to change the colour in a space, for example using the aging person's preferred colours in paint colour, objects and fabric of a space? This talk will examine how aging people see colour, colour preference of aging adults and discuss the benefits and risks of colour tuning light.

Keywords: *Aging, Lighting, Health, Built Environment, Technology*

Impact of the artificial lighting's colour temperature on the elderly's circadian cycle

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Abstract

Light plays a fundamental role for the human being, support for photosynthesis and vision. More specifically, when it's artificial, it can have a strong impact on the body, especially blue light. Thanks to her study "Aging reduces the stimulating effect of blue light on cognitive brain functions" researcher Véronique Daneault has indeed demonstrated that in the elderly, suffering from visual impairment often inscribed in a context of poly-pathologies, the effect of the blue light is less. Caused by a declining response to irradiance, opacification of the lens, a reduction of the pupil, the quality and the amount of light that can reach the retina is thus reduced. These multiple factors thus affect the effect of light on brain activity. But even more damaging than the effects of blue light on the life's quality of the elderly, the most important element remains the age. In spite of the classical environmental disturbances, the noise or the social agitation, the age leads to a major evolution of the circadian cycle and thus of the hormonal rhythm. We are witnessing a phase shift leading to a "morning" chronotype, affecting the quality of sleep, causing multiphase sleep and phases of "nocturnal agitation". It also influences cognitive abilities and mood. Also found in the study of teacher-researcher Cho-Yi Chen, "Effects of aging on circadian patterns of gene expression in the prefrontal human cortex" better cognitive performance in the morning, before deteriorating during the day.

This phase shift also causes a gradual decline in capacity, requiring an intermediate rest phase, the nap, but which can also result in a semi-vegetative diurnal state. Having observed, thanks to Véronique Daneault's previously mentioned study, the stimulating nature of blue light in the elderly at the day's beginning, it would be appropriate to consider compensating for the change in the circadian rhythm of these users thanks to a chromatic dynamic within its environment. If indeed, the blue light allows the stimulation of the brain activity, on the contrary a warm light, yellow / orange, makes it possible to initiate a phase of rest, of sleep. Thus recreating the colour cycle of natural light, this chromatic dynamic would help the users in his various daily phases, to weight the evolution of the circadian rhythm. A beginning of answer could then be drawn thanks to the biodynamic lighting. We will study this lighting of the Philips brand and its potential to adapt to the living environment of the elderly, then considering an In-Situ study of its chromatic potentialities.

So, let's ask ourselves the following question: would a daily chromatic dynamic, similar to the natural light cycle, made possible by a Human Centric Lighting, not be able to become a driving force for the improvement of the environment, the rhythm of life of the elderly, thus ensuring a daily comfort?

Keywords: *Aging, Biodynamic lighting, Chromatic cycle, Comfort, Daylight*

A Study on Afterimage Evaluation consequent on Changes in Lighting Area and Illumination Presentation

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Abstract

Modern lighting has become available for system design, so is it available for multi-dimensional lighting other than one-dimensional lighting. By this, composition of lighting rays in line with a human's complex behavior without setting them uniformly.

The method of changes in behavior-starting-point lighting creation comes to have an unequal luminance ratio, and the unequal luminance ratio causes a very high feeling of fatigue on a human's visual-perceptual elements.

The afterimage among the elements, which make it possible to identify a human's luminous ability, is the phenomenon, in which visual action remains even after the light stimulus is removed, and this study judges that it might be possible to identify an excited state of an eye caused by a light stimulus.

Hereupon, this study identified the degree of an afterimage consequent on existence, or non-existence of dynamic changes (changes in area and space illuminance) of lighting in lighting environment available for lighting creation changes, and intended to organize the index for controlling an afterimage.

The evaluation results are as follows:

1) An afterimage in time of creation constancy, appeared the most noticeably in low area & high illuminance, and the higher the illuminance, the more it increased. Accordingly, the solution to an ideal design plan is the one for the large area & low illuminance, which should be fulfilled with less than 150lx for both 900 x 900 (mm) and 900 x 2100 (mm).

2) The afterimage in time of lighting creation changes was found to be much influenced by 300 x 300 (mm)_150 lx in following creation, which belongs to the scope of 'an unpleasant afterimage' in changes of small area & high illuminance in following creation, and thus attention is required in its use.

An ideal design plan is available when 900 x 900 (mm)_50 lx in preceding creation changes to 900 x 2100 (mm)_10 lx in following creation, and the use of (B)-grade where 'an afterimage begins' according to a user creation characteristic should be also taken into account. In addition, lighting design should be considered within the scope of similar area & illumination between creations if possible.

Keywords: *System Lighting, Presentation Change, Evaluatin index, Afterimage, Lighting design, Light stimulus*

An approach to face contrasts in women faces under CIE standard illuminants and representative white LED sources

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Abstract

We started from average experimental measurements of spectral reflectance factors at 3 different regions of the body (forehead, cheek and neck) in a set of 87 young and healthy women from two different ethnics (50 Caucasian and 37 Oriental), plus 5 commercial red lipsticks. From these object colours we computed several CIELAB colour differences ($\Delta E^*_{ab,10}$) under 18 light sources, divided in next two groups. Group 1: CIE standard illuminants A, D50, D55, D65, D75, F2, F7, and F11; Group 2: A set of 10 white LED sources, representatives of those currently available in the market, which includes 5 phosphor-converted blue LEDs, 1 hybrid LED mixing a phosphor-converted blue LED and a red LED, 2 RGB LEDs, and 2 phosphor-converted violet LEDs. As an approach to the study of contrasts in women faces, assuming that the neck may also influence face appearance in some images, we have analysed the magnitude and characteristics of $\Delta E^*_{ab,10}$, focusing on potential relevant changes produced by modern white LED sources (Group 2) with respect to main CIE standard illuminants (Group 1). We can summarize our main results in the next three epigraphs:

I) Results considering only one region of the body. The average $\Delta E^*_{ab,10}$ between the two ethnics was 7.4, 6.6 and 3.3 for neck, forehead and cheek, respectively, with very small standard deviations ($< 0.2 \Delta E^*_{ab,10}$ units) both in Groups 1 and 2. These $\Delta E^*_{ab,10}$ were mainly in lightness and chroma for neck and forehead, but mainly in hue for cheek, with considerably similar results for all 18 light sources.

II) Results considering two regions of the body. For the 18 light sources, the average $\Delta E^*_{ab,10}$ for cheek-forehead, cheek-neck and forehead-neck were 4.9, 5.4, and 4.2, respectively, in Oriental women, and 2.7, 7.6, and 5.3, respectively, in Caucasian women. Thus, we found lower $\Delta E^*_{ab,10}$ values for Oriental than for Caucasian women, except for cheek-forehead. Hue differences were the predominant ones in cheek-forehead for Caucasians, but not for Orientals, with similar results for the 18 light sources. The standard deviation of these colour differences were small ($< 0.8 \Delta E^*_{ab,10}$ units) both in Groups 1 and 2.

III) Results considering cheek (the closest measured region to lips) and commercial red lipsticks. $\Delta E^*_{ab,10}$ values were very large (between 10 and 45 units, approximately), and predominantly constituted by differences in chroma or in lightness, depending on the lipstick considered. Interestingly, the standard deviations of $\Delta E^*_{ab,10}$ values were consistently higher in Group 2 than in Group 1 for all five lipsticks, in a factor up to 2.2. The main deviations in Group 2 are attributable to values obtained for the two RGB white LEDs.

In overall, from current results we can conclude that white LED light sources, which will be the major sources for lighting in the near future, may provide an increasing gamut of contrasts in women faces. Further studies considering specificities of skin in different ethnics may be useful to cosmetic industry.

Keywords: Colour difference, white LED, colour inconstancy, human skin, cosmetics.

Effects of Light Colour on Appearance of Interior Material and Preference of Lighting

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Abstract

This study aims to clarify the preferable lighting conditions for the appearance of the interior material. We conducted a subjective experiment using scale models of rooms.

Before the experiment, we made four types of 1/10 scale model of rooms, "Simple", "Natural", "Traditional" and "Japanese". "Simple" room was composed of walls with white wallpaper (vinyl cloth) and wooden floor. "Natural" room was composed of wooden walls and wooden floor. "Traditional" room consisted of brick walls and wooden floor. "Japanese" room was composed of walls with wallpaper (vinyl cloth like sand-wall) and tatami-floor. Each scale model equips two RGB LED lamps and three white LED lamps which could control correlated colour temperature. Next, twelve kinds of lighting conditions were set with four levels of CCT (3300K, 4000K, 5000K, 6700K) and three kinds of *duv* (-0.01, 0, +0.01) in each CCT condition, using five LED lamps above mentioned.

Participants observed each type of room model under twelve lighting conditions, and evaluated the naturalness of colour appearance of walls and floor with a numerical scale from 0 (very unnatural) to 6 (very natural). Additionally, they answered the impression of the room using semantic differential method with eighteen pairs of adjectives in a seven-steps scale, and also rated the preference of lighting with a numerical scale from -3 (not prefer) to +3 (prefer). Twenty female university students participated in this experiment voluntarily, and they were in all twenties and normal colour vision.

As the results of the naturalness of colour appearance, the evaluation of white wall in "Simple" room was good under 5000K in *duv*=0, and *duv*=-0.01, and 4000K in *duv*=-0.01. Also, the evaluation of wooden walls and wooden floor in "Natural" room was good under 3000K in *duv*=-0.01, 4000K in *duv*=-0.01 and 4000K in *duv*=0, and that of brick walls in "Traditional" room was good under 3000K in *duv*=-0.01, 4000K in *duv*=-0.01. The evaluation of sand-wall and tatami-floor in "Japanese" room was good under 5000K in *duv*=0, but was bad under 3000K in *duv*=+0.01.

According to the results of factor analysis on the impression evaluations, "Potency" and "Evaluation" were extracted. It was cleared that "Potency" in the rooms under the lighting in low CCT (3300K and 4000K) was high, and that "Evaluation" in the rooms under the lighting in low *duv* (-0.01 and 0) was high.

AS the results of the preference of lighting, "Simple" room and "Traditional" room were most preferred under 4000K in *duv*=0 and *duv*=-0.01, and "Natural" room was highly evaluated under 3000K and 4000K in *duv*=0 and *duv*=-0.01. However, "Japanese" room was preferred under 4000K and 5000K in *duv*=0.

In conclusion, the lighting in 3000-4000K and negative *duv* is preferred in "Simple" room, "Traditional" room and "Natural" room, whereas the lighting in 5000K and *duv*=0 is preferred in "Japanese" room. Therefore, the preferred lighting colour depends on the interior material of room.

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Keywords: *Light colour, Naturalness of colour appearance, Interior material, Preference*

A Study on a Senior Citizen's Discrimination of Colour Perception consequent on Colour Temperature & Illuminance of LED Lighting, Character Size, Ground Colour and Character Colour - On the basis of Visibility Range of 2m -bold

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Abstract

This study intended to look into the colour perception discrimination in the elderly's vision of similar colours. This study proceeded with experiments on the four sorts of basic colours of NCS (Natural Colour System) of colour specification, i.e. red, yellow, green, blue by putting a difference in black colour degree, pure colour degree, black pure colour degree and colour mixture proportion. At this moment, this study also looked into whether there existed a difference in colour perception discrimination depending on the colour temperature, and illuminance of LED lighting, and text size.

This study did experiments in the space (5.18m×4.31m×2.50m) consisting of luminous ceiling. The lighting presented in time of experiments was 3,000K and 6,000 K in colour temperature, together with 100lx, 500lx, and 1,000lx in average illuminance. This study also used colours for evaluation centring on individual 100% colours of red, yellow, green and blue which are 4 sorts of basic colours of Natural Colour System of colour specification. Also, this study applied S3040 as the ground colour by each colour. In addition, this study applied the colours which made a difference by 10% & 20% respectively in the black colour degree, pure colour degree & pure black colour degree and colour mixture proportion as text colours, and organized the text size with a total of 4 sorts (6cm×6cm, 3cm×3cm, 1.5cm×1.5cm, 0.75cm×0.75cm in width & length). Also, this study organized and presented 6 sorts of Arabic numerals (2,3,4,5,6,9). This study presented the evaluation object in comparison with the ground colour and text colour manufactured like this on one side of the wall of the experimental space. Then, this study got the participants in the experiment to adapt themselves to the given lighting environment for more than 1 minutes at the position 2 meters away from the evaluation object, and to say the numbers indicated by an examiner. The examiner filled individual experimental results in the evaluation sheet. This study organized the participants in the experiment with 20 general adults in their 20s~30s, and another 20 elderly people aged over 65.

Experimental results are as follows:

1)The general adults in their 20s~30s were found to be able to read numbers under all conditions when the visibility range was 2 meters.

2)The elderly people, when the visibility range was 2 meters, were found to be able to read numbers under all given conditions in case of a difference between the black colour degree. In other words, the results showed that it's possible for the elderly to perceive a colour and a text when a text size was more than 0.7cm×0.75cm, and black colour content showed a more than 10% difference, respectively, and when illuminance was more than 100lx.

In contrast, in case of a difference between the pure colour degree, the black pure colour degree and colour, the elderly people showed a different result according to a text size.

3)There was no difference consequent on colour temperature. It is thought that the influence by brightness is bigger than the one by colour temperature.

Keywords: *Elderly, LED lighting, Illuminance, Text Size, Colour*

The spring natural lighting chromaticity in interior: a case study for elderly people

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Abstract

Natural light (quantity, duration and time, distribution and direction, spectral power distribution) is important for non-visual processes by setting the principal biological clock to the day/night cycles and by enabling the regulation of the body (heart rate, body temperature, blood pressure), the mind (cognitive performances, subjective alertness, short-term memory) and behaviour (mood, appetite, wakefulness/sleep). The NIF (Non Image Forming) effects of natural and artificial light have been extensively studied in fields of application such as workplaces, education and healthcare. Differently, the research has performed limited studies in domestic interior applications but the interest is growing, in particular considering the needs of lighting for the circadian system of elderly people. They can suffer from the disruption of the circadian system due to the limited availability of natural light filtering through the windows and due to the natural modification of the age: the yellowing of the crystalline lenses along with the reduction of the number of neurons in the retina and in the suprachiasmatic nucleus (SCN). Owing to this limited amount and quality of light able to influence the endogenous circadian system of elderly people, physiological and neuropsychological disruptions can occur: insomnia, reduction of physical health, limited cognitive performance along with the decrease of mental well-being and depression.

In order to understand the contribution of natural light for the well-being of elderly people in the domestic interiors, the natural light conditions experienced in a real environment have been investigated through a field case study: a living room - kitchen of an apartment on the third floor of a residential building in Milan with a west exposure (Lat. 45.504044 - Long. 9.177164). Measurements of Illuminance at the Eye (E_{eye}), Spectral Power Distribution (SPD), Chromaticity and Luminance were performed from four different observation positions and were repeated every hour (8:00 a.m. – 6:00 p.m.) during the course of the astronomical spring equinox day (March 22nd, 2017). The results show that, in interiors, elderly people could be exposed to insufficient levels of natural light, even in the spring season, during the morning hours which are mostly important for the activation of NIF responses and as well as for the synchronization of their circadian clock. These results derive both from the specific orientation of the windows of this case study and from the sky conditions which occurred during the measurements (prevalently overcast sky). Circadian activation occurs through the natural light only when the observers' gaze is perpendicularly oriented towards the windows, at very close range, in the afternoon, with circadian activation above the maximum threshold at 4:00 pm. Furthermore, the effectiveness of natural light for the circadian system decreases away from the windows, in the more distant areas of the room, due to lower direct light penetration and higher levels of indirect lighting with an almost constant CCT.

Keywords: *Circadian Lighting, Spectral Power Distribution, Lighting Design, Spring Equinox, NIF effects*

Effect of colour purity of LED light on time-sense perception

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Abstract

The use of light-emitting diode (LED) lighting has now become widespread. Such light sources emit light in the primary colours of red, green, and blue, and are thus capable of reproducing most chromatic colours. Such light colours have been found to have both physical and psychological effects on human beings. For example, some studies have reported that long-wavelength (red) light increases alertness in the daytime. Takahashi et al. showed that high-purity green lighting tends to lengthen time perception of 600 seconds. However, the light colours used in those experiments were limited to high-purity red, green, blue, and white. Taking the above studies into consideration, this study aims to clarify the effect of colour purity and LED lighting chromatic colours on long-interval time sense perceptions. In our experiments, white light and three purity patterns were used for red, green, blue, yellow, cyan and magenta, respectively. The colour purity patterns of the chromatic light were 50, 75, and 100%. The selected task in our experiments was resting in a chair. Once the task had started, subjects were asked to state when they believed that 1200 seconds has passed, after which their time perception was compared to the actual elapsed time. Flicker values were measured before and after the experiment in order to gauge eyestrain. Subjective evaluations were conducted before and after the experiment using the semantic differential (SD) method. In this assessment, 12 pairs of words were employed: not uncomfortable/uncomfortable, not sleepy/sleepy, bright/dark, unoppressive/oppressive, warm/cool, calm/restless, stress-free/stressful, rested eyes/tired eyes, feels short/feels long, like/dislike, strong/weak, non-glaring/glaring. The results showed that declaration times were longer than 1200 seconds for all light colours. Moreover, except for red 75, green 75/50, blue 100, cyan 50, and magenta 75, the times were felt to be shorter than under white light under chromatic light colours. However, no significant differences were observed for each light colour. Moreover, it was showed that the differences in flicker value before and after the experiment were small when declaration times were long. In other words, little eyestrain occurs when the time perceptions were short. In the subjective evaluation, a weak correlation was shown between the words of "feels short/feels long" and the declaration times. Based on above results, the effect of colour purity on time-sense perception was not observed in this study. However, it is thought that it will be necessary to increase the number of subjects in future studies because our results suggest that there are light colours that can shorten time perception more than white light.

Keywords: *colour purity, light colours, LED, time sense, chromatic colour*

Colour and Culture



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colour & human comfort

Colour, Geometry, Consciousness

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Abstract

This paper explores the ways in which colours are related to geometry and the ways in which both interact to express as well as to evoke different states of consciousness in the different vehicles of Tibetan Buddhism (Shamanism, Tantra, and Dzogchen) as well as in current studies in the mathematics of consciousness.

In contrast to the Cartesian duality that creates a hierarchy between the lowly body and the superior mind, shamanism does not separate the self from nature nor body from mind, and aesthetic experience is similarly integrated with health and spirit. Colours, as associated with the natural elements of nature therefore have an important value. If aesthetic pleasure is important not only on a superficial level but can increase one's life force, then colours are more than superficial ornaments and can be understood as food for the soul.

If the path of shamanism is about harmony with nature, the path of Tantra is the path of transformation and all practices transform experience into bliss. Physical sensations are turned into heat and pleasure, vision is transformed into divine visions, and sounds are transformed into mantras, the five negative emotions are transformed into five positive qualities, the physical body is transformed into a body of light and the suffering being is transformed into the enlightened Buddha. Yogic practices such as physical movements, breathing, visualizations and sounds are rigorously practiced in order to transform the physical, emotional and mental experience. Colours are essential dimension of these practices and they are strategically with particular geometrical forms such as the Mobius ring. According to studies in mathematics, the ring change the nature of the colours- from distinct entities to an expression of flux and fusion. The form in conjunction with the colours therefore move the experience from separateness into unity that does not dismiss the existence of the colours as colours but opens our perception of them as intertwine.

Dzogchen teaches that the basis of all phenomena is inseparable emptiness and luminosity. Emptiness means that all beings and things have no essential, distinct and stable identity. Luminosity is both the concept and the sensual experience that best represent awareness. Emptiness is symbolized as the space out of which all phenomena arise and to which all phenomena cease. Light is the display of the five lights, the five elements, the manifestation of all things and all experiences. The revelation of the innate awareness that allows the light to shine out is the nondual experience of the nature of mind.

Ultimately, colours and have been traditionally used in the spiritual tradition of Tibetan Buddhism to bring harmony on a physical, emotional, mental and spiritual level. This paper demonstrates the movement from robust to nondual consciousness that is facilitated through practice of colours in conjunction with geometry.

Keywords: *Geometry, spirituality, Tibetan Buddhism, consciousness, mathematics*

Colours Used in Ancient Persian Rituals

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Abstract

There have been many customs and rituals practiced in ancient Persia – some of which are still practiced to this day in Iran (and other countries) – mainly related to Mithraism and Zoroastrianism. Mithraism was a religion centred on the God Mithra. Zoroastrianism is one of the world's oldest religions originating in Persia during the second millennium BCE. Ascribed to the teachings of the Iranian prophet Zarathustra, it exalts a deity of wisdom, Ahura Mazda (Wise Lord).

This study explores the colours used in the Ancient Persian Rituals by going through traditions, customs, and festivities during Mithraism and Zoroastrianism.

The first part of this study examines the colours used during Mithraism. It gives a brief introduction into Mithraism, its customs and rituals including the seven grades of initiations and the colours associated with them. For instance, the first grade of initiation is referred to as (black) Raven, and although raven is the messenger; but in Persian literature, raven is also referred to as someone who is not trustworthy. Raven and the colour black being chosen as the first grade of initiation symbolize someone who is naïve and about to end the old life and enter a new life (of Mithraism). It further discusses the colours associated with the days of the week, for example blue representing the colour of Monday, or green representing the colour of Friday; and colours associated with Mithraic festivities, for instance purple representing the colour of Mehregan (one of the most important national celebrations of Persia, celebrated since Persian Achaemenid Empire to this day, Mehr = Sun), or red (pomegranate and watermelon) and yellow (grape and lemon) being decorated on Yalda night (Winter Solstice, Birth of Mithra) where both colours (red and yellow) represent colours of twilight and sun.

Next, the colours of Zoroastrianism are discussed. The meanings of colours, colour characteristics of the customs, festivities, and religious ceremonies and rituals are reviewed. For example, it is discussed how the colour green (meaning peace, hope, and life) is considered a lucky colour and is used in celebrations such as engagements and weddings (from the engagement dress to the colour of tablecloths, envelopes and handkerchiefs). White is considered a clean, sacred, pure colour and is used in religious practices such as Sedreh-Pushi (putting on the Sedreh or the sacred clothing), or in festivities such as Esfandgan (an ancient Iranian celebration, dating back to Persian Achaemenid Era, devoted to earth, women, and mothers – celebrated on February 18th). In addition, on Tirgan, yarns made up of colours of rainbows (meaning love and peace) are used. One of the mythical principles of Tirgan celebration is Arash Kamangir (Arash, The Archer) myth and his courage to make peace and fix the boundary between Iran and Turan; hence the usage of colours representing love and peace during this celebration.

In sum, this study will provide us a unique insight into this Ancient world and will help us understand colour values, practices, and aesthetics of the Persians and Persian Rituals.

Keywords: *Mithraism, Zoroastrianism, Persia, Rituals, Colour*

Colour-word associations: University undergraduate prospectus as a case study

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Abstract

Colour plays an important role in conveying complex meaning and today is ubiquitous in all forms of visual communication. Colour is an important component in logos, symbols, emblems, packaging and the choice of colour impacts on consumers' product choice (Westland and Shin, 2015). Yet little is known about the relationship between semantic networks and the colour spaces. The objective of our study was to analyse the associations between colours and words to determine whether a structure would emerge from consensual associations for a well-defined corpus of words. The University of Winchester (UoW) 2015-16 undergraduate prospectus was selected as a case study as colour palettes provided by designers are applied to semantic categories with no particular rationale. By asking students to associate words to colours, the objective was to reveal (if it exists) the underlying structure of association between words and colours. One hundred and forty-five words stemming from UoW prospectus were selected on the basis of their frequency and relevance concerning the University activities and values. Nine colour samples evenly distributed on the colour wheel were chosen. Using a questionnaire, 85 undergraduate students were asked to indicate which of the nine printed colour samples they most associate with each of the 145 listed words.

A correspondence analysis used to visualise the data, suggested a three-dimensional structure accounting for 78% of the variance. Examining Dimension 1 (D1 accounts for 35% of the variance) vs. Dimension 2 (D2: 28%), the 9 colours show a triangular arrangement with dark green/green in opposition to pink/orange/purple/yellow along D1 and with navy blue/red forming the triangle's apex along D2. Words most commonly associated with dark green/green included 'field work' 'sustainable' and 'geography' and those the most associated with pink/orange/purple/yellow included 'arts', 'performance' and 'choreography'. D1 was tentatively described as corresponding to 'Natural environment vs. youth & creativity' semantic categories. 'Masters degrees', 'accounting' and 'politics' were most associated to dark blue/red and could be identified to 'professional responsibilities' for D2. The third-dimension accounting for 12% of the variance distinguished pink/purple from yellow/orange, with the former associated to 'choreography' 'performance' 'dance' 'desirable' and 'gender' and the latter to 'children/youth', 'Christian foundation', 'freedom', 'volunteering', 'spirituality' and 'well-being' and was identified to 'Performing Art' vs. 'youth and spirituality' semantic categories.

In conclusion, a consensus obtained in a word-colour association revealed the underlying structure that specified the semantic categories and the associated colours for this particular corpus of words.

Keywords: *colour-word association, colour symbolism, correspondence analysis*

Colour influence in the favelas requalification process: Heliópolis case study

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Abstract

The favela is a place where colours and textures are associated with the apparent coating materials of brick, plaster and concrete, with the predominance of different earthy tones ranging from brown to grey. These colours and textures camouflaged or highlighted by light integrate the landscape marked by the improvisation and the temporary dwelling that ended up becoming definitive.

In the specific case of the favelas, the complex psychophysiological interactions of colours transcend the relationship between form/background, compositions, surfaces, light and distance. Moreover, the perception of apparent colours and materials, predominant in the Brazilian favelas, are associated both with the context of violence, poverty and improvisation that demarcated these places as lack of identity and culture.

Colour in architecture contributes to the relationship with the environment because it can provide physical and psychological comfort, communication clarity, aesthetic affirmation, identity, spatial orientation, typological, morphological and historical adequacy, therefore, it is a privileged tool to transform (Durão, 2013).

Certain interventions have applied vibrant colours to the façades of some of Brazil's major favelas, using colours as a prominent feature of the grey landscape. This type of intervention had great repercussion with the project of the Brazilian architect Ruy Ohtake, who voluntarily conceived the project for the painting of two hundred and seventy-eight façades of the favela of Heliópolis, in the city of São Paulo in 2003. This project which had the active participation of the community was initially executed without the support of the public power, only with the donation of private companies and it drew attention to the situation of the favelas.

Some interpretations highlight the influence of colours on the community's identity-building process, leading to a more positive image of the favelas and contributing to the improvement of the community self-esteem (Kosmala & Imas, 2012), while other interpretations consider the interventions as a romantic and cosmetic camouflage of the ignored reality (Rahman, 2014) encouraging tourism of poverty (Rolfes, 2010), without significant repercussions for the improvement of the living conditions of their inhabitants.

In the light of the above, this paper presents the case study of the project developed by the Brazilian architect Ruy Ohtake to the favela of Heliópolis, discusses the scientific and media views on this type of intervention in urban space and reports some of the developments and benefits of this project for the community.

Keywords: *Colour in the built environment, favelas requalification process, Heliópolis, Ruy Ohtake, Cultural identity*

Colour in Architecture and the Writings of Pseudo- Dionysius, The Areopagite

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Abstract

This work is part of a research project developed on colour in architecture based on texts that would have been written by a Syrian mystic of the fifth century who used to conceal his identity under the alias of Dionysius the Areopagite, a council member of the Athenian Areopagus law court and follower of the apostle Paul, as mentioned in the book of Acts in the Bible (Acts 17:34). Dionysius has acquired an almost apostolic notoriety, given the enormous influence his writings had in the Middle Ages. This text presents concepts about colour as seen from the perspective of Plato's works and Goethe, with the aim to apply them in the studies of the chromatic perceptual processes of architecture. It aims to address concepts that can contribute to a better understanding of historical approaches to these processes and the relationship between harmony, chromatic diversity, and totality. It also aims to analyse aspects related to colour that may have influenced Gothic buildings, particularly the Abbey of Saint-Denis in France and the work of Suger, a French abbot.

In the work of Dionysius, all reality fundamentally consists of hierarchical levels and a triad. Within each hierarchical level there is a ternary structure (three levels with subdivisions in three others), with three functions within all of them: the first, union and perfection; the second, enlightenment; and the third, purification.

The spiritual interpretation of colours is correspondingly repeated in the levels of the Church. The earthly Church is analogous and correspondent with the heavenly Church above. The sacraments, symbols, and ceremonies reflect the order of the Church above, while the colours of the Church correspond to the colours of the angelic world.

Symbols are used as a way of transforming the immaterial into material, transforming into human what is divine, bringing the transcendental to our level, and, at the same time, keeping the profane out of reach.

According to Georges Duby, on the work of Abbot Suger in the construction of the abbey of St. Denis, between 1135 and 1144, the monument was conceived as a theological work founded on the writings of the abbey's patron, Dionysius the Areopagite. The central idea is "God is Light." Light, whether "created or uncreated, in which every creature that receives and transmits its enlightenment participates according to its capacity or its place in the scale of beings" (DUBY, 1979:105). The innovations of St. Denis reverberate in several Gothic cathedrals, such as Chartres, Burges, and Angers.

One of the aspects found in several authors cited by Dionysius in defining Theosys, particularly in Goethe and in some researchers of environmental chromatic perception, lies in the conceptualization of harmony and the idea of complementarity and unity. Harmony is manifested in the search for unity through diversity and chromatic totality, as something intrinsic to human beings. Colours represent light to weak human eyes that cannot look at the sun, the source.

Keywords: *Colour in architecture, Dionysius The Areopagite, Abbey of Saint Denis*

Colour and Authenticity

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Abstract

The action of time and light grant variable qualities and expressions to the colours of architecture, to the patina and metal alloys in the sculptures. To find authenticity, it is sought to identify the colour intended at the time the objects were executed, the principles and techniques that substantiated the interventions and the qualities of the supports. The systematization of diverse information gathered on the subject refers to different frameworks of authenticity - historical, aesthetic, of materials and of surrounding space - that must be solved through a scientific methodology.

The central question of the reflection arises from the statement made by the agents involved in the cleaning of the statue of D. José I in Terreiro do Paço, Lisbon, in 2012. They affirmed, in order to justify their action, that the aim was to “bring back the initial colour” of the bronze statue, a more important philosophical and scientific question than the one of cleaning the statue. The materials change as time passes, and one has to know the metal alloys, which are the ones that are more resistant to the action of time and the surroundings, what is the composition of the applied alloy, if there is galvanic corrosion. Reinforcing this fact, it is also important to know which patina was initially applied to protect the material from time wear. The metals create patinas, a posteriori, by the action of time and due to environmental conditions, revealing a wear process that has to have an appropriate action, controlled through insightful cleaning, monitoring and maintenance. Thereby, to the initial colour of the statue it was already added an expectation of its behaviour. The patinas acquired from the effect of the time wear and local conditions, must withdraw the excess and everything that may carry physical risks of degradation. The technics of intervention, of materials identification and of cleaning must be adequate, having in consideration the qualities of the metallic alloy.

Also the paints’ pigments in the case of the plasters of the buildings’ façades in the Terreiro do Paço Square must maintain their initial characteristics despite their exterior exposure. This is different than the used colours, resulting from aesthetic options, political determinations or public opinion surveys. The use of natural pigments or adequate paints, is one of the determinant factors in preserving the chromatic qualities of the buildings as they bring back their authenticity, but it is always necessary to consider the characteristics of the support in order not to destroy its qualities.

The conscience of an adequate technical intervention that has in mind the degradation of the material, must be compatible to the value of the action of time conferred by the patina, acting scientifically after the diagnosis. The initial use of a protection patina in the metal and the use of pigments and paints in the finishes in plasters must be in order that materials have the predicted effect so they improve their behaviour as time passes by. These are technical and critical aspects that justify the intervention and build the aim of reflection.

Keywords: *authenticity, patina, initial colour, metamorphose, cleaning*

“Edible” colour names: Cross-cultural comparison of Russian and English

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Abstract

A significant number of colour terms are derivatives from names of objects. Common for native speakers in different languages are referents to coloured objects relating to food and edible substances, such as fruits, berries, vegetables, nuts, spices, beverages etc. In the present study we explored differences between Russian and English languages in incidences of colour names related to categories of food and edible substances.

Colour names were elicited in a web-based psycholinguistic experiment (Mylonas and MacDonald 2010; <http://colournaming.com>). Colour samples (N=600 in total) were approximately uniformly distributed in the Munsell System; an unconstrained colour-naming method was employed. Native speakers of Russian and English participated in the study; all were aged 16 years or older. Russian speakers input their responses using a Cyrillic alphabet keyboard.

Excluded were responses of participants with colour abnormality, as estimated by a colour-vision test, part of the program. A refined dataset comprised 14,260 responses from 713 Russian speakers (380 females, 333 males) and 5,428 responses from 272 English speakers (159 females, 113 males). In data of both Russian and English we focussed on specific categories, such as “berries”, “fruits”, “vegetables”, “fish”, “beverages”, “dairy products”, “sweets” etc. For each language dataset, we estimated the following linguistic measures: (i) the inventory of colour names in each category; (ii) frequency of each term’s occurrence; and (iii) number of unique mono- and polylexemic descriptors derived from each object name (derivational productivity). Russian basic colour terms (BCTs) oranževyj ‘orange’ and koričnevij ‘brown’, as well as English basic colour term orange were excluded from the analysis since they are deeply entrenched in both modern languages and their meanings had emancipated from the original object referents.

We found that in both languages colour words derived from names of objects related to food and edible substances constitute a significant number: 238 terms (17%) among 1,422 Russian unique colour words, compared to 200 terms (16%) among 1,226 English unique colour words. Interestingly, the list of the ten most frequent (counterparts of) ‘edible’ colour terms overlapped only partly between English and Russian. In particular, in Russian the most frequently offered colour terms were salatovij ‘lettuce-coloured’ and two non-BCTs denoting shades of PURPLE, bordovij ‘claret’ and malinovij ‘raspberry’. In comparison, in English the list was championed by maroon and two frequent non-BCTs denoting PINK shades, peach and salmon. In both languages the most frequent colour terms revealed rich derivational productivity, although word-formation patterns differed considerably between English and Russian.

We conclude that in both Russian and English the choice of ‘edible’ colour-term referents is indicative of availability of objects related to food and edible substances in the natural environment, but also reflects social reality, including the established cuisine, food and flavour preferences. Despite globalization influences on the food assortment and the entire nutrition landscape, the inventory of language-specific ‘edible’ colour terms and their referents manifests culture-specific culinary worldview.

Keywords: ‘edible’ colour names, Russian, English, cross-cultural differences

Less Theory and More Observation: A Current Method to Learn Colour Based on Phenomenology and on Goethe's Farbenlehre

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Abstract

This research arises from a diagnosis made to the inclusion of colour in artistic education in Chile (2015) which evidenced the need to provide resources for colour training to students at all levels (primary, secondary and university) as well as to the teachers that lead the artistic courses, who pointed out as the main problem the scarcity of resources to train themselves and to be able to explain the colour appropriately to their students.

The solution to this need for resources had to contemplate certain evidences related to the unfortunate reality of the Chilean academic artistic system, where only 20% of the people who teach an artistic subject in the schools have a university education in art: that means that the majority of teachers come from a background in subjects not directly related to colour such as literature, history, religion, English, etc. Additionally, teachers don't have much time to train themselves and the lack of trained people to train teachers; the lack of low cost didactic material available in the Chilean (and international) market that can be accessible to public, municipal and state schools, among others. In the search for a reference model for solving the problem, a conceptual parallel is established with the Theory of Colours of J.W.V. Goethe. In the 19th century, he proposed a model for learning colour based on the naturalist observation of the chromatic phenomenon, considering colour first as a pictorial problem and then as a physical phenomenon. He also proposed a series of experiments for the observation of colour in everyday situations, available to everybody, whether or not they have artistic training. This is expressed, for example, in the original name of his work in German, *Farbenlehre*, word that refers rather to a teaching of colours (*lehre*) and not to a theory (*theorie*), as it has been inaccurately translated into languages such as Spanish and English.

Due to the above, an experimental methodology for colour learning is proposed, based on the phenomenology of colour of Goethe's *Farbenlehre*. This methodology inverts the classical model 'from theory to practice', proposing a method from observation, passing through practice until arriving at the personal theoretical reflection (observation-practice-theory). It contemplates a colour course named Applied Colour in which first, the individual and guided observation of the phenomena of the surroundings by the students (and teachers) through the realization of qualitative experiments; then, the experimentation and chromatic register of the experiences using the coloured-pencil technique; and finally, remarks on the observed and on the practical work. With all this, the personal and experiential acquisition of the chromatic theory. This method also proposes, among other things, the realization of the colour lessons outside the classroom since the observation should be done in the environment, where the main didactic materials are the elements of the landscape (colour changes according to the light of the day, the harmonies and contrasts present in the environment, etc.). The teachers can accompany and guide the observation and the students learn about colour through the direct perception of the phenomena at the same time that they are enriching their aesthetic experience of their own environment.

Keywords: *Colour Education, Phenomenology, Goethe, Colour Training, Farbenlehre*

Colour Associations in Different Cultures

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Abstract

In order to create human comfort and wellbeing with colours we have to know how the colours are perceived and what associations the colours create within the persons exposed to the colours. What are the colour associations in other cultures? Do colours have different meanings in other cultures?

The aim of this research is to investigate if there are distinctive patterns – similarities and differences – regarding how subjects from different cultures connect 24 selected words with colours. The paper will present the results of a comparative study between subjects' colour associations in different cultures. The findings should be of interest for academics and professionals working in the remit of visual communication, architecture and design in different cultures.

The method used in this research has also been used in other studies, the first time in a pilot study made in Sweden and Nepal in 2016 which was presented at the AIC2016 conference in Santiago. Since then the number countries extended from 2 to 9.

The data in this study was collected in Germany, Iran, Japan, Nepal, Russia, Saudi Arabia, Sweden, Turkey and Uganda. The subjects speak and understand English. They do not have any known colour defects and they are born and live in the same country. In the study, students and laypersons was given 24 words in English. The words that are investigated are of different characters; some of them may have a more obvious connection to colours, as the words 'warm' and 'cold'. Others are more of an emotional character such as 'sorrow' and 'happiness' while others might be more subjective like the colours for the words 'me' and 'others'. The 24 words tested in this study are warm, cold, sorrow, happiness, calm, upset, near, distant, young, old, feminine, masculine, fast, slow, strong, weak, false, true, cheap, expensive, friendly, dangerous, me and others. In total, the dataset included 18,072 responses from 753 participants.

The subjects were asked to match each word to a colour from a chart with 27 selected colours from the NCS system. The results will be presented with statistics and diagrams showing the chosen colours, and analysed in terms of how coherent are the answers and which potential patterns emerge specific to the countries and their cultural contexts. It will be possible to compare the answers of groups separately and to analyse if there are differences in the chosen colours related to the subjects' sex, age, religion and experience of colour.

Keywords: *Colour associations, design, psychology, culture, architecture*

Rethinking colour as a Multisensorial experience

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Abstract

In previous arts-based colour research, the knowledge of colour has generally been understood through different disciplines, instead of formulating it into a holistic and multisensory experience. In my artistic experience when working with colours, I have started to study and understand colour in a more holistic way. This approach has guided my research to re-think the experience of colour in a newish, multisensory way, which will impact also the art pedagogy.

In this paper I explore the interaction between colour and the human experience. The research is focused on colour as a multisensory phenomenon, where colour is understood as an active agent and more like a process. In my doctoral dissertation, I understand colour experience to be connected not only with the human perspective but also with many different kind of entities, such as the air we are breathing, water, wind, natural and built surroundings, as well as human and non-human contacts such as technology, plants and animals.

The research is framed by posthuman philosophy, which is partly interested in understanding the human position not being in the centre of everything. At this point of my research, I am relying on philosopher Rosi Braidotti's (2013) philosophy about ethical questions within the Posthuman turn. In her philosophy there are questions that are related to the qualities of different kind of entities like non-human nature or animals. Posthuman theories have an increasing interest to study and play with "the others". These theories wonder, what is the meaning of the "subject" when it is connected to many kinds of relationships. What kinds of qualities are needed in the cooperation with nature and other non-human objects around us? Are they really "objects" or should we start to rethink them as active agents?

This paper discusses colour as one possible entity among other entities. In my research I will look for a new way through which colours are actively shaping the human experience. The research is carried out within the framework of artistic research. My practice in artistic research is based on art pedagogy and teaching colour in art education. Art education in Finland is part of the development of new modes for multidisciplinary education in basic education. These reforms call for new suggestions that could work in collaboration with other disciplines in schools. The research will have significant contribution to the development of teaching colour in art education. Understanding colour as a multisensory phenomenon will expand the possibilities of teaching and learning not only art but also diverse ecological issues and values.

Keywords: *Posthumanism, artistic research, relational ontology, art pedagogy*

Our Approach to Mediation on Colours

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Abstract

Since January 2017, our association has been developing a cycle of four exhibitions in Flutgraben's 200 sq. m gallery space, at the heart of an artists' house in Berlin. Approximately 2500 people have visited one or more exhibitions since the first opening. How to satisfy the various desires and needs to understand of our audience? Beyond traditional formats such as texts and panels, to what extent do colours allow us to implement more interactive mediation devices? And how are our visitors impacted by these devices? Through these exhibitions, we implemented various types of tools and devices, which we classified into five categories.

Your world of colours: We first assume that each of our visitors already have opinions and pre-conceptions about colours. Thus, we invite them to express their preferences or own interpretations of colours. For example, we exhibited a poster with 20 nuances of blue, which stated "Blue is the worldwide favourite colour, but which is your favourite blue? Put a sticker on it and discover its name". Expressing one's taste while learning to better define it is part of our mission.

Add your colours: We also invite our visitors to become more creative, and actively participate and engage with the exhibitions, in order to provide them with a more personal and subjective experience of colours and their uses. Our visitors, thus, had the chance to create their own pigments and put them on canvas or other media. For instance, one of our exhibits was the famous orange Berliner trash bin, on which visitors could freely paint or draw. They could also take part in a seedbomb workshop to add green to the city.

Colours' recognition games: Learning about colours is also about becoming more sensitive to their nuances and to appreciate their diversity. Simple games which can be played from three years old on also made adults curious and enthusiastic. For instance, we developed a pairing of blue eyes game, where 49 left eyes had to find their right one - patience highly required!

Educational games: We believe learning by playing is an experience which is often overlooked in traditional exhibitions. Thus, among others, we created a game of the goose about the history of the blue colour.

Wow-effects: Learning can also be carried out through cognitive experiences, which can leave traces on individuals and have a long-lasting meaning. In our exhibition about the colours of nature, we built a plant tent, a space to raise awareness about the beauty of nature and the need to preserve it.

The ways our installations got used up, the feedback that we got from visitors but also our inner team's feedback helped us understanding what works the best and what could be improved upon. Establishing a permanent space to exhibit colours will obviously bring a load of new challenges, but these previous experiences will enable our team to create durable installations that give a sense of colours to our diverse audiences.

Keywords: *Mediation tools and devices, audience-targeting*

Effective Colour Communication

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Abstract

Effective communication is a fundamental factor in the workplace, increasing productivity and creating a more positive and encouraging atmosphere, whilst reducing conflict, stress, and frustration between people of different backgrounds. In the colour design area, there are two main groups of professionals that use colour and require collaboration/teamwork: designers and chemists. Collaboration between these two groups is inevitable throughout the colour design process from creating new colours to final product application. The main role of the designer colourist involves consulting clients, forecasting new colour trends, creating new colour concepts whilst considering budgets, painted colour application for surface materials and so on. In contrast, the chemist works in laboratories, mixing pigments and thinners in measurable quantities to create new colours, and testing paint strength and durability.

In reality, the work of these two groups overlaps. Yet they often face communication difficulties because of a lack of shared understanding about different ways of describing colour and because of different educational/disciplinary backgrounds. This in turn can lead to negative attitudes towards each other and can adversely impact on the atmosphere of the workplace, especially among early career professionals.

The goal of this research is to investigate colour communication differences between two groups of participants – one from design and the other from chemistry/engineering.

Experimental data on describing colour samples was obtained from sixteen student participants from design and chemistry/engineering backgrounds. Design participants tended to use more creative and imaginative terms, as well as a wide range of semantic fields (a term borrowed from linguistics). On the other hand, participants from chemistry/engineering backgrounds described samples objectively and more precisely. They used a limited number of semantic fields. In terms of describing the process of changing the appearance of one sample to another, participants from chemistry/engineering used technical terms and described the process more systematically in comparison to the design participant group. Participants from the design background were less likely to explain the process of changing the appearance of a sample. They tended to stay focused on the difference between samples.

The examples of language use collected in this study provide evidence that people from a design background use a more abundant vocabulary than people from a scientific background. These comparisons are not intended to suggest negative or positive judgements by the researchers but to describe the different values of these participants. The results of this research offer additional ways of understanding different approaches to describing colours. The research provides justification for further study of communication between colour-using professionals in the work place.

Keywords: *Language, Describing colour, Semantics, Colour association*

The Symbolic Meaning of Colour Terms Related to Architecture in Chinese Poetry

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Abstract

The symbolic meaning of colour terms related to architecture is embedded in traditional Chinese poetry. The symbolism serves as an inherited aspect of Chinese cultural identity, deeply rooted in each generation's memory. Its vitality is so tenacious, reaching beyond the influence of religion and politics, because historically Chinese believe that China is built on literature, and poetry is the core. Moreover, the symbolic meaning is not merely confined to poetry, instead, it runs in a circle between the conceptual world and the practical world. Specifically, it plays an important role in the colour usage in the architectural construction process, and in turn established architectural colour always provides inspiration to the poets.

The aim of this paper is to explore the value of architectural colour to colour terms, and the core attribute of those colour terms. This research can be understood as studying the relationship between traditional Chinese architectural colour and local culture, rather than as a linguistic study. Several research questions are addressed as following: Firstly, what kind of architecture or architectural components may be linked with specific colours in poetry? Secondly, what are the symbolic meanings of those colour terms? Last but not least, are the meanings consistent historically, or subject to change?

The research mainly looks into the Chinese poetry which was written from the Tang Dynasty to the Qing Dynasty. In this poetry the symbols of colour terms that are studied are distilled by generations of intelligentsia and contain multiple meanings. Meanwhile, Chinese colour terms related to architecture are usually a combination of two words- the first word is the name of colour, the second word is the name of the category of architecture or architectural component. However, both of the two words are variables in colour terms, and they determine the expression of the meanings. Thus, on one hand, this research is a focus on the colours used with a high frequency by poetry, such as vermilion, grey-lavender, earthen-grey and white; on the other hand, stresses are also laid on the corresponding architecture and architectural components, such as storied building, pavilion, palace, house, door, window, eaves and wall. As the symbolic meaning of colour terms are decoded, the paper finds that the architectural colour, as a variable, significantly affects the expression of the meanings, and those meanings and symbols are inclined to be consistent historically.

Keywords: *architecture, architectural colour, symbolic meaning, Chinese poetry, inheritability*

Colour on the Hydraulic Tiles on the Colombian Caribbean: Case of Study, Barranquilla

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Abstract

The following research project is focused on the recognition of the traditional work of cement tile artisans in the Colombian Caribbean, the enhancement of cultural and historical aspects, as well as, the aesthetic and chromatic values that represent each of the unique designs that characterize the buildings of tropical architecture and their trajectory and validity over time. Framing the traditional trade and hydraulic tiles as products of the cultural and graphic heritage of the Colombian Caribbean region.

As an initial case study, a pilot methodological study is carried out to analyse the graphic patterns of cement tiles and their manufacturing processes in the city of Barranquilla, Colombia, considered as the national epicentre of the arrival of materials and construction techniques to its port, that brought with them the migratory currents at the height of the industrial revolution in the South American countries.

In the tropical architecture of the neoclassical period (nineteenth century) diverse stylistic influences of marked European and North American origins are mixed, among them the French Neoclassical, Baroque, Mudéjar, Neo-Gothic, Art Nouveau, Art Deco and even Neo-colonial stand out, which are combined to produce a singular eclecticism. These allowed the development of architectural projects with an aesthetic and plastic management very different from the traditional colonial pattern, responding to the social transformation and adoption of new codes and socio-cultural and economic roles of the time, hydraulic floor designs are the result of a craftsmanship finely made, of details rigorously treated with diversity of colour palettes that materialize the conception and design of spaces that become projectors of social life and a true channel of communication and cultural exchange.

Cement tiles and mosaics, venture as a novel material in tropical architecture, providing a significant change in spatial management. Providing the spaces with aesthetic, bioclimatic and hygienic benefits. The adoption of hydraulic floors then becomes a sociocultural differentiator, thanks to the great diversity of graphic motifs and chromatic compositions that make them unique pieces that manage to transmit or reflect the modernity desires of the society of the time and the cultural exchange of graphical designs patterns.

Finally, it could be assured that the hydraulic floors represent the graphic heritage of the Caribbean. Thanks to the diversity of chromatic patterns and palettes that recreate unique designs in a tropical context, the transformation of classic models of European origin and their cultural adaptation, makes this trade a cultural legacy of great value, which remains in use today.

Keywords: *Tiles, Colour, Graphic, Heritage*

Quing: the first of five colours

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Abstract

In the first Chinese glossary that has reached us, The Book of the Three Characters (also The Classic of the Three Characters) written by Wang Yinglin (1223-1296), minister at the Song court, that it was used as support text when teaching the reading and writing of the difficult sinograms to first grade students. This text is found:

“青赤黄，及黑白。此五色，目所识。” “Qing, chi, huang, and then heie bai.”

These are the five colours known to the eye.

This text accompanied the chromatic education of Chinese children until the '50s in the last century. The five colours in this penta-chromatic scale are famously: green/blue, white, yellow, red, black.

Nevertheless, while translation of four of these terms is overall simple, as far as the first colour Quing is concerned it becomes uncertain, as often happens when one refers to these hues in ancient languages.

In fact the translation of terms from ancient languages that refer to blue and green is rather problematic because many peoples, to various extents, did not separate green and blue hues into two separate families but gathered them in one single category: in English grue, from the union of green and blue. The same word could therefore designate both these hues or even extend its meaning to dissimilar colours with different symbolic meanings. Meanings linked to the plant cycle, water, the sky, youth... so much so that one could state that the term used to indicate this green/blue shade possessed multidimensional, evocative and syncretic aspects. In ancient China, Quing, the first of the five colours on the chromatic scale, presents the same indefiniteness.

In antiquity it could describe a whole array of hues that nowadays seem to us absolutely far from each other: azure, blue, green, glaucous, greenish hues, dark blue, steel blue, marine blue, bluish hues, black and grey. It was essentially the colour of a type of jade with hues ranging from pale green-greish azure to black which was associated to spring, wood, East and the sour taste. It described the colour of nature and the sea, of mountains seen from a distance, in such a way that to reach an exact definition of it ancient language scholars suggest to circumscribe the term to its historic context and the circumstances in which it is used.

This research aims to investigate the symbolic meanings and cultural bearing to which this chromatically ambiguous term referred to, trying to unearth - in art, within social customs, in mythology, in philosophy, in alchemy and traditional Chinese medicine - the reference hue and, in case there should be any, the symbolic meanings still in use in the In-between Land to date.

Keywords: *Green, Blue, Ambiguity, Tradition, Symbology*

The building to let in Lisbon, colour and identity

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Abstract

The buildings to let shaped the image of the city. Their colours give them a specific identity. From the Gaioleiro building (1861-1930) until the modern building (c.1951-c.1960) the regulations defined aspects of the façades, dwellings, building materials and, colour palettes to be applied to finishing details. From this study emerges a list of elements that must be preserved on the rehabilitation and conservation of this heritage.

The notarial register of 5th August, 1861 sets the appearance of the Gaioleiro building, when a new model of staircase emerged and ends in 1930 when the General Regulation of the Urban Construction for the City of Lisbon was approved. In 1869 the colours and building materials are specified: the staircase would be in modern style of curved pieces of woods; the entrance would be paved in black and white stone in a chessboard pattern; the first step would be in squared stone as the arch.

The notarial register of 1863 shows the free use of colours in the doors and door-posts. Apart from white, other colours, including orange, could be used, as pleased the owner. In 1866 the rooms were lined with wallpaper tile.

The 1930's Regulation, active until 1951, established bland shade colours for the façades. Within this norm the colours could vary from different tones of pink, grey, blue, cream-coloured, yellow, green and were applied to modernist and Estado-Novo buildings. The rose tones dominate in the monumental Areeiro urban complex. In Rua do Salitre, Rua Sousa Viterbo (Bairro Lopes), non-monumental areas, were used a variety of colours, in Rua D. João V axis, an Estado-Novo urban complex with some monumentality were applied rose tones and a variety of bland shade colours.

The descriptive memory of Carlos Mardel 106 (1939) helps to precise the colour palette of Estado-Novo interiors. According to the 7th edition of the 1930's Regulation the garnishing of the exterior openings, when not in concrete or squared stone, could be in stone masonry or solid brick. This norm would be a path to modernity as can be seen in Rua de São Marçal 176 (1944-project, 1947-ampliation) and in Avenida da Republica 36-36F (1948), where the solid brick stands out as a strong red, full of modernity.

The 1951's Regulation defined that the quality and nature of the building materials applied to any building must assure the more adequate salubrity and aesthetic conditions to the use of the building. The use of new building materials or construction techniques would imply an approval of the Laboratory of Civil Engineer. This permitted the free use of colours and building materials in the modern buildings as can be seen in Praça das Águas Livres 8-8I/Rua Gorgel de Amaral 1-1A, Calçada Engenheiro Miguel Pais 42, Rua da Imprensa Nacional 64-64D/Rua Marcos Portugal 91-91D, which are buildings in the historical city. Their colour palettes, ranging from bland shade to strong and vibrant colours, aided by the use of tridimensional glazed tiles, help to construct the image of the Lisbon of the epoch.

Keywords: *building to let, regulation, building materials, colour palette, identity*

Human well-being: A contrastive analysis of phraseological units with colours in Albanian and German

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Abstract

The present paper compares colour symbolism in Albanian and German from a phraseological point of view. Phraseology is the discipline of the fixed phrases that in system and sentence function and mean as single words (lexemes) (Palm 1997:1). Phraseological units (Burger 2007, Dobrovolskij, Piirainen 2002) are phrasemes or idioms composed of at least two lexemes, that is words (Palm 1997: 2). Among different types of phraseologisms, the article analyses Farbphraseologismen (see Wanzeck 2003), that is phraseological units with colour naming components, related to human comfort and wellbeing such as good and goodness, success, generosity, honesty, etc., focusing on their symbolic-cultural meaning (Dobrovolskij, Piirainen 2002). The objective of this paper is thus to describe, through the contrastive analysis (Puato 2016), linguistic and cultural equivalences and differences in colour phraseology, taking into consideration also the pluricentric character of both languages (Clyne 1992, Muhr 2016, Muco 2018).

The reference analysis model for the Albanian-German phraseologisms, namely multi-word units, is that of interlingual equivalence which is divided into three categories: full (=), partial (\pm) and zero (\emptyset) equivalence (Kahl 2015). The contrastive analysis is based on the cognitive approach, being cognitive linguistics “interested in knowledge through the language” (Geeraerts, Cuyckens 2007:6). In this perspective, “linguistic knowledge involves not just knowledge of the language, but knowledge of the world as mediated by the language” (Geeraerts, Cuyckens 2007:7). Consequently, being CL usage-based (Kristiansen, Achard, Dirven, Ruiz de Mendoza Ibáñez 2006:2), it studies formal language structures not as autonomous but as “reflections of general conceptual organization, categorization principles, processing mechanisms and experiential and environmental influences” (Geeraerts, Cuyckens 2007:3). Among all the domains of cognitive linguistics, we are in the field of cognitive sociolinguistics, which “combines the use-based CL tenet with fine-grained research on language variation and examines the correlations with cognitive models, now widened as cultural models” (Kristiansen, Achard, Dirven, Ruiz de Mendoza Ibáñez 2006:14). On these assumptions, phraseological units containing colour denominations are studied as cognitive and sociolinguistic varieties.

In conclusion, Albanian and German seem to have common semi-symbolic use of colour pairs in the well-being multi-word units. Colours can have different figurative meanings based on sociocultural context and (con)textual usage.

Keywords: *contrastive analysis, colour, phraseology, Albanian, German*

Visible Dispersion in Negative-Index materials: a Photorealistic Spectral Rendering approach

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Abstract

In an isotropic material, its refractive index (n) can be defined in terms of its relative electric permittivity (ϵ_r) and its relative magnetic permeability (μ_r) as $n = \sqrt{\epsilon_r \cdot \mu_r}$. In general, ϵ_r and μ_r are complex numbers, whose imaginary parts account for the losses of the material. As the typical transparent materials have positive ϵ_r and μ_r , the positive square root is used for n by convention, but a simultaneous change in the sign of ϵ_r and μ_r has no effect on the equation. In 1968, Veselago inferred that the existence of materials with simultaneously negative electric permittivity and a negative magnetic permeability implied that the refractive index of such material would be negative. At that time the proposal was only a thought experiment, but recent studies have shown the feasibility of engineering artificial materials with this property, usually known as metamaterials. The vast majority of these metamaterials have been demonstrated at frequencies ranging from microwave to infrared, and recent results has been achieved in the blue spectral region.

Several researchers developed photorealistic images of isotropic material with negative refractive index at visible frequencies using POV-Ray, an open-source raytracer. The goal of this work is to add to these previous studies, focusing on light dispersion phenomena. To this end, spectral renderings of photorealistic images have been made of how light would behave when passing through simple optical devices (such as lenses, prisms, flat-parallel plates, etc.) using POV-Ray, a free open source ray tracing program. POV-Ray, however, does not perform spectral calculations. Instead of computing and storing light intensities for every wavelength, POV-Ray uses an additive representation of colour of only three values (RGB: Red, Green and Blue), which saves both computing time and memory. But materials have unique spectral responses, thus, in order to provide fully correct colorimetric results, all calculations should be done wavelength by wavelength. A POV-Ray developer implemented this idea in the program, so that it could be used as a spectral rendering engine, rendering a set of grayscale images, each representing a specific wavelength. The output is a set of 36 high dynamic-range images representing the wavelengths from 380 to 730 nm in steps of 10 nm. The 36 images are finally combined and converted to tristimulus values at the very last step of the calculation using the CIE colour matching function.

Surprising and educationally useful results have been obtained with the aim of providing with a visual interpretation of the atypical dispersion phenomena of negative-index materials.

Keywords: *Spectral rendering, Metamaterials, Geometric optics, Dispersion, Education*

Magical realism and chromatic archeology: *the colourist and Procida*

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Abstract

The subject of the study proposes a crossed look, chromatic travel in the island of Procida, located in the south of Italy, off the coast of Naples.

The purpose of this intervention will be to offer an immersed look, a documented look, and finally a poetic look at this island territory.

Jean-Philippe Lenclos the first painted in 1982 the chromatic portrait of Procida. This study is one of many, which he describes in his book "Colours of Europe" published in 1995. We have as well made a study trip to the island in 2016.

From one thought to the other, from one colourist to another one, the studies will cross each other, questioning contretypes methods and field practices. This is, indeed, the job that will be questioned in writing, as well as the issues related to the practices of referencing chromatic data on a territory, but also and especially the singularity of the view of eachone.

The on-site analysis carried out in 2016, with its colour-matching as a foundation, is enriched by the methods we have put in place over the years within the Nacarat company, which produces colour charts throughout France and has developed innovative methods of analysis and referencing chromatic data. We will also complete our study by analyzing two works, *Il postino*, a Michael Radford's movie, shut in 1994 on the island, on the friendship between Pablo Neruda in exile and a modest Italian postman and the novel *Arturo's Island*, written in 1957 by Elsa Morante, initiatory journey of a young adolescent living on the island.

It is in each of these two works that we will capture the other identity of the island. The descriptions of the site and the shots in situ interest us, of course, but it is also the identity of the place that we try to understand through those two fictional stories. Indeed, The questions raised by these two authors constitute for us a ground of exploration of territory unique and precious. We will borrow from the writer Elsa Morante the term of Magic Realism, and will try to understand how artistic works enrich and complete our view on a chromatic territory, within the framework of research work, but also and especially, within the framework of project practices related to the profession of colourist specialized in heritage and architecture.

Geography of colour (J.P. Lenclos), Magic Realism (E. Morante) and Chromatic Archeology (Nacarat / X. Ollier), three founding terms in the understanding of the territory, will be crossed and analyzed over the course of the study.

Keywords: *Geography of colour, Magic realism, Chromatic, archeology, territory, colourist*

The Colour of the Sky: from the Cyanometer to Architecture

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Abstract

From the most distant Eras of mankind's history, the human being has always marvelled at the beauty of the "blueness" of the space above him. That intangible matter gave rise to one of the oldest and continuing struggles in colour history: to be able to capture that hue; that feeling of spatium; of infinity.

In the 18th century, Swiss physicist Horace-Bénédict de Saussure invented a device to measure the "blueness" of the sky - the Cyanometer. This device was built to prove that the variations of the blue in the sky were caused by the amount of water vapour in the atmosphere. Saussure painted fifty-two watercolour shades of Ultramarine Blue in a circle that he held up to the zenith at a standard distance from the eye. The shade matching the colour of the sky established the degree of blue.

Later, German naturalist Alexander von Humboldt, asked Saussure for a cyanometer and carried it with him on his voyages and explorations worldwide.

As a "Light and Colour" teacher at Lisbon School of Architecture, the first exercise I always propose is related to the observation of the laws of colour harmony present in Nature. Guided by the curiosity about the Cyanometer's principles and their possible applications to Colour Studies in Architecture, I have led the students on a research concerning the registration, in NCS (Natural Colour System) samples, of the variation of the sky's colour.

After the first observations, the students found three main reasons for the sky's colour variation: geographical orientation, hour of observation, and the observation angle. They were asked to create a Cyanometer that could incorporate these findings. Therefore, in addition to the colour circle used in the common cyanometers, the devices were produced using a compass and a clock. One of the groups was even able to create a process to measure the observation angle.

The results pointed to colours ranging from light to medium tones (05% to 40% of Blackness) and also to light and medium saturated colours (05% to 60% of Chromaticness). The colours of the sky at North were always darker and more saturated than at the other cardinal points, at the same hour. But the most surprising results were related to the Hue: in 85% of the observations, the colours were grouped into two colour families: R80B (Red with 80% of Blue) and R90B (Red with 90% of Blue). All the observations were distributed from R60B to R90B. The conclusion is that the sky, leastwise in Portugal, always has a bit of Red mixed in with the Blue!

As the results were registered in a standard colour notation, it becomes possible, for the first time, to use them to communicate, understand and discuss the variations of the sky's colour within its three dimensions, and to apply it to a colour palette for Architecture.

The paper will present the students work, its conclusions and an application of the findings on a Colour Study for a school in Lisbon.

Keywords: *Cyanometer, Blue, Sky, Architecture*

Didactic of colour and contemporary art

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Abstract

A didactic of colour that has strongly influenced several contemporary artists has been the one of Johannes Itten (1888-1967), artist, theorist and lecturer whose teachings have moulded directly many future artists and academics – Weimar (1919-1922), Berlin (1926-1934), Zurich (1938-1954), Ulm (1955) – and indirectly the successive generations that studied on his textbooks and on courses based on his concepts. Today, in spite of some authors disputing his theory from a colorimetric standpoint, his method remains valid and is applied in the planning of visual and art projects and taught in many schools around the world.

This work intends to analyse and describe Itten's influence on the oeuvre of a group of Italian artists active in the Seventies, who introduced themselves to the public at the city library in Pergine Valsugana (Trento - Italy) publishing the manifesto *Astrazione oggettiva* (Objective Abstraction) and a portfolio of six serigraphies each (cm. 70 x 100), printed in 60 editions, as a demonstration of their research on the language of colour. They were: the young Mauro Cappelletti (1948), Diego Mazzonelli (1943), Gianni Pellegrini (1953) e Giuseppe Wenter Marini (1944), gathered around the charismatic figures of the two senior artists: Aldo Schmid (1935) e Luigi Senesi (1938).

The group elaborated a chromatic theory and practice focused on abolishing the author's subjectivity and any emotional or symbolic aspect of colour, to identify the inherent laws of the chromatic language.

The sudden death by railway accident of two of the leader artists, marked the premature end of the collective experience of which remains an important theoretical and operative legacy on the chromatic research of contemporary abstractionism.

In this work particular attention shall be dedicated to the oeuvre of two of the main protagonists: Aldo Schmid e Luigi Senesi, who studied the geometrization and mathematization of Itten's chromatic relationships, applying them with different contrasts and combinations in the realm of colour, and experimenting diverse interpretations and variations. In 1976 Schmid presented the work *Non coloure* (No colour), comprising 720 variations obtained from the main 6 colours, and in the same year Senesi presented *Post cromatico* (Post - chromatic), comprising 57 colour-combining solutions in a single graphic module.

Keywords: *Colour, Education, Art, Aesthetics, Perception*

Painting in Lab: Sensory Experience on Primary Blue

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Abstract

This research project of an ongoing Ph.D. research in Artistic Education that I am calling 'Lab Colour Sense' aims to summarize and discuss the process that occurs in human perception: sensory impressions, organizing process, and the interpretative process of Visual Perception and Dermo-Optical Perception (DOP). This study focuses on the interaction between the physiological and cognitive processes that origin the determination of emotions. The participants of the 5th Encounter on Practices of Research in Art and Education were invited to analyze their cognitive perception during the contact with "primary blue" colour with the intent to investigate the dialogues between body and colour during the practice of painting, through self-experience and self-analysis. This research workshop attempts to abstract oneself from their own experience, wherein the methodological process is to investigate how participants create their methodology which led their actions/experiences with colour. With such a framework, applied to colour, the participants were asked in this workshop to deal with colour and appreciate different cognitive processes, with the intent to understand perception as an active process of creating meaning by selecting, organizing and interpreting emotions. The processes of interaction/observation/recording of the phenomenological analysis of perception related to colour in this painting practice context was recorded with no other ambition than to describe this process as accurately as possible, based on both the participant's linguistic analysis and their descriptive texts.

Working as an artist and as a researcher in both, painting and artistic education, the research attitude towards this study comes down only as a mediator and researcher in action of this dialogic process of interaction with perception, concepts, and materials. In this process, as an individual creation, is not replaceable or teachable. Instead, it consists of procedures that generate a methodology. This fact is well exploited by Weber and Mitchell (1999), and quoted by Hernández (2008, pp. 85-118). This workshop is a path necessary for building and articulation of our perception of cognition relational procedures with colour during the act of painting. The analysis of the reflexive process and artistic expression reveals private self-aspects and puts us in full connection with our emotions. That is a multisensory response that gives rise to learning at the level of the senses. In this direction, questioning the accuracy required for scientific investigations when applied to education, it is possible to consider that principles and procedures of artistic activity may transform educational practices.

Keywords: *Painting, colour, human body, cognitive education*

Colour Free, Colourlessness

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Abstract

On the 30th of May 1979, in the New York Times, Ada Louise Huxtable expresses her views on Aalto's Mount Angel Abbey Library according to the following words, "The Aalto palette of white walls, black seating, and pale, warm woods, a beauty intensified by natural light from high windows and skylights and warmed by a carefully supplementary incandescent glow, proves again that no colour can be the richest colour." In what might be called a surprising narrative of the architectural discourse, Ada Huxtable illustrates a full colour environment despite the fact that the conclusion goes to a somehow colour free architectural environment. This type of speech may arise from the difficulty of describing an actual architectural discourse and also from the great difficulty that such discourse exposes in describing colour as a fundamental environmental phenomenon.

The reference to "warm woods" certainly embodies what is widely accepted as Aalto's signature and, in a lato sensu, to Scandinavian architecture. But it creates a displacement within the wholeness of the architectural environment where the artificial and the natural oppose each other and yet can be combined. In this particular discourse it is somehow suggested that the perfect fulfilment of architecture with colour must be the access to the natural colour of nature.

Yet the perfect colour of nature can be challenged. Gauguin's selective methodology regarding the reading of environment concerning colour, created along with other painters such as Van Gogh, or the Impressionists versus the Expressionists proper ground for a sense of metamorphosis from the natural to the un-natural. Thus, former concepts of form such as the contour of the object, a Renaissance concept, give place to more complex evaluation of the world we live in. The world we have to transform to live in, in order to create our own culture. Surface versus impression needs a characterization to each contour that is blind and is where colour-texture lives a unique life. And architecture despite of being able to be defined by the contour of geometry is full of surfaces and inherent colours. From the ground we step on, to the shelter with ceiling and wall and openings that define space, colour-texture became parts of the tectonic evaluation of the built object.

But the search for the natural colour as a perfect match to architecture may need some further evaluation. In 2005, Dominique Perrault states that "Il n'y a aucune relation entre le naturel et l'artificiel. Cela n'existe pas. La nature est un matériau parce que c'est un matériau. On peut la manipuler ; partant, elle devient artificielle. [...] la nature dans son acception du XVIIIe s. n'existe plus." And thus, colour may struggle for her own survival as an autonomous thing that cannot exist alone because it must be confined to some type of materiality as an actual architectural thing.

Keywords: *Aalto, Library, Mount Angel, White, Colour*

Which is the Colour of the Dove's Plumage? A Study of the Colour Adjective *yraqraq* in Psal 68:14

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Abstract

Psalm 68 is a well-known psalm due to difficulties in its interpretation. In it YHWH's words are heard. He is addressing his people using the image of a dove. The poet describes its wings and its plumage. To do this, the psalmist uses a beautiful parallelism and a recurrent literary topic: silver and gold. This often appears in the biblical corpus (Zech 9,3; Prov 3,14; 8,10.19; 16,16).

Nevertheless, unlike what happens with the silver, the gold is described through the adjectival lexeme *yraqraq*. In this way the poet highlights the gold with which he describes the dove's plumage. The hue of *yraqraq* has been much discussed both among exegetes and the modern versions of the Bible. In fact several hues have been proposed: yellow, green, bright or shining or simply gold. These hues are possible inside of the chromatic spectrum of this colour term. This shows the difficulty in interpreting the term *ירקרק*, *yraqraq*. This dilemma can be observed in translations from antiquity: the Septuagint translates *χλωρότητι χρυσίου* golden greenness (NETS), the Targum of the Psalms uses a gloss, pure gold and the Vulgate presents two translations: *viror* (the Psalterium iuxta Hebraeos) and *pallor* (Psalterium Gallicanum).

Exegetes, seeing that the old versions do not help to resolve the question, have chosen to determine the hue of *yraqraq* by studying which kind of dove inspired the poet. Some of them proposed that the dove is not real, but a military trophy in the form of a dove such as the winged Anat in the iconography of Ugarit. These trophies were made with gold, silver and/or bronze, hence the colour of the gold was not yellow but a lighter hue, greenish due to the alloy of gold with other metals. Contrary to this, other scholars have claimed that it was a real dove. For some, it is the white and grey dove well known nowadays that in its flight towards sky, when released in a victory ceremony acquired a shining yellow reflecting the rays of the sun. For others, the dove belongs to a species which inhabits Palestine whose hues are mustard, yellowish green and grey, the *Treron Phoenicoptera*.

As is observed, the hue varies depending on the kind of dove it is thought to be. Given this difficulty, our proposal is that it will be necessary to reanalyse the poem to analyse the poem itself and carry out a deeper analysis using the recent contributions of Cognitive Linguistics to Lexicography. Cognitive Linguistics stresses that the essence of language is the meaning. Among the means that people possess to access it are: the embodiment, the necessity to acquire an encyclopaedic knowledge (the experience of the world of the speaker), the value of connotation and the continuum between the pragmatic and the semantic. Based on these guidelines, a semantic analysis of the adjectival lexeme *yraqraq* can be carried out, which will allow us to determine its meaning and thus, its hue.

Keywords: *colour term, cognitive linguistics, bible, hue, green*

Cooking as an experiential method in colour education

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Abstract

This article presents a project carried out with students on the Colour module, a basic first year module at “Escuela Superior de Diseño de Madrid”, during the academic year 2016-17. Colour is a basic mandatory module for students on the different disciplines of design (graphic, interior, fashion and product). This is a theoretical-practical module taught over the course of just one semester.

The suggested activity is part of the theoretical content of colour perception, eye physiology and injuries of the mechanisms involved in vision. The starting point is a proposal to read a chapter titled “The case of the colour-blind painter” from the book “An anthropologist on Mars” (Oliver Sacks, 1995). The main character in this article is a painter who becomes colour-blind after having a car accident. He sees the reality in grey scale and shades of brown. As a result of this, he can’t stand eating coloured food and being in places in full sun, and he also has serious difficulty to develop his artwork. In order to cope with this situation, he makes changes in his everyday life: he chooses food that is white, grey or black in colour (such as yoghurt or white rice), he leads mostly a night life, and he develops a monotonal visual art.

Students carry out the research aiming at three main goals that limit the activity. The first goal is to design an achromatic edible gastronomic experience. This action is created for an individual who has become colour-blind. In this case, the individual is a painter who has a deep knowledge of colour at the professional, perceptive and emotional level. The second goal is to explore ways to obtain achromatic ranges with food and by cooking it. The third goal is to solve the spatial scenery, the staging of the gastronomic proposal. Students must suggest how to plate up their designs and define guests positioning.

This methodology is developed throughout different semesters of the same academic year with two groups of 20 students. They are split up in four groups of 5 students for the first semester when they work in teams. For the second semester, the activity is carried out individually. Students are asked to submit an inspiration panel, to give a reflection in public, followed by staging the gastronomic activity and providing guidelines to enjoy it. This final session is attended by an expert who makes highly relevant remarks about the work submitted.

The conclusions drawn show three outstanding results. First, the use of cooking as an experiential tool that works as a pedagogical innovation strategy. Second, that exploring with food provides new research methods for the development of achromatic and chromatic scales. Third, motivation is increased and students’ active involvement is promoted. Students suggest new research work based on this gastronomic experience.

Keywords: *colour, food design, higher education, achromatopsia*

Examining and documenting architectural finishes and surfaces of built heritage

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Abstract

The historical development of built cultural heritage can be clarified by performing an architectural paint research (APR) on all finishes and surfaces. Finishes on architectural elements that belong together, forming one so-called colour scheme, represent a specific period in history. Finishes can be found on exteriors and interiors of buildings. The original, first colour scheme, ordered by the owner, is most often designed by artists, architects, or craftsmen. Later schemes are inspired by changes in fashion, use of the property, or ownership. Each colour scheme incorporates valuable information, not only about the use of colour, materials, and decoration techniques, but also about the historical ways of living, how to represent one's status, and how to create a suitable place to live, relax, raise families, or work. Finding, documenting, and interpreting these colour schemes allows for informed conservation decisions. Two initiatives aim to improve the APR working field: a Centre European de Normalisation (CEN) standardisation project and the development of KDTools, a software application.

Every practitioner, either self-employed or working in a cultural heritage institution, has developed their own investigation procedures and documentation methods. This has resulted in a great variety of quality in APR reports. The CEN standardisation project, Investigation of architectural finishes - Procedure, methodology and documentation (CEN/TC 346/WG13), initiated by the Swedish National Heritage Board, aims to improve the overall quality, cooperation, and reporting on APR projects in general. An international group of European experts is producing a standard to provide comparability of results, improved access to results, and better interpretation of built heritage. The current draft of the standard outlines the basic procedures for on-site investigation and specifies the minimum requirements for APR reporting.

At the same time, a newly developed documentation software, KDTools is introduced, designed especially for use in the field of APR. It offers to document, store, and visualise findings with improved accuracy by providing thesauri in different languages; it has an extensive architectural term catalogue and allows for the exchange of information between all participants (colleagues, commissioners, decision-makers, heritage authorities, etc.). Exchanging information internationally or searching data independent of the user's native tongue is part of the concept and is built in.

In this paper, we discuss these two developments within the field of building conservation: How both practitioners and commissioners will benefit by adopting a CEN standard, and how APR practitioners can work more efficiently, produce all-inclusive reports, and store language-independent data online. This will allow for new research opportunities on Europe's painted historical colour schemes in an unprecedented way.

Keywords: *Architectural Paint Research (APR), documentation, CEN standard, built heritage*

From Colour Café to Speed Dating: 8 experiments and 3 exercises in an advanced colour course

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Abstract

During the previous decade, Dresden's School of Architecture has become well-known for its colour collection and its three-week intensive colour module. For one week respectively, students focus on colour foundations, colour in urban design and colour in interior design. In addition to this program, we also offer a number of advanced courses at the graduate level, of which we will present Space|Colour|Light at this conference.

How can we motivate students, who are accustomed to designing primarily via concept and form and use colour merely as an added by-product, to explore the sensual experience of colour, material and light right from the start of the design process? How can we teach them to explore colour as an intrinsic part of the experience of our world and hence as an integral and necessary part of the process of conceiving design ideas?

In order to awaken the students' motivation to explore the world of colour, we have over the years designed a series of experiments, that are conducted with different content during the respective terms. Typically, we use a succession of six to eight exercises during the first half of the course, followed by a design project in the second half.

A. Series of Experiments: 1. The Colour Café - Sensual Qualities of Colour: To discover sensual qualities of colours, students share platters of different foods and drinks, and by mixing seven to ten colours, compose compositional cords which best represent the sensual memory of the foods; 2. Material Qualities of Colour: Students produce colours from different natural substances (vegetables, fruit, teas etc.), mix them with a variety of different binders (oils, egg, chalk, acrylics etc.) and study the different sensual effects of these combinations; 3. Live and in Colour: Through a series of photographs, students produce visual compositions by placing 15 x 15 cm colour swatches in real life settings (interior, exterior, built, natural etc.) and study the impact of this colour in the different environments; 4. Speed Dating - with Tadao, Steven, Luis & Peter: Using photographs of spaces by famous architects, students explore the interrelationship between spatial geometry, colour, material and light by representing the setting in a model and experimenting with different kinds of lighting, colour and material to produce a photo close to the original; 5. One Litter Design - Sale Stimulus Colour: How do the colours of a product address the lifestyle associated with it? Using the example of a milk carton, students use the colour cords from experiments 1 & 2 to produce different carton designs for varying audiences. 6. Art & +++ Grasp, Comprehend and Classify: Works of six artists each from the themes Art & Space, Art & Material, Art & Light serve as examples, that students analyse in regard to the use of colour, light and space in their work.

B. Design Projects varying each term: 1. Analysis - Body and Space: Views of and from one's own body as a detector of scale, spatial structure, atmospheric qualities are photographically documented; 2. Content - discover and reinterpret: Describe aspects students particularly liked and verbalize them in a 'limbic map'; 3. Synthesis - Function & Appearance: Determination of functional qualities of the space, design furniture and poster for the first exhibition; 4. One cubic meter of appearance: Finalization and translation of the most important part of the concept and atmospheric qualities into int a full scale mock-up of one cubic meter of space.

Throughout the previous ten years of teaching this course, we have noticed strong differences in how an understanding of colour and light develops throughout architecture projects and we feel that students achieve a better grasp of how colour can be used as a compositional instrument in designing architectural space and form.

Keywords: *color education, architecture, interior design*

Colour as a designer of an urban place: patrimony, identity and tourism in the city of Cordoba, Argentina

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Abstract

The urban transformations in the last decades represent new conditions, both material and contextual, and consequently, there are new ways of using urban spaces that imply a change in their concept and appreciation.

In the context of the contemporary city, the role of cultural tourism has gained importance in the dynamics of urban processes having an impact on certain areas by fostering their full value, restoration and, in some cases, even turning them into commercial areas to the detriment of others. In turn, patrimony is a value that unites society, creating a sense of belonging to certain place and group. In this framework, the intervention of urban chromatic design in Belgrano St and surroundings was a vital element in the history of the area and the driving force for the construction of an urban place at present known as “Güemes”. The urban colour, as one of the structural components of the language of the city, provides environmental qualities that contribute to meet the needs and desires of man in his urban experience and construction of sense of place.

The neighbourhood of Güemes in the city of Cordoba has traditionally been a working-class area. At the beginning of the 80's, the “Paseo de las Artes”, a centre of cultural activities, was opened as a result of the new intervention strategies in the city. This centre was set up by renewing a group of working class houses where colour and the new activities showed an image that was consolidated as an urban landmark throughout time.

In the 90's a joint intervention of urban chromatic design was made. The municipal government, neighbours and the Institute of Colour of the Faculty of Architecture of the National University of Cordoba worked together. The central concept was Belgrano Street that consolidated the area with unique physical and socio-cultural features. The chromatic expression on facades, the restoration of humble architectural patrimony, the diversification of commercial and recreational activities together with the participation of inhabitants all over the city strengthened a new identity of the area.

In the last decade, the rising participation and use of urban spaces by the local community have turned the neighbourhood into a cultural, recreational and commercial urban area. As a result, the area has become another new attraction broadening the tourist options.

To sum up, the uniqueness of “Güemes” comes of consecutive interventions on different scales that belong to diverse processes and ideas. Among them, the chromatic design, the appreciation of humble patrimony and local tourism come together as organizers of the urban place and its identity. As a consequence, the urban place becomes a contemporary testimony where spaces and places, traditions and innovation intertwine, complement each other and live together.

Keywords: *colour, urban place, patrimony, identity, tourism*

Colour through the centuries. The Major Seminary of the Sagrada Familia, Coimbra, from the 18th to the 21st century

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Abstract

The use of colour is highly dependent on style, protocol, and ritual, particularly in religious buildings. Unfortunately, decisions about colour tend to be neglected when restoring historical buildings. We developed a five-step methodology of colour intervention, to help technicians in the decision-making process. As a case study, we describe the intervention at the Major Seminary of the Sagrada Familia in Coimbra, Portugal.

The main building is late Baroque and was completed in 1765. Its design is attributed to Italian architects, and decoration elements such as the chapels' colourful marbles and the iron gates were imported from Bologna. The original building had a distinctive Italian style with red ochre lime façades and green railings. At the end of the 19th century, new symmetric pavilions were built flanking the Seminary following the same styles of the original and still using the language of their era. By this time, the three buildings had white lime plaster façades, which have been maintained.

Creating a chromatic strategy should be considered as soon as the project starts, since it will have an impact on how the project itself will evolve. Consequently, we started our work by developing an integral chromatic study in which to anchor our subsequent decisions, as well as enabling us to find a compromise between the past, the present and the future of the building.

Firstly (1) we gathered the scarce historical information available related to the building's chromatic make-up. We also (2) looked for specific evidence, successfully obtaining original colour samples from several important elements of the building. Based on this information, we reconstructed a colour palette of the building (3) and created a new colour chart (4) to make cohesive decisions for current and future works. The test tool became crucial to consolidate our strategy and provided us with empirical elements that allowed us to discuss and meet contemporary aesthetic preferences. Tests also allowed us to understand the ageing process of the materials (5) and to recalibrate initial chromatic decisions.

For the Bolognese gates, it was important to find the original green colour. We found a sample within the many layers with about ten tones, all in the green spectrum, with the exception of one blue lapis lazuli. For the façades of the entire complex, we weighed the possibility of a return to red, but decided that it would not have been coherent since the three buildings had become a new unified entity with its own identity, and were all painted in white after the construction of the two flanking pavilions. Consequently, we proposed to maintain the white colour, which related to both traditional and contemporary Portuguese architecture.

The main achievement of this project was to reunite and organize a thread of the history that preserved the identity of the building, and to propose a chromatic intervention and methodology that works for a 21st century program. The role of architects and technicians is crucial to guarantee that a global view of the entire restoration intervention will determine the chromatic choices.

Keywords: *Religion, history, restoration, chromatism, methodology*

Colour and Health



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colour & human comfort

Comparison of Skin Colour between Healthy Subjects and Patients with End-Stage Kidney Disease

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Abstract

Kidney has four important functions to maintenance of homeostasis; Control of water and electrolyte, Control of Acid-base Equilibrium, Discharge of Metabolites and Hormone Production and Control. First three functions are implemented through formation of urine. With decreasing these four renal functions, renal failure is developed, and a lot of symptoms appear. If renal failure deteriorates and becomes End-stage kidney disease ESKD, patients need to be treated with blood purification method.

Japan has about 320,000 ESKD patients, and about 80% of ESKD patients in Japan are treated with hemodialysis. Usually, hemodialysis takes 4 hours at one time to eliminate excessive water and electrolyte out of patients' blood, and to supplement necessary materials to survive. Hemodialysis treatment cannot be a perfect substitution for real natural renal functions, so patients are required a long-time dietary treatment, medication and attention to concomitant diseases. Medical staff especially nurses rely on their intuitive interpretation whether patients become ill based on observation of ESKD patients' skin colour. Some research reported the ESKD skin colour, but the skin colour change in worsening health condition is not scientifically quantified.

Our research finally aims to explore causal relations between End-Stage Kidney Disease (ESKD) patients' skin colour and blood conditions with their vital data. Therefore, in this paper, we reported a collection of ESKD patients' skin colour, comparison with healthy subjects' skin colour, and the ESKD skin colour change under hemodialysis treatment.

First, the ESKD patients' skin colour under hemodialysis treatment was measured. For this experiment, the results of 13 Japanese ESKD patients over 65 years old (6 females and 7 males) were used. Some subjects have diabetic nephropathy. In the hemodialysis cycle which takes three times a week, the longest gap is at the beginning of the week, and then the accumulated water and waste materials reach a maximum. Therefore, subjects were measured at the beginning of the week. The two parts of patients' skin were measured; back of hand and inner forearm. Their skins were measured just before hemodialysis, every hour and the end. The spectrophotometer CM-2600d was used for this experiment; measurement diameter=3mm, D65, SCE and 10 degrees.

Next, we compare between ESKD skin colour before hemodialysis and healthy subjects' skin colour of our previous research. In our previous research, we artificially produced the shocked (circulatory dysfunction) skin colour which was the most prominent symptom in shock with the distal ischemia portion (back of hand) of healthy subjects.

As the results, there were large differences of ESKD patients among individuals and measured parts; inner forearm and back of hand. The skin colour of Elderly male's ESKD patients was not much different from healthy subjects' skin colour. On the other hand, the skin colour of elderly female's ESKD patients was darker and more yellowish. ESKD skin colour after hemodialysis had a tendency toward darker and reddish change. But as compared with circulatory dysfunction skin colour differences, there were no significant differences among dialyzed skin colour.

Keywords: *Human Skin Colour, ESKD, Hemodialysis, Spectral Reflectance Factor, CIELAB*

A Study on Stress under Chromatic LEDs in Residential Spaces – Examination of Red and Blue Monochromatic Light Effects and their Subadditivity

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Abstract

LEDs have been already widespread in current residential spaces and some of them can control light intensity and colour and emit monochromatic light. There are some reports on the physiological influence of monochromatic light on human beings, however, in residential areas white lightings, which include various spectra, should be basically used for visibility, therefore we should know the effects of the mixture of the monochromatic lights. It has already been reported that additivity does not usually hold for suppression of melatonin secretion in physiological experiments. In this study, we would like to verify whether the additivity of monochromatic lights in the residential spaces will hold or not with respect to occupants' stress.

The experimental conditions are as follows; subjects were 31 students (average 21.7 years old, 15 females, 16 males). An experimental room was 3370mm in width, 2400mm in depth and 2700mm in height, and it had a LED light panel (400mm in height, 640mm in width) on the wall. We used blue and red lights in this experiment and their spectral distribution did not overlap at all, and the dominant wavelength are 460nm and 629nm respectively. Illumination conditions were eight. For details, the vertical illuminances at the eyes were 15lx, 18lx, 26lx for each blue and red light, red-blue mixed light 18lx, 26lx. Subjects sat on the sofa and performed three tasks (KAPRA, Sudoku, sketch) during exposure under each lighting condition. Two conditions were conducted at one time, irradiated for 50 minutes for each condition. Before and after the exposure, we set darkness for 10 minutes and measured their heartbeat and blood pressure while subjects were keeping resting states. We utilized HR (Heart Rate), HF (High Frequency) and LF (Low Frequency) as the physiological index obtained by Fourier analysis of heart rate variability. The psychological evaluation sheets were also prepared, and subjects answered the questionnaire immediately after each irradiation and just before the end of it.

In the following analysis stress level was inferred from increase or decrease of HR and HF just after the exposure to each lighting condition, compared with the HR and HF values before the exposure. When the illuminances at the eyes were the same, red light raised the stress level higher than blue light. We suspected the influence of baroreceptor reflex under the red light, however, there was no relationship between blood pressure and stress. There were also no significant differences on psychological evaluations among lighting conditions. Regarding subadditivity, we investigated the additivity/subadditivity of stress by using irradiance. The coefficient of determination of linear regression model between the increase rate of HF(Y) and irradiance(X) was 0.72 in this experiment. Based on the analysis on the relationship between irradiance and the HF component of HRV (heart rate variability) in this report, additivity of the monochromatic light effects was observed, however, the range of illuminance/irradiance at the eye was very narrow in this experiment, and more experimental data will be necessary to reach a clear conclusion on subadditivity/additivity for stress.

Keywords: *monochromatic light, chromatic lighting, stress, physiological index, psychological evaluation, subadditivity*

Colour perception characteristics: comparative studies among pre-, peri- and post-menopause women

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Abstract

Female hormones such as estrogen and progesterone crucially affect women's minds during the menstrual cycle and menopause. Temporal physiological changes of these hormones sometimes shape the person's perception or cognition. In particular, some women in the menopausal phase, when levels of female hormones have markedly decreased, face various health changes including hot flashes and night sweats, and cognitive modifications such as psychological deficiencies in visual and spatial perception, cognitive functions such as general cognitive ability, emotional cognition, memory and concentration, and depression. However, methods for psychological evaluation and mechanisms of the cognitive modifications, particularly for colour perception, during the menopausal transition in women have remained unestablished. Here, we experimentally investigated how menopause influenced colour perception, comparing women who were pre-, peri- and post-menopausal. We examined their colour perception by conducting simple colour judgment tasks using coloured facial schematic stimuli including emotional facial expressions. We recorded reaction times of participants to answer the colours (either red, yellow or blue) of three types of face stimuli (happy, neutral and sad) and corresponding scrambled face stimuli. Emotional facial expressions are often connected with specific colours according to the culture and society, e.g., a happy face with yellow and a sad face with blue. We hypothesised that when participants discriminated the colours of the stimuli, emotional facial expressions could interfere with colour perception, and reaction times of the discrimination could accordingly be delayed. The results showed faster reaction in the pre-menopause women than the peri- and post-menopause women, and substantial reaction delay for blue only in the post-menopause women, while reaction times of pre- and peri-menopause women did not differ by colours. However, we found no interference with reaction times to colours by emotional facial expressions. Our results revealed differences in colour perception among pre-, peri- and post-menopausal women, and perception of blue could be affected by menopause. Theoretically, blue colour is processed first in the retina, where the short-wavelength sensitivity cones are responsible for its perception. Recent studies showed hormones' influences on the short-wavelength sensitivity cones, suggesting a possible role of hormonal decreases in the decline in the perception of blue. Additionally, women in the luteal phase during the menstrual cycle, and in peri- and post-menopause, are likely to have difficulty in discriminating blue. Women in menopausal transition experience a decline of hormone levels, and blue sensitivity may also decrease following the hormone level changes, although the mechanisms remain unclear, and aging factors should also be considered. Our findings may be consistent with these previous findings about a specific deficit in perception of blue caused by menopause, suggesting a possible hypothesis about menopause-dependent perceptual modifications in women.

Keywords: *visual perception, colour, menopause, emotional facial expression, blue deficit*

Destinations and Directions: Colour and wayfinding for a dementia ward

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Abstract

Guidelines for the design of dementia care facilities tend to focus on colour contrast, often simplistically interpreted as a contrast in hue. Without the involvement of design professionals, the use of guidelines can lead to homogenous, monotonous and under stimulating environments. Although recent dementia design research notes the importance of layout, landmarks and colour, it has also identified a lack of empirical evidence in relation to wayfinding. Even as spatial orientation declines as the disease progresses, certain abilities, which allow for navigating space, may remain resilient, and it is accepted that further research is required. The paper will discuss a live project for a colour installation within the male dementia ward at the Royal Edinburgh Hospital, with reference to the three main user groups: staff, carers and patients. It will suggest that design specificity in response to place and people, supported by knowledge of the potential of colour to modify space, can enhance the everyday lives and well being of long term building users.

The colour design was developed in collaboration with the nursing staff and the carers' forum - most specifically, the wives of the long term residents. Two themes emerged, which have driven the design response, namely 'destinations and directions'. The ubiquitous pale yellow walls used throughout the hospital make every space look similar and feel characterless. Carers emphasised a need for spaces that are more homely and sophisticated, and small places within the circulation areas where they can sit with their relatives. The ward was not originally designed for dementia patients, and circulation is confusing and disorientating, with a long internal corridor leading to a square plan, incorporating several changes of direction. Patients can simply get 'stuck' in corners, needing the help of staff to lead them out.

A secondary aim of the live project was as an educational tool for a group of third year architecture students who were studying colour for the first time and who volunteered to paint the ward. Each intervention demonstrates different potential uses of colour, for example spatial adjustment, contrasts in light reflectance, defining spaces with character and the strategic placement decorative graphic motifs within the circulation areas.

The paper will evaluate the project, drawing on previous research, for example by Chalfont and Rodiek (2005), who suggested an inclusive approach to the design of satisfying and pleasurable spaces for all users, as opposed to a focus on environments designed to limit challenging behaviour in patients. The provision of distinctive cues at decision making points is noted by Chmielewski & Eastman (2014), while O'Malley, Innes and Wiener (2017) propose that memorable landmarks can act as beacons to aid navigation. The general thrust of research has been to support a shift from a medical terminology of the condition, to day to day living and working experiences. The paper highlights the need for an integrated approach to colour design beyond the unthinking, 'tick box' application of a reductive set of principles in relation to the design of spaces for people with dementia.

Keywords: *Colour, dementia, wayfinding, design, live project*

Saturated Space. Colour schemes for elderly in Nursery Homes

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Abstract

The aim of this paper is to present a study on how the use of saturated colours can improve the environment of nursing homes, and how it affects the behaviour of elderly and employees. Colour makes a vital tool in establishing safe, explanatory and stimulating environments, especially for people with dementia, but in Norwegian nursing homes the hues are faint or non-existent. This is due to either neglect or some alarming guidelines that dislocate colours as triggers of agitation in the inhabitants. Two pilot projects examine specific colour schemes in relation to these issues, seen in connection with light, material and articulation of space, as well as pathfinding and identity. How do these groups perceive and experience colour as supposed to those with normal eyesight and cognition?

The program is linked to my research project at UiB/KMD: Colour between Art and Architecture, which focuses on how Architecture can benefit from artistic colour practise in terms of quality of hue and materiality. It rebels against the flatness of industrial colour. Paint has been mixed "by hand" in both projects.

Earlier scientific results on the impact of colour for people with dementia has been a vital platform in order to back off ideas of colour as irrelevant as a disturbing element in nurseries. Our main guidance has been the research on colour and dementia by Helle Wijk, Associate Professor Sahlgrenska University Hospital, University of Gothenburg, Sweden. The projects are also included in the work of a new European network on Light and Colour in Architecture for the care and wellbeing of older people. This group emerges as an initiative to study and provide a response to the increasing progress of ageing. As experts in colour and light in architecture, the Research Group aims to establish guidelines for the chromatic characterisation of the different architectural spaces designed for the elderly. Finally, Le Corbusiers Colour Philosophy and practise, including his Colour Keyboard has been a guideline for the projects, both as a material method and as an aesthetic impulse.

Projects: Gullstøltunet Nursing Home owned by the Municipality of Bergen was built in 1992 and is in good condition, but is lacking colour. It is situated in a suburban area with greenery and a park surrounding the buildings. It has 90 residents with a permanent place and private rooms with bathroom and toilet.

Bergen Red Cross Nursing Home is a private non-profit institution owned by Bergen Red Cross. The nursing home receives grants from the City of Bergen. It was opened in 1969 and has today 174 patients divided into eight departments with single rooms and a day ward. The environment is generally decorated in a yellowish white colour, no contrasts, poor lighting and reflecting floors.

The projects have focused on the sections for dementia. None of the interiors in the allocated areas reflected today's standards of universal design before intervention, nor those of homely, yet safe and stimulating environments.

Gullstøltunet was finished in 2015, Red Cross during autumn 2018.

Keywords: *Colour, comfort, stimulation, orientation, elderly*

Colour Emotions of Japanese Subjects for Antioxidant-Enriched Virgin Olive Oils

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Abstract

Olive oil is popular in European countries, but it was not so popular in other countries. However, the consumption of the olive oil has been increasing recently in some countries by health consciousness. Virgin olive oil is one of healthful oils. In order to make a more healthful oil, it is tried to put lutein into virgin olive oil. International Olive Council (IOC) announced the total of consumption of olive oil in the world has been increasing. Especially, the olive oil consumption of countries out of Europe has been increasing.

In a previous study (L. Gomez-Robledo, et al. 2015), it was analysed about how the colour of virgin olive oil changes when we add lutein and β -carotene enriched extract from the *Scenedesmus almeriensis* microalga. In addition, it was tried to know how Spanish subjects perceive the change in colour by using semantic differential method. The aim of this study is to understand the colour emotions of Japanese subjects on olive oil and that including lutein, through the similar experiments of the previous study. Another aim is to know the difference between Spanish and Japanese results.

A visual evaluation test using a similar experimental method and conditions of the previous study was conducted to twenty Japanese students (10 males and 10 females). Six samples of different extra-virgin olive oils were used. In addition, each one of these samples has adding different concentration of extract microalgae: 0.00 mg/ml, 0.10 mg/ml, and 0.21 mg/ml. A total of eighteen olive oil samples have been used in this experiment. In addition, in order to know the recognitions of Japanese subjects for olive oil, a questionnaire survey was conducted.

The visual evaluation test was conducted using semantic differential method with ten sensory word pairs: Aromatic-Odourless, Bitter-Sweet, Fresh-Rancid, Healthy-Unhealthy, Like-Dislike, Natural-Artificial, Spicy-Non spicy, Tasty-Insipid, Textured-Smooth, and Deep-Pale. In order to know the colour emotions for olive oils and their relations, factor analysis was used.

The results of the visual evaluation test were similar to the Spanish results obtained in the previous study. Both of Spanish and Japanese subjects don't like reddish olive oils. However, the difference of the 'Like-Dislike' of Japanese subjects for the samples was a little smaller than that of Spanish subjects. There were high correlations between some pairs of emotions whose meanings were more related to colour preference. The number of the high correlation emotion pairs was larger than that of the previous study. Through the factor analysis, two factors were found. The first factor, which most of emotions contributed, has very high cumulative contribution rate. These analysed results mean that Japanese subjects had similar evaluation on more emotion pairs than Spanish subjects, especially among emotion pairs relating to colour preference.

One of the interesting results obtained by the questionnaire survey for Japanese subjects was that the most excellent point of olive oil is 'good aroma' and the second excellent point was 'good for health' and 'good taste'.

Keywords: olive oil, antioxidant-enriched, health, colour emotion, visual evaluation

Colours scenarios for senior's wellbeing in leisure activities

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Abstract

As elderly population increases in number, with economic difficulties and health problems, in developed societies (and expectable to grow in undeveloped ones), it is urgent the adaptation of the environments and as well concerning their sustainability like in safety/efficacy/efficiency (ONUUBR, 2018).

Aimed to meet the UN/United Nations goals by 2030 (numbers 3, 10 and 11 respectively, "Ensure a healthy life and promote wellbeing for all, at all ages...Reducing inequality within and between countries...Making Cities and Human Settlements Inclusive, Safe, Resilient and Sustainable" - ONUUBR, 2018) with the CIAUD Research Unit, at Products Design level (aimed to develop methodologies/techniques for designing models - CIAUD, 2018), designing themselves in a project of inclusive and ergonomic spaces way, and exploring the element «colour» in natural and constructed environments, assuming the importance of elderly leisure in an urban society (Nunes, 2016).

It is intended to make the following research question: When in leisure, what will be the behaviour of the Portuguese elderly (influence on wellbeing) vs. colour parameters in the environment?

The article intends to present the postdoctoral research (Lisbon School of Architecture, University of Lisbon) to scientific community, namely the study methodology, goals, the present phase development and some results expectation, as well harvesting enriching inputs from the peers. Methodology is assumed to be mixed, based on a quantitative and qualitative basis, through content analysis (Bardin, 2009), and using User-Centred Design Methodology by interviewing/inquiring the senior population.

As mentioned by the UN, in 2030 almost 60% of the world's population will live in cities and with long longevity facing better living conditions and medical increase's inputs but bringing, among others, social concerns. Thus, the author proposes to investigate the behaviour of the elderly in relation to the role of environmental colour (mostly indoors, where they spend mostly of the time) exploring these scenarios, inducing biological-physical, psychological and social wellbeing, concepts inherent to the health one according to WHO/World Health Organization (USP, sd). It should be noted that in Portugal, and according to INE 2003 data, it is mentioned that between 2000-2050 it will increase the female senior population by 16.4-20.4%; and 13.1-16.1% in men. So, another question to be investigated would be whether or not there is a basis for a research on the level of gender-differentiated behaviour, regarding the colour parameter.

As well as methodology research, colour and senior's wellbeing are the chosen propose for this paper discussion approach. Note that our life is fulfil with colour - vegetal and animal kingdom (e.g. trees, bees) or inert materials (e.g. rocks). Unfortunately, some of us may not receive that information because could born blind, is daltonic, or with the age process the vision process may collapse. Life satisfaction and his quality may be achieved by creating environments that use colour assertively. For that reason, there are many studies around the colour and never are too much once it is a complex matter, diverging in fields like: Health, Psychology, Physiology, Lighting, Colometry, Built Environment, Arts/Design, Culture, Landscape, Digital Colour, etc.

Keywords: *Senior, Colours, Performance, Leisure, ONU2030*

Colours of Wellbeing – the Colour Forecasts of Intercolour Finland

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Abstract

This paper discusses the connection between wellbeing and colours in the trend colour forecasts of Intercolour Finland (Suomen Intercolour -yhdistys ICfin ry). The goal of the study is to uncover how colours and words relate conceptually in the colour forecasts. Colours can affect our feelings of wellbeing, mostly based on the conceptions and ideas we relate to them on a personal and cultural level. Colour forecasts give information about colour trends and consumer opinions of the near future. Past colour forecasts give an outlook on the societal aesthetic values and collective colour preferences. The forecasts of Intercolour Finland offer a comprehensive view on the continuum of colours used in Finland, which makes them an invaluable source of colour information.

The study searches to answer the following questions: What does wellbeing mean and how does it appear in Intercolour Finland's colour forecasts? What is the connection between words and colours describing wellbeing? Which colours in the forecasts represent wellbeing?

To find answers, a thematic analysis and three semi-structured interviews were conducted. The data for the study was acquired from Intercolour Finland's colour forecasts from season S/S 1995 to S/S 2018. The analysis focuses on the verbal descriptions of themes and the corresponding colour swatches. Each forecast includes approximately 30 colour swatches, divided in 3-4 themes explained in short verbal descriptions. Interviews with colour specialists and members of the Intercolour Finland association were conducted to complement the information acquired by thematic analysis. The interviewees' professional views give an understanding of the nature and status of wellbeing in forecasts, while the forecasts offer concrete information on how wellbeing and colours connect with each other on a verbal and visual level.

The thematic analysis revealed that wellbeing is one of the six main themes that appear in the forecasts. The theme of wellbeing can be further divided into five subthemes; mental, physical, social and hedonistic wellbeing and lifestyle. In the data, there were 312 shades of colour related to wellbeing. The colours were classified in three ways; according to theme, according to hue and according to lightness and saturation.

The results show a vast variety of colours related to wellbeing. The largest group categorized by hue were greens (52 samples) while the smallest group were purples (26). Categorization according lightness and saturation showed that light colours (112) were clearly the largest group, while dark colours (54) were the smallest. Categorizing colours by subtheme did not give explicit results. The categorisation showed that mostly light colours were related with mental wellbeing, while hedonistic wellbeing was characterized primarily by pure colours. Other subthemes were a mixture of several colour types. These findings refer to that the colour most often experienced to represent wellbeing, and particularly mental wellbeing, is a shade of light green. However, people don't see colours or experience colours the same way. Thus there does not exist a colour that represents wellbeing universally, and the variety of colours in the results of this study confirms that.

Keywords: *Colour conception, wellbeing, conception of wellbeing, colour forecast, Intercolour Finland*

Colour and therapies in TEACCH and Snoezelen rooms

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Abstract

As a part of an investigation about the design of therapy rooms in schools, we felt the need to understand how different therapy rooms work, regarding the activity intended.

We have selected TEACCH and Snoezelen therapy rooms for their characteristics regarding methodology used, being TEACCH a structured teaching space and Snoezelen a multi-sensory space with a non-directive approach. Furthermore, for allowing a wide range of therapies to be performed in both spaces, for example, speech, physical, psychomotricity, and occupational therapy, etc.

This paper inquires on how colour is used in TEACCH rooms versus Snoezelen rooms. The study aims to clarify how colour teaching, learning and experimenting might be used as a tool for autistic children in such environments. The underlying research was driven by the following questions: How can colour, introduced in games, equipment, objects, images and projections, be used as a teaching tool in a TEACCH room, as opposed to a Snoezelen room? How does a therapist work on specific skills with autistic children in a structured therapy room environment such as TEACCH, in comparison to a non-directive therapy room environment such as Soezelen?

The methodology adopted for the qualitative study includes an extensive literature review, combined with observation in TEACCH rooms and Snoezelen rooms; interviews to therapists from different areas, and analysis of the equipment used in each room. The approach used by TEACCH and Snoezelen is described briefly, as well as the components of both therapies, such as room characteristics, work systems, colours used in rooms, and how therapists present equipment and exercises to the children using the space during colour exercises and experimenting sessions.

We have compared the use of colour in both physical spaces, as well as how colour is worked by therapists with the participants. Different approaches to therapies were selected, to determine how their differences affected the manners in which therapists work with autistic children.

We then compared the results about how therapists use the rooms, and how colour is used in each therapy and space.

Research results indicate that colour is used in diverse ways in both environments, being one of the major differences the way in which it is introduced to the children, as well as the use of light in connection with the equipment. In the TEACCH environment the therapist produces games, visual tools and objects for the children to work with; as a result, the children are encouraged to execute the game individually and to work on their own independence. In the Snoezelen environment the entire room can be used as a 'tool', or as an 'equipment' given the fact that light and colour can change the environment completely by introducing colour in a very purposeful manner. Hence, both therapies work with colour as a tool, but adopt different strategies.

Keywords: *Colour, TEACCH, Snoezelen, Autism, Design for health*

European Research Group on Light and Colour in Architecture for the care and wellbeing of older people

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Abstract

We present the synergies, objectives and reasons that drive the formation of the new European Research Group on Light and Colour in Architecture for the care and wellbeing of older people. It emerges as an initiative to study and provide a response to the lack of knowledge concerning supportive physical environments for the increasing amount of older persons worldwide. As experts in colour and light in architecture and caring science, the Research Group aims to establish guidelines for the chromatic characterisation of the different architectural spaces designed for the elderly as well as illumination. Thus, in a global way for the different European countries, these guidelines allow to achieve a habitability specifically adapted to their physical, sensory and psychological requirements.

AIM: To contribute with evidence based knowledge on visual comfort in the elderly, determined by modifying environmental schemes based on light and colour, from a multidisciplinary approach.

To contribute to the development of knowledge of the perceived characteristics of different architectural spaces for older persons from the sharing of the results obtained in the various European countries.

To contribute and provide chromatic guidelines to architects and designers in order to apply them in their projects.

To disseminate knowledge and promote its use to improve the quality of life and visual comfort of the elderly in the spaces they inhabit.

To promote and raise awareness among stakeholders in hospitals, municipalities, private entities and the population in general, about the importance of colour and light in the architectural space, through the definition of more precise measures that can provide a solution to specific case studies.

WORK: The work is addressed towards theoretical research that allows, through forums, conferences and meetings, to discuss and summarize the results developed by the different countries of the new European Research Group, such as Sweden, Spain and Norway, with the intention to include other countries.

The program to be developed covers the set of tasks that are expected to be investigated by an interdisciplinary team. First, each task will be developed individually by each country. Subsequently and with the sharing of all of them, the needs of the social group will be studied in a global way, both from a scientific and technical point of view.

RESULTS: The established new European Research Group on Light and Colour in Architecture will contribute with profound knowledge on evidence- and experienced based knowledge on interior spaces that meet the needs of older residents, in order to improve their habitat and wellbeing. The knowledge will be discussed and disseminated through seminars, congresses and scientific journals.

Keywords: *elderly, colour, built environment, visual comfort, European Research Group*

Colour and Physiology



AIC LISBOA 2018
colour & human comfort

Visual images as Visual Information Units

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Abstract

When we talk about vision and visual images, we always think in a global and continuous image, occupying our entire field of vision, without holes or gaps. A fully completed image, well defined and focused, in which all elements of the visual world are in a perfect state of geometric definition, all the distances between elements are perfectly defined and understood and where the laws of perspective fully work. However, visual images are made of visions (small independent spots) but also, and mostly, of memories, so the question to answer is - "What are the pure visual images we see, before the work of memory (that portion we could name "visual information unit") and what do they really look like?".

As our proposal is to present the kind of visual image that feeds vision, before visual memory is applied, we have to know where people are looking on when they observe spaces. Considering that we live in an architecture world, inhabiting cities and living in houses, this work was developed under the three-dimensional architectural environment, both indoor and outdoor, that we live in day by day. Architectural spaces were observed by different participants in order to get samples of visual information from those observations.

The process of compiling these images was done with the use of eye tracking technology. The images were generated in video format and all the collected elements were transferred to a photographic support where fixations and saccadic eye movements were notated in order to make comparative analysis.

The collection of eye tracked visual data was completed by considering two different kind of approaches related to the visual scape: indoor and outdoor spaces (architectural spaces and urban spaces), and spaces whose design has been done under different rules of geometry: spaces ruled by orthogonal geometry and spaces ruled under non-orthogonal geometries.

By an analysis of the retina, made in order to know its composition related to the number of photo-sensitive cells, its features and its distribution, allows us to determine the development of image definition at the eye and, therefore, to construct a sample of a Visual Information Unit to be presented as the result of this work.

The merging process of data, to build the image-synthesis, was constructed, from the video support to the photographic support, frame by frame and dot by dot. Using a cad software to draw the lines and dots, and a photographic production software to edit the image-synthesis, all the work is a whole handmade graphic design construction.

In conclusion, we present two final images that will show how we see the visual world around, allowing us to better understand the significance of memory when completing the blank spaces of the visual image - creating the elements of visual world that we never saw.

Keywords: *Eye movements, Fixations, Retina, Image, Eye tracking*

Influence of the Number of the Distractor Colours on Performance in the Visual Search Task Cued by S-cone Stimulus Value

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Abstract

Dichromacy might be assumed a disadvantageous colour vision, because it is originated by two type of photoreceptors whereas trichromacy is originated by three types of photoreceptors. However, some studies have indicated that there may be some advantages of dichromacy. Morgan *et al.* (1992) experimented with a task that required observers to detect different oriented targets from in red-green camouflaged objects, and showed that dichromats performed better than trichromats. In their experiment, the red-green camouflaged pattern had an influence as a type of visual noise that impaired searching for trichromats, but no effect for dichromats because they could not discriminate the red and green colours. Moreover, Katsura *et al.* (2016) reported that dichromats showed better performance than trichromats did when both the target and the distractor became reddish or greenish in a visual search task cued by S-cone stimulus value. Their result might be explained by colour discrimination or categorical colour perception.

In the present study, we investigated whether a visual search paradigm based on colour discrimination could explain their results. The stimuli consisted of thirteen coloured disks. One disk was a target, and the other twelve were distractors. There were two distractor conditions: a one-distractor-colour condition and a two-distractor-colours condition. A target colour was assigned to one of the disks and a distractor colour was assigned to the other twelve in the one-distractor-colour condition. In this condition, it is possible to examine the effect of colour discrimination property on detection time because the detection time depends on the colour difference between the target colour and the distractor colour in the visual search task. In the two-distractor-colours condition, we replicated the experiment by Katsura *et al.* The target colour and the distractor colours were only different in terms of S-cone stimulus value in both conditions. In addition, the S-cone stimulus value of the target colour was mid-point of those of two distractors in the two-distractor-colours condition. The observer's task was to indicate the quadrant in which the target disk was located. We measured a duration time to detect the target colour in the above two conditions. Two protanopes, two deuteranopes, and four trichromats were participated in this experiment.

The detection times in the two-distractor-colours condition were consistent with those of Katsura *et al.* Namely, the detection time was shorter in dichromats than that for trichromats when the target and the distractors were reddish or greenish. On the other hand, we could not obtain such a tendency in the one-distractor-colour condition. Furthermore, the difference of the detection times between trichromats and dichromats was small in the one-distractor-colour conditions. These results suggest that the visual search performances cued by S-cone stimulus value when two colours were assigned to distractors could not be explained by the colour discrimination property.

Keywords: *dichromacy, visual search, S-cone stimulus value*

Categorical Colour Naming in Anomalous Trichromats for Colour Stimuli with Different Durations

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Abstract

Whereas trichromats have three types of retinal cone photoreceptors, dichromats only have two types. Despite lacking one type of photoreceptor, dichromats can distinguish colours using trichromat-like colour names (e.g. Montag and Boynton, 1987). Montag (1994) suggested that residual cone pigments rather than rods affect dichromat performance in the categorical colour-naming task. However, dichromats produced trichromat-like colour-name responses in long stimulus duration conditions only.

There is another type of colour vision called anomalous trichromacy. Like trichromats, anomalous trichromats have three types of cones, but the spectral sensitivity of one of the cone photoreceptors is shifted. Furthermore, the degree to which cone peak sensitivity is shifted varies among individuals (Neitz *et al.* 1999).

In this study, we investigated whether the behaviour of anomalous cones in anomalous trichromats was similar to that of residual cones in dichromats in the categorical colour-naming task. In addition, we were curious about how colour-name responses corresponded with the amount of shift in peak cone sensitivity in anomalous trichromats. Therefore, we measured colour-name responses in anomalous trichromats using different stimulus durations.

In the experiment, a colour patch was displayed on a grey background on a LCD monitor. There were colour patches for a total of 1023 colours mainly chosen from the Munsell colour system. There were five stimulus duration conditions (50 – 800 msec.) for trichromat, and seven conditions (50 – 3200 msec.) for dichromats and anomalous trichromats. The observer's task was to assign one of 14 colour names in Japanese on the presented colour. One protanomal, one deutanomal, one deuteranope, and two trichromats participated in the experiment.

In the results, the colour category regions were localized and stable for all stimulus durations in the trichromats and the protanomal when the Munsell value was 5. On the other hand, the colour category regions were not stable for the deutanomal and deuteranope observers. The deutanomal observer exhibited categorical colour naming properties of both dichromat and trichromat observers. Moreover, when the Munsell value was 5, the categorization of the protanomal observer resembled that of trichromats, but when the Munsell value was 9, the categorization of the deutanomal observer resembled that of the trichromats, and that of the protanomal no longer resembled that of the trichromats. It is possible that the similarities in categorical colour perception in trichromats and anomalous trichromats are dependent on lightness and colour vision type. Further investigation will be necessary to determine the contribution of anomalous cones to categorical colour naming.

Keywords: *Categorical colour naming, Anomalous trichromats, Dichromats, Trichromats, Duration time*

Spectroscopic Effects of Display Devices on the Human Non-Visual Characteristics

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Abstract

It has been found that the human eye's response to light affects not only visual colour perception but also unconscious non-visual physiological phenomena, such as the secretion of the melatonin hormone. The melanopsin-containing intrinsic photosensitive retinal ganglion cell (ipRGC) regulates the melatonin hormone level and affects the circadian rhythm of humans. Melanopsin is one of photopigments related to non-image-forming pathways and is most sensitive to short-wavelength visible light. This biological action curve, called the circadian sensitivity function ($c(\lambda)$) shows a peak wavelength in the range of 450 ~ 480 nm. In recent studies, however, only the blue light does not affect the circadian rhythm, because ipRGCs receive indirect synaptic input in the retina layers from rod and cone cells. These means that melanopsin and visual photoreceptors, which are most sensitive to green range (around 555 nm) wavelength, are complementary in modulating non-visual responses.

The circadian rhythms are biological patterns with a period of approximately 24 hours. These biological clocks have evolved to synchronize the rotation of the earth (day/night cycle), and it has been reported that many problems occur when this balance is broken in various kinds of light environment. Typical problems we experience are sleep disturbance, depression, and jet lag. Furthermore, neurodegenerative diseases such as Parkinson's disease have been reported to be associated with circadian rhythm. Actually, because we are using many display applications in our daily lives, it is one of the important light environments. Therefore, it is necessary to study the effect of these displays on human non-visual characteristics.

In this study, we analyzed spectroscopic responses how the light of various wavelengths affects human circadian characteristics by calculation of the circadian action factor (CAF), which is defined as the ratio of the circadian efficacy of radiation (CER) to the luminous efficacy of radiation (LER). Our calculated results show that at the same white colour temperature condition, the more blue wavelengths are red-shifted, and the green wavelengths are blue-shifted, the greater the effect on the non-visual system. In addition, we notice that the green wavelength as well as the blue wavelengths of light from a white light source affect the human circadian rhythm. In order to verify the calculated results by experiments, we synthesized perovskite QDs (CsPbX₃ (X = Br, I) composition) with various peak wavelengths, and then fabricated white LED packages with various green/red QDs combinations. From the results, we proposed optimum red/green/blue wavelengths combination that has great effects on circadian rhythm. This study proposes future research directions considering parameters related to the non-visual characteristics as well as the visual parameters of informational displays.

Keywords: Spectroscopy, non-visual, circadian, display

Impressions of a Combination of Two Colours Are More Frequently Represented by Nouns Than Adjectives: In the Japanese Case

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Abstract

When expressing the impression of colour, do we prefer using nouns or using adjectives? In this study, we investigated whether impressions of a colour scheme can be represented more frequently by adjectives or nouns. We also investigated whether nouns (associated with colours) or adjectives (expressing the impression of colours) are recalled first.

In past research on describing colours with nouns, Palmer et al. (2010) found that colour preferences are correlated with colour associations. Kunugida et al. (2008) also conducted research in the same area; they used Putian's research method and examined the colour association process, focusing on the effects of ambient lighting design on psychological associations with colour. Ito and Oyama (2005) classified the functional relationship between the Munsell colour system and colour emotions using the SD method and proposed a monochromatic emotional expression and an emotional expression of two colour schemes. In addition, Makino and Takahashi (2012) created a three-colour scheme and examined the difference in impressions using onomatopoeia with coloured images.

However, it is believed that not only adjectives, but also nouns are included in the answers from subjects regarding colour schemes. Since Ito and Oyama (2005) used the SD method in the experiment using nouns, nouns were not given due consideration. As regards research on nouns, Kunugida et al. (2008) paid attention to the associative process, examined the design process of ambient lighting and its effects on psychological associations, and developed a design based on human impression evaluation. Based on the research method used by Kunugida et al. (2008), we carried out our experiment.

Participants were 20 Japanese college students with normal visual acuity and colour vision. We used two-colour arrangements to investigate whether adjectives expressing impressions of colours, or nouns coupled with colours, are recalled first. Materials included a total of eight coloured materials, comprising eight colours (red, orange, yellow, green, blue, purple, black, and white), from which we prepared 64 pattern combinations. Each two-colour scheme was presented, and participants were asked to orally respond (in an open-response format) within 8 seconds. Participants also rested for 8 seconds between each set. The experimenter classified response words into adjectives expressing impressions of colours and nouns associated with colours.

Analysis of variance revealed that the total number of nouns produced in this task was significantly larger than the total number of adjectives ($p < .05$). Additionally, significantly more nouns were answered first ($p < .05$). Analyses of whether adjectives or nouns were recalled or recalled earlier revealed that nouns are more likely to be recalled than adjectives. There were no significant differences based on the different colours. It is our opinion that the big differences in the responses that were influenced by personality were also the cause for the ways in which the different colour combinations were perceived. Purple has long been a nobleman's colour in Japan; however, our results suggest that it is negatively perceived, such as "dark", "poisonous", "cold", "creepy", "sober".

Keywords: two-colour scheme, impression, association, noun, adjective

A Study on Light Adaptation Time and Glare Evaluation of the Elderly

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Abstract

Aging causes the eyes to accumulate waste matter in the eyes, reducing the clarity of vision and increasing glare. In addition, visual functions relating to the light degrades, making it difficult for the elderly to rapidly adapt to changes in brightness. Light adaptation refers to the function of the eyes to adjust to the change from darkness to brighter environments. In general, the rod cells work to adapt to brightness changes for twenty to forty seconds through the rapid α -adaptation mechanism, which in turn causes the slower β -adaptation in the cone cells to complete the light adaptation process. More aged people have increased light adaptation time (Kline & Schieber, 1985), and Coile CD et al. have reported that elderly subjects in their seventies experienced more than ten minutes of delayed adaptation sensitivity compared to the younger subjects in their twenties. Conventional lighting environments use on/off controls that instantly changes the intensity of light, making it difficult for the eyes to easily adapt. Recent rise in the LED lighting technology, however, enabled dimming and sensing switches that can provide relative visual comfort in regard to lighting.

As such, the current study aims to evaluate the visual recognition, brightness recognition, and glare recognition in the most frequently habited indoor lighting environments, experienced by a group of younger people in their 20s and 30s and that of senior citizens over the age of 65s

The results of the current study can be used to establish a database for understanding lighting environments that are adequate for living spaces for the elderly. The experiment was conducted in a space with a dimension of 3,250mm(W) x 5,080mm(L) x 2,700mm(H), featuring a ceiling light. The lighting environment consisted of 55 grids (1 EA: 300 x 300mm), and no households or irritating colour factors influenced visual evaluation. The subjects were exposed to light changes from 0 lx to 10 lx, 0 lx to 100 lx and 0 lx to 1,000 lx, in colour temperatures of 3,000 K and 6,000 K. The perception target was set four meters from the experiment subjects, and the targets' sizes were 3cm x 3cm and 1.5cm x 1.5cm. The two groups were composed of twenty adults in their twenties and thirties and twenty senior citizens over the age of sixty-five. The light adaptation time and glare evaluation results from each subject group were analysed and compared using analysis of means. A test of significance of difference was also conducted to identify whether there was a significant difference between the evaluation results from the two groups.

Keywords: Senior Citizen, Lighting Environment, Glare, Light Adaptation, Perceptual object

Colour and Psychology



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Rethinking Baker-Miller Pink through gender studies

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Abstract

In August 2016, the fashion brand Vollebak launched the "Baker-Miller Pink Relaxation Hoodie," a pink sweatshirt including a hood with a mesh mask that you can entirely zip up. This is supposed to allow a certain exclusion from the world without causing any sense of claustrophobia. This new product launch quickly rekindled the debate about the Baker-Miller Pink (BMP). Alexander G. Schauss recognised in 1979 the BMP as a peculiar shade of pink able to soothe the mind and decrease muscular strength. It is currently used on the walls of several prisons and police custody facilities, particularly in Switzerland and the United States, where it is expected to help calming the inmates. Through various media appearances, it became a cultural phenomenon that could even be described as an "urban legend."

A recent study of Genschow, Wänke & Gersbach (2015) shows the importance of the symbolic significance of pink; associated with femininity, putting this colour in the male and virile context of prisoners' living space would be an experimental bias. The selection of experimental subjects in a prison was already featured as a methodological bias by other studies: Profusek & Rainey in 1985, and Gilliam & Unruh in 1988. The aim of this article would be to rethink the BMP, from its theorisation to its implementation, through a bibliographical synthesis of the work done on the BMP. It will be a question of a rereading of these studies from the point of view of gender studies, by questioning the importance of the gender of the experimental subjects (mainly men) recruited in the different experiments. It is also appropriate to replace these studies, and then the applications of their findings, in the male prison context in which gender stereotypes and the expression of virility are central to the relationships maintained between individuals of the same sex.

Since the Western world considers pink as a feminine colour, it is therefore perceived as an anti-masculine colour, which can be associated with homosexuality when a man wears it. On the one hand, male prison world's relations are built around masculinity as a defence mechanism against failure and regression (Gaillard, 2015), pink spaces have humiliating effect on most agitated prisoners more than the "kinesoid method" one described by Schauss: this phenomenon would explain the inmates' increase in aggressiveness once exceeded the surprise effect of a pink room. On the other hand, we also tend to insufficiently conclude to the psycho-physiological effect of the BMP when the experiment is conducted with students in studies of Pellegrini, Schauss, Kerr & Ah You (1981) and Keller & Vautin (1998). It is therefore useful to rethink the use of pink for this purpose, as an ideological reaffirmation of gender stereotypes ("pink is for girls"), but also as a reactivation of homophobia as a system of exercise of power over individuals subject to the "make the man" injunction, as it was the case during Second World War when Nazis placed a pink triangle on homosexual deportees to humiliate them.

Keywords: *Baker-Miller Pink, colour effect, masculinity, homosexuality, prison*

Women, Emotions and Colour

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Abstract

Women use colour to express emotions in everyday life. And as society is changing, every generation faces particular everyday situations to solve, and each generation has a specific way to communicate this fact would mean that there are differences in the use of colour as a communicating element. Likewise, with the emotional meanings that each generation has. It is even possible association emotion-coloured specifically determined by the stage of life and age when women are.

Therefore, this research aims to determine the influence of the stage of life in the formation of the concept of emotions as well as the association is made with the colour, for this purpose a questionnaire was developed, which was requested subjects, write the words that relate to the emotions, in addition to write the colour associated with which those emotions. The resulting words are called defining words, it was made with an analysis that allowed them to know if the words given for each emotion were different or not after the age of subjects. Regarding the colour associated with each emotion, a comparison between age groups was performed to determine whether or not any significant difference was explained by the characteristics of the subject age characteristics. Both results analyses resulting associations between emotions and the colour was made. To do a study of semantic networks was conducted with 300 women between 20 and 80 years old with a design comparative research of three independent samples; transverse description. Descriptive statistics were used (comparative by chi-square) and evaluative technique natural semantic networks.

The variables measured were: the colour assigned to each emotion and the defining words of each emotion (anger, sadness, fear, joy, surprise, disgust, love, hate, anxiety, guilt, confusion and happiness) in the three groups studied.

The results found that there are statistical differences between groups of women in the defining words while expressing emotions much similarity between them. While for the association of emotions with colour some significantly different.

Keywords: *emotion, colour, semantic networks, stages of life*

The Effect of Artificial Light and Wall Colours on User Preference: Living Room Example

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The identity of a space is formed by the gathering of many physical elements as the shape and the size of the space, the surface colours, interior fittings and the properties of the light that illuminates the space. The objects and surfaces in an environment are distinguished predominantly by their colour, as well as their shapes and textures. Colours can also have different effects on people as they are mediated by us in perceiving and understanding of the environment.

Everyone may have different colour preferences for the walls of the space they live in. These colour preferences may vary for different functional units (office, home, etc.). The colour characteristics of the light used in the space have great importance in the perception of colour preferences made for interior surfaces and equipment. As it is known, the perception of colours occurs as a result of the light coming on the surface creating a sensation in the person. It is impossible to talk about colours in a place where there is no light.

The perceived colour of an illuminated surface varies depending on the properties of the light. In other words, the main determinant of the colour properties of a surface that is illuminated by a particular light source is the spectrum of the light. If the light illuminates the surface is white (achromatic), the surface will be perceived “inherent colour”, namely it will be perceived correctly. If the colour of light that illuminates the surface is coloured (chromatic), the surface will be perceived different than inherent colour. Especially, a space illuminated by coloured light can cause unexpected and undesirable effects on the person and can be perceived in a different identity. In general, when designing interior colour schemes, it is not considered which light source should be used in the space and the colour of the light sources are chosen by the random selection of the users. This phenomenon can naturally lead to the creation of different impressions.

In this paper, the results of an experimental study to determine the colour preference of the users and effect of lighting on the surface colours for the living room will be presented. The method of the research can be summarized as;

- Demonstration of different coloured samples chosen according to the Munsell Colour System under different light sources in an experiment room
- Determination of the wall colour preferences of the subjects for the living room,
- Evaluation of survey results.

Keywords: *Lighting, Colour of light, Living room, Wall colour, Colour preference*

Experimental Investigation into the Mediating Variables of the Relationship Between Colour Focality and Colour Preference

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Abstract

Nearly every language has a set of basic colour categories (BCCs). Within a BCC, the member colours differ in their focality, namely, their closeness to the prototype colour. Colin Martindale and Kathleen Moore (1988) reported that their experimental subjects, who were Americans, tended to prefer high-focality colours to low-focality colours. Our study is the first attempt at clarifying the continuous relationship between colour focality and colour preference, and, more important, the first to investigate the psychological variable(s) that mediates this relationship.

Through a literature survey on colour affective evaluations, we collected 22 colour impressions that might influence colour preference, and treated them as possible mediators between colour focality and preference. We took the “psychological processing fluency (PPF)” of colours as another mediating variable candidate, in view of Rolf Reber et al.’s (2004) hypothesis that high focality facilitates psychological information processing, leading to high preference degrees.

We conducted two psychological experiments using the Japanese language. Experiment 1 had 22 subjects, and Experiment 2 had 29 subjects. All were native Japanese speakers with no colour vision deficiency. The test colours (TCs) were 30 Munsell colour chips sampled from six Japanese BCCs. Experiment 1 had two sessions. In each trial in Session 1, the subject was asked to watch a TC for 5 s and, after 30 s, find it in a colour array. The PPF of each TC is quantified as its mean short-term memory accuracy, because short-term memory accuracy reflects multiple PPF-related perceptual properties. In Session 2, to quantify the focality of each TC, we asked the subjects to report the colours in the array that belonged to each BCC. In Experiment 2, the subjects rated the TCs on 22 Likert scales representing the 22 colour impressions and another Likert scale measuring the preference degree.

We found a significant negative linear relationship between colour focality and colour impression gracefulness ($R = -0.584$, $P < 0.001$) and a significant positive linear relationship between gracefulness and colour preference ($R = 0.623$, $P < 0.001$). This finding implies that high-focality colours were evaluated as being less graceful, and thus were less preferred than low-focality colours. This data interpretation matches Helmut Leder et al.’s (2004) psychological model of aesthetics and is supported by the fact that in many colour-related areas in modern Japan, such as apparel design, cosmetics, and city planning, high-focality colours are generally sensed as flashy, gaudy, and unpleasant. We found no other colour impression having a significant relationship with colour focality. PPF’s role as a mediating variable was also not supported. Although a significant quadratic relationship was found between colour focality and PPF, no significant relationship was detected between PPF and colour preference.

In conclusion, in modern Japan, colour focality has a negative impact on colour preference, which is mediated by colour impression gracefulness. However, as high-focality colours are popular in places such as Korea, the U.S., and Scandinavia, the focality–preference relationship of colours and its mediating variables likely vary across cultures.

Keywords: *Colour focality, colour preference, colour impression, gracefulness, Japan*

Emotions, colours and space

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Abstract

The surroundings in which individuals develop are of vital importance since they can be a source of comfort, or, on the contrary, a stress generator. Since its origin, the human being has been looking for areas that provide security from hostile elements, either physical or psychological. For this, they have created houses or spaces harmoniously designed with colours that provide them the wellbeing they are always looking for.

Since ancient times, many cultures have claimed that colour has an important effect on health and emotions due to the relationship between the tonalities projected by nature and the relationships they cause in people, such as the tranquillity the sea gives or the fear caused by the darkness.

This dissertation conducted this research with the purpose of discovering how a monochromatic illuminated environment influences emotions and feelings, as well as the meanings people associate with the term colour/emotion/feeling.

For this purpose, a monochromatic controlled environment was built in a laboratory with white walls and dimensions of 2.91 m. x 1.36 m. x 2.41 m., with an RGB strobe which projected 7 chromatic stimuli in the following order: pink, green, yellow, black, red, blue and white knowing in advance that an environment with those characteristics does not exist in the natural and cultural environment.

The study was assisted by 20 participants, with a mean age of 26.45 years, who were given a pre-test where they had to associate three meanings with the colours and then relate three colours with a list of emotions and feelings. Subsequently, we carried out a guided interview and Osgood's Semantic Differential scale to find out how they felt in a totally monochromatic environment and the emotions they associated with it. Finally, they were asked to mention three meanings they associate with the colours.

During the experiment, we appreciated an increase in the concepts used to describe the colours after the application of the chromatic stimuli. However, they were terms that were constant such as aggressive associated with black, passion with red and love with red and pink. The negative emotions had small variations such as anger associated with red, black, and brown, fear associated with blue, green and black, and violence with red and purple.

On the other hand, positive emotions had a greater variability in its chromaticity, such as vitality related to red, yellow, and green, pleasant to orange, blue, green and white, happiness to black, yellow, and white, joy to pink, orange, yellow, blue, green, purple and white and relaxation to white, blue, green, brown and black.

Keywords: *Colour, emotion, space, monochromatic, meaning*

Categories on a colour plane constituted by Yellow-blue and Lightness in Dichromats

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Abstract

Colour vision is diverse, and includes protanopia and deuteranopia. Recently, a system for universal colour design has been proposed that enables dichromats to understand colour information in visual display materials. Generally, in universal colour design, designers first determine colour arrangements that are appropriate for normal trichromats. Next, they confirm whether dichromats can discriminate the colours by simulating the colour appearance experienced by dichromats. Sato (2005) and Oide et al. (2016) proposed a new universal colour design method. In the new method, designers first determine colour arrangements in a colour plane constituted by yellow-blue and lightness that dichromats are able to perceive. Next, they change each colour along each confusion colour line. Even though the colours have been modified, dichromats perceive the colours as unchanged. Thus, the colour appearance of the stimuli is preserved for dichromats. This method is complicated by the reality that protanopic confusion lines and deutanopic confusion lines do not agree. To address this, Oide et al. (2016) proposed the introduction of acceptable colour shifts within a consistent colour category that is appropriate for dichromats.

In this study, we sought to clarify acceptable colour shifts by measuring colour categories in the colour plane constituted by yellow-blue and lightness for dichromats and trichromats. The stimuli were 90 colour patches positioned on a yellow-blue spectrum with dominant wavelengths of 575 nm and 475 nm, respectively, as a horizontal axis, and lightness as a vertical axis. The background colour was N 9.5 because we supposed that of a visual display material was white. The stimuli were presented with a LCD display. Participants were asked to draw boundaries to divide the colour plane into the instructed number of colour categories and to mark a representative colour for each colour category on a sheet of paper. When drawing boundaries, participants were asked to think of the colours on a railway map as an example of visual display material with divided colour categories. A representative colour was defined as a colour patch that characterized the colour category. The number of colour categories started at 2 and increased to a maximum point, which was the point at which the participants stated that it was too difficult to discriminate the colour arrangement of the visual display materials. Participants included 12 normal trichromats, 3 protanopes, and 6 deuteranopes. Our results indicate that dichromats could divide the colour plane into at least seven categories. We considered categories with similar characteristics to be identical colours and named the colour categories. The colour categories that dichromats selected most frequently were, in order of descending prevalence, yellow, blue, darker yellow, dark yellow, grey, dark blue, and black. This mostly corresponded to that of normal trichromats. In conclusion, the colour categories usable to design a colour arrangement in a colour plane constituted by yellow-blue and lightness were yellow, dark yellow, darker yellow, grey, black, blue, and dark blue.

Keywords: *colour deficiency, dichromat, colour universal design, colour category, colour arrangement*

Comparison of preferences and impressions among interior images, colour-simulated interior model images, and colour-simulated abstract figure images

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Abstract

Empirical studies regarding colour harmony theories or colour combination preferences have been based primarily on the harmony or preference data of colour-simulated abstract figures. However, this kind of survey does not automatically provide direct knowledge for adapting to concrete design objects, such as buildings, furniture, clothes, and so on. Commonalities and the differences between them should be confirmed.

This study aims to clarify differences in preferences and other impressions on three abstraction levels for interior images: interior images, plain interior model images, and abstract figure images.

(1) First experiment: It was executed to search interior images on the Web using 22 words expressing impressions of interiors at first. In the first experiment, impressions of 240 images that were selected from 660 gathered interior images were rated by 20 female university students with using six bipolar and 14 unipolar semantic scales that included preferences and the 22 words used for image searching.

(2) Second experiment: In the next step, 240 interior model images (colour-simulated using five representative colours from the images used in the first experiment) were rated by 20 female university students. Each respondent used the same scales as those in the first experiment.

(3) Third experiment: In this experiment, 240 abstract figure images having the same colour combinations as the images used in the second experiment were rated by eight female university students. The scales were the same as those in the first experiment.

Following are the main results from the analyses of data obtained from the three experiments:

(1) Four factors — “brightness and cuteness,” “calm and simplicity,” “elegance,” and “country style”—were obtained from the factor analysis using data from the first experiment, based on the condition that eigenvalues were greater than 1.0. The factor coefficients suggest that the former two factors were influenced largely by colours and the latter two factors were influenced largely by the style or condition of the interior. Even though all factors related to the preferences, the second factor had the greatest correlation based on the results of a regression analysis.

(2) The correlation coefficients were less than 0.46 in the comparison of preferences from the three experiments. This result points to the difficulty in examining the effects of interior colour design according to knowledge regarding abstract colour design.

(3) The room interior images preferred over interior model images contained many similar hues in colour combinations. The interior model images preferred over abstract images contained many unclear but similar combinations of warm colours.

The expression of colour images on the interior was executed in the manner of the Colour Image Scale proposed by Shigenobu Kobayashi. Variations in the breadth of felt impressions of samples on three impression dimensions depend on the impressions. It is a different feature from the Colour Image Scale.

Keywords: *Interior, Preference, Impression, Colour combination*

Indications for a Valid Colour Test to Measure Personality, Visual Needs and Preferences for Tailored Design Applications

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Abstract

To design tailor-made products and spaces, with positive identification and client well-being as a result, designers increasingly want to gain insight into their customers' personal preferences. Today, this happens through time-consuming conversations, mood boards or home visits. As designers are insufficiently psychologically skilled, the correct conclusion is not guaranteed. To accommodate the problem, the present study examines the validity of a simple colour test, which could rapidly and playfully provide insight into the design preferences of customers.

The basic assumption is that personality and colour preferences are innately determined. To fit in closely with this biologic-genetic aspect the 3-dimensional bipolar model of the Genetic Semantic theory is chosen as the framework of the present colour test. Each dimension contains contrasting colour parameters derived from the opponent colour system from the retinal ganglion cells, i.e. blue-yellow, green-red and black-white, supplemented with the three basic dimensions of colour experience, i.e. Hue (cold-warm), Lightness (dark-light) and Saturation (grey-coloured). Thus, resulting in six bipolar colour questions, presented as colour and palette pairs.

Together with an abbreviated BIG FIVE personality test (NEO-FFI-20-item), with Openness to Experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism as super factors, the colour test was presented to a random sample of 173 Belgian citizens within an age range of 18 to 89 years, of which 56% women.

Independent Sample t Tests show significant links between the BIG FIVE traits and the colour choices. Extraversion has an influence on the 'blue-yellow' choice. Conscientiousness influences the 'black-white' choice and Openness with Extraversion influencing the Hue choice. Less significant but still striking compared to the other results, are Conscientiousness with Neuroticism influencing the 'green-red' choice, Agreeableness affecting the Lightness choice and Openness with Neuroticism influencing the Saturation choice. Looking for Pearson Chi-square dependencies between the six dimensions of the colour test, the 'blue-yellow' dimension correlates with Hue and 'black-white' with the Lightness as well as the Saturation dimension. There is a striking result for gender, scoring solely and significantly on the 'green-red' and the Saturation dimension. Women go more for red and for a coloured palette than men. Both dimensions are likely associated with the Neuroticism trait. Additionally, more youngsters choose significantly black, negatively correlating with Conscientiousness, and the warm palette, correlating with Extraversion. Novel to this study is that these observations reveal a systematic genetic pattern of three dimensions with polar concepts, each of which seems to cover a domain of personality compatible with Eysenck's three-factor personality structure with Extraversion, Psychoticism, and Neuroticism as super factors.

Notwithstanding the limitations of this study, the present colour test actually does provide information about personality and in extension about preferences and needs in terms of design. The overall results promise to have great relevance to designers and their clients' well-being.

Keywords: *colour test, genetics, personality, preferences, design*

Effects of adjacent chromatic clothing colours on facial skin colour appearance

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Abstract

The colour appearance of a female facial skin colour is the most key factor for colour reproduction. However, it is known that the appearance of skin colour varies depending on adjacent colours such as clothes and cosmetics. The purpose of this study is to clarify how colours adjacent to a face such as clothes and cosmetics affect the appearance of facial skin colour.

In the experiments, the subjects evaluated the appearance and impression of skin colour of a female facial image attached with various colours of clothes and cosmetics images. The image stimuli were displayed on an LCD monitor which was precisely calibrated to the CIE XYZ system in a dark room. The three groups of the face stimuli are a composite image of face and clothes (1: scarf and 2: turtleneck) or cosmetics (3: eyeshadow and lip colours). The three rectangular stimuli 4, 5, and 6 have the same skin colour area and adjacent colour area as the face stimuli 1, 2, and 3 respectively. The skin colour used in the experiment was the average skin colour of Japanese female. The test adjacent colours were medium saturation red, yellow, green and blue.

The experiment was employed by the Scheffé's paired comparison methods (Nakaya's modified method). The test and the reference images were presented at the same time on the monitor side by side. The stimulus pairs were selected from the same category group (ex. Group1: a composite image of face and scarf). The 10 subjects evaluated the colour appearance and the impression of the test skin colour displayed on the right side of the monitor by 9-point scale for four adjective pairs ("reddish - yellowish", "bright - dark", "vivid - dull", and "whitish - blackish") compared with those of the reference skin colour image on the left side of the monitor.

It became clear that the appearance of skin colour differed depending on the colour adjacent to the face image. In particular, the appearance of skin colour varied depending on whether the adjacent colour was on the outside or inside of the face image. If the adjacent colour is outside the face image, it means to wear a colour scarf or a turtleneck sweater or the like. When the adjacent colour was outside the face image, the hue contrast effect appeared strong. If the adjacent colour was inside the face image, it means that make-up. In the case of inside the face image, the assimilation effect appeared strong.

The result that the appearance of skin colour was changed strong in terms of the face stimulus rather than the rectangular stimulus indicated that the shape of the face made a large influence. It was also suggested that the skin colour appearance might be influenced depending on whether the adjacent colours was part of human body or not.

Keywords: *colour appearance, facial skin colour, hue contrast effect, hue assimilation effect, colour induction*

Architects and Chromophobia: black and white as a moral choice

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Abstract

Contraposition between colour and non-colour, or between black/white and colours, is so ingrained in modern mentality that it is difficult to trace the origins of such a phenomenon. Almost always a-cromia was associated with a value of sobriety, seriousness and respect, and the colour values reappointed to lightness, frivolity or a rather unspecific sense. The world of art, as well as culture in general, is full of examples in which colours are considered baroque and excessive, having as a counterpoint the chromatism as a symbol of rectitude.

More than a formal choice, the choice for no colour in art, design, taste, is often a true ethical principle. It is mainly from the 16th century, in which ostentation of physical and material appearance assumes as an intellectual attribute, revealing the possibilities of displaying culture, knowledge and opting for well-considered decisions, renouncing the mundane, the exterior, the superficial in favour of inner qualities expressed in the use of black.

Since the portrait of Castiglione painted by Rafael in 1514, Man is assumed by garment: the ethical fashion, as stated by Riello (2013). By choosing black, acknowledges the attitude to communicate inner composure, behavioural integrity, abdicating the colours and leaving them to non-fashioning environments. The virtuous man should avoid excesses to live a life in balance, which does not imply the renunciation of luxury by the extreme quality of textiles. During capitalism, the choice for dressing dark becomes a symbol of social status and success, especially among those who succeeded in life and won their own fortune, not by family privileges, but by workplace skills.

In our approach, we cannot fail to consider the producers of architecture, which increasingly choose the chromatic anonymity which translates in black for the costumes and white for the buildings. To substantiate these positions, we can outline a chronology of this attitude starting with Adolf Loos who condemned the ornament not sparing the colour, or with Le Corbusier that considered colour a matter for wild, choosing mostly the candour of white lime or the truth of the cement for their buildings. The choice of white sobriety in his creations, was index of purity, "mediterranean", rationality, or alternatively chose to monochrome as a guarantee of respect versus the substance and the times as the sole possible interlocutor with the urban space.

The element that makes this attitude more curious is that dressing black is a choice which overcomes gender differences: men and women in architecture choose black sobriety. When in fact we know historically that women were reserved the colourful and pompous dresses but social roles of facade and reflection of the social condition of the family, contrasting the male bourgeois universe, where the formal sobriety was inversely proportional to the amount of social and economic power.

The theme may have already been touched in works such as "Why do the architects wear black" of 2008 from Cordula Rau, but the present paper proposes to analyse the historical motivations, sociological and artistic works of this choice, comparing them with the respective artistic pathways.

Keywords: *Black, White, Architects, Morality, chromophobia*

In depth-analysis of the Number of Salient colours in Natural images

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Abstract

Colour diversity of natural images and its dependence with natural spectra, local colour properties or the probabilistic nature of observer judgements have been extensively studied and analysed. During the past decade many works have been also developed trying to find algorithms to evaluate where humans look, i.e. the saliency map, in a scene based on a reduced number of visual features. Nevertheless, the study of colour diversity and the influence of saliency areas of the images attracting observers' attention has deserved little attention. In a previous paper (Ojeda et al., Appl.Opt., 56 (19) 2017) we addressed this issue and found a significant reduction in the number of discernible colours when the images were masked with their corresponding saliency maps.

In the present study we have analysed again the influence of salient regions in the number of discernible colours of 600 colour images, which were rendered under 108 natural illuminants with Correlated Colour Temperatures (CCT) from 2,735K to 25,889K. Chromatic diversity was used in this work linked to the discernible colours around the fixation areas characterized by the saliency maps.

The colour distribution was characterized computing the fraction of discernible colours expressed as a function of the number of times of occurrence in the image (Montagner et al., J. Opt. Soc. Am. A 33, 2016). Both magnitudes are related by a power law which slope was obtained. Our results show lower slopes (few colours and monochromatic areas) for salient regions than for the original ones with higher slopes (more colours and less uniform areas). The mean slope calculated for the frequency of colour occurrence in the original images is -1.32 and -0.94 for the salient regions.

When the percentage of reduction of the average number of discernible colours between the salient regions and the original images was computed, a reduction in the number of them between 40% and 63% was obtained. Obviously, the number of discernible colours in the salient regions should be below the corresponding number when the whole image is considered (as the salient region will contain an averaged 69 % less number of pixels). However, our results suggested that a reduction in the average number of discernible colours for salient regions was always 7%–18% above the number computed in the regions of the image with the same number of pixels obtained masking the original image with the horizontally and vertically flipped and 180° rotated salient masks.

Keywords: *Natural images, Number of discernible colours, Saliency*

Image of Purple and Orange by Pleasantness Seekers and Comfortableness Seekers (2): Difference between Males and Females

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Abstract

Following our previous research that has been presented in the last three AIC meetings (Takahashi and Hanari, 2015; Takahashi, Hanari, and Miyake, 2016, 2017), relationship between individual's colour preference and his/her personality concerning pleasantness and comfortableness was examined. Pleasantness is an active kind of our good feeling that is characterized by properties such as excitement, change, and surprise. Comfortableness is a passive kind of our good feeling that is characterized by properties such as calmness, stability, and ordinariness.

In the last year (Takahashi, et al., 2017), we focused our interest on the relationship between pleasantness seeking and purple preference, and between comfortableness seeking and orange preference, since these relationships have been found in the preceding two studies (Takahashi and Hanari, 2015; Takahashi, et al., 2016). The results showed that pleasantness seeking had a positive correlation with restful image of purple, and comfortableness seeking had a positive correlation with restful image of orange, suggesting mental affinity between pleasantness and purple colour, and between comfortableness and orange colour. However, unlike the preceding studies, correlation between pleasantness seeking and purple preference, nor between comfortableness seeking and orange preference was not found. Unbalanced sex ratio of participants in that study (50 males vs. 128 females) was supposed to be one of possible causes of such unexpected result. Consequently, in the present study, we re-examined the same question by increasing data samples, especially those of males, in order to investigate possible difference based on participant's sex.

Together with old samples, a data from two hundred and eighty-six participants (136 males and 149 females, 1 unspecified) was analysed. They answered the questionnaire in which his/her degree of preference of twelve colours presented as colour chips (red; 5R 4.5/14, orange; 10R 6/11, yellow; 5Y 8.5/12, yellow-green; 5YG 6.5/9, green; 5G 4.5/10, blue; 2.5PB 4/11, purple; 10P 4/11, pink; 5RP 6.5/9, brown; 7.5R 4/6, white; N9.5, gray; N5.5, and black; N1.5, on visual analogue scales), tendency of seeking pleasantness and comfortableness (five items each, on 11-point scales), and the image of purple and orange colours (eight items, on 11-point scales) were asked. Data of the image of purple and orange was subjected to a factor analysis (maximum likelihood method, Promax rotation) and two factors were obtained, named Restfulness and Surprise. Then, the correlation analysis among indices was conducted separately for male and female datasets.

The results showed that females with stronger pleasantness-seeking tend to feel purple colour restful, but males with stronger pleasantness-seeking do not, suggesting possible difference between males and females in the way of feeling pleasantness, in the way of seeing purple colour, or both. Other than that, however, no difference was found between males and females. And no relationship between pleasantness seeking and purple preference nor between comfortableness seeking and orange preference was found either. Some sex differences found in this study concerning image of colours and its relationship with pleasantness and comfortableness seeking should be further investigated with accumulation of data and theoretical elaboration.

Keywords: *Colour preference, Colour image, Pleasantness and comfortableness*

Investigating Perceptual Appearance Qualities of Real-World Materials under Different Illuminations

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Abstract

Humans instantly recognize material appearance using the object surface and environment information, while also judging its perceptual appearance qualities. In recent years, many studies have investigated perceptual material appearance using mainly computer graphics (CG) stimuli. However, the study of perceptual appearance using real-world materials has not been made abundantly clear even though the appearance of CG and real material stimuli are not quite similar. In our previous study, we investigated the perceptual qualities of surface appearance using real materials and degraded images of the same materials. Our results revealed that the representation method of some materials affected their perceptual qualities. However, our previous experiments were conducted under only fixed D65 local illuminant.

In this study, we further investigate the perceptual appearance qualities of real materials by conducting psychophysical experiments under different color illuminations to verify the color adaptation effects during observations. In our psychophysical experiments, three different illumination conditions were prepared for assuming the complete chromatic adaptation. They were a standard condition, an incomplete chromatic adaptation, and no adaptation. We used a dataset of 34 real materials comprising 10 material categories (stone, metal, glass, plastic, leather, fabric, paper, wood, ceramic, and rubber) to cover a wide range of appearances for each material. The observer evaluated eight perceptual appearance qualities (glossiness, transparency, colorfulness, roughness, hardness, coldness, naturalness, and prettiness) using a 6-point scale under different illumination conditions. The experimental conditions were of three types, as follows: (Exp. 1) The stimuli were set under global and local illumination of standard illuminant D65. (Exp. 2) The stimuli were set under global and local illumination of standard illuminant A. (Exp. 3) The stimuli were locally illuminated by standard illuminant A, which was surrounded by the observation window with matte black paper in a darkroom.

The results indicate that except for the quality "coldness", the perceptual appearance scores showed no significant difference among the three illuminations. The perceptual appearance quality of "coldness" among the three illumination conditions was significantly different. This result suggests that the constancy of perceptual appearance works for most perceptual qualities under different illumination conditions using the illuminants D65 and A. However, "coldness" perception was strongly affected by color adaptation. Furthermore, in the comparison of results between Exp. 1 and Exp. 2, coldness for four material categories (stone, wood, metal, and ceramic) and transparency and roughness for woods decreased with significant difference. In addition, the results of hardness and coldness for ceramics showed a larger significant difference. These findings reveal that the perceptual appearance quality evaluations of coldness for wood and ceramic might be affected by the chromatic adaptation.

Keywords: *appearance, materials, perceptual qualities, surface perception, illumination*

Digital Colour



AIC LISBOA 2018
colour & human comfort

Metallic Diffuse or Specular Inter- reflections of Light and Spectral Multiplication for Accurate Rendering

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Abstract

Metallic surfaces are from very ancient times used for their capabilities to produce an intense specular reflection when polished. The reflection properties permit to define gloss as well as visual comfort or at the contrary a glare effect. Unpolished metallic surfaces never cause such uncomfortable sensations. It appears that the physical process of reflection of light by metallic surfaces, in diffuse or specular mode, leads to a fast brain analysis allowing us to understand what kind of material is producing such a visual effect. The specular transportation of light from a metallic smooth surface to another part of itself permits to instantly understand the nature of that surface. Several level of successive reflections from the metallic surface over itself enrich the perceived radiance by the human eye. That enrichment is caused by the addition of the successive spectral powers of the reflection spectrum to the first reflected light from the surface. The multiple reflections of light increase, by a darkening effect acting on the colour of the metallic surface as viewed on a convex shape only. An isolated convex metallic smooth surface may appear as another metallic material for the same lighting, state of surface and viewing conditions. That confusion is resolved when inter-reflections are present. The successive reflections of light rays are then augmented by the reflectance powers of the Fresnel factor R (≤ 1). After each reflection on the surface the total received radiance is multiplied by itself and modulated by the angle of reflection on the surface. By this process a polynomial in powers of R can describe the complete radiance the observer is receiving. At the contrary, taking into account this modification of the received radiance in an image of a real 3D scene, might help to identify the specular materials responsible for the change in colour lightness. For non-specular metallic surfaces, as unpolished surfaces, the radiative transfer is described by diffuse inter-reflections. The example of an electrolytic copper surface, thus diffuse, illuminated in day light appears as light pink. For two similar plates of the same metallic deposit facing each other they will appear orangey. We will present spectral simulations and pictures of real objects placed in similar conditions of lighting and viewing for comparisons. The visual recognition of some common metallic surfaces becomes understandable when considering situations of inter-reflection of light. Gold or copper, being familiar, are then well identified and discriminated from their imitations in real or virtual world when placed in situations where inter-reflections of light are present.

Keywords: *Metal, radiative transfer, specular reflection, rendering*

Semiotic Colour Characters (SCC)

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Abstract

Semiotic colour character (SCC) set is a bid to create an alphabet specific to colour and light description and display, yet common to all languages and trades. It is intended for the integration of colours as signs like any other in a text flow. We think that this approach is relevant when colour constitutes the substance of the textual information and not the form of it. Examples of uses include inter alia, colour sample transmission, road signs and emoji. Given that the aim of this alphabet is to meet the needs of a large range of specialists in many different trades, such a project essentially appeals to every person and organization who wants to contribute to the development of a universal base, useful for every kind of communication process that includes colour.

How can we provide an intuitive set of signs called icons or glyphs, depending on the design we consider, meant to be the least common multiple of what we name sublanguages, which is also easy to understand and useful in every technical environment? Is it possible to consolidate the description of colour by different professionals, different file formats, different application programs? How is the perception made by human beings of a set of signs specific to colour description?

In computer file formats the doxa tends to restrict colour to the aesthetic, to the form of information, more than to the substance. Semiotic colour characters (SCC) aims to provide the opposite. It is a project of linguistic engineering in the field of colour and light. It can only be seen as a system of four items named "designs", which are:

- 1 SCC meaning, exposed in a request for comment for the computer community;
- 2 SCC icons have to be implemented as fonts or pictures;
- 3 SCC adjectives could be a proposal for Unicode and ISO 10'646;
- 4 SCC sublanguages design will utilize the abilities of SCC.

As a result, colour will be accepted as a language in the same way as Greek, Chinese, Byzantine musical notation and Mathematical formulas.

SCC is not a scientific study in itself, nor is it a norm or even a recommendation, it is an essay, a draft, an interdisciplinary common denominator. It must be put to the test, because it is a proposal to every person and organization who wishes to contribute to the development of a universal base, useful for every kind of communication process including colour. That's why it is presented at a very early state in its development. We hope that SCC will progress and be given some recommendations and establish norms in the field of colour and light.

Keywords: *semiotic, semantic, icons, Unicode, colour*

Colourization of Dichromatic Images

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Abstract

What it is like to be colour blind? What colours do dichromats see? How much 'colour' is really missing from a dichromat's experience. Since it has been reported that many people do not realize they are colour blind until they are many years old, perhaps the difference is not so significant. Of course, we likely can never know what another person experiences, but we can explore what colour information dichromatic vision provides. In recent years, many colourization methods have been described in the computer vision literature. Given only a greyscale (i.e., luminance) image, these computer-based colourization methods generate a colour image with very believable colours. Colourization methods are generally based on 'deep learning' the connection between luminance, the context, and probable colour. It appears they encode knowledge about the world such as clear sky is blue, clouds are grey, beaches are a sandy colour, forests and grass are green, and so forth. Since colourization works for luminance images, we explore how well they might work for dichromatic images. The results of colourizing dichromatic images can be expected to give us more insight into what colour information is present, as well as missing, for the dichromat at a more experiential level than the standard statements that deuteranopes -- observers lacking M cones--- cannot distinguish some reds and greens from one another. We employ a modification of the colourization method of the Iizuka et al. ("Let there be colour!: Joint end-to-end learning of global and local image priors for automatic image colourization with simultaneous classification," Proc. of SIGGRAPH 2016, 35(4):110:1-110:11, 2016) to colourize dichromatic images. In particular, given an image in sRGB (non-linear), it is converted to linear XYZ (CIE XYZ space), and then to LMS cone space using the Hunter-Pointer-Estevéz transformation matrix. To simulate a deuteranope, the M channel is discarded, yielding an LS image. The neural network is trained on a set of 50,000 images from the Microsoft COCO image dataset. The training involves inputting the LS image and the corresponding LMS image. During training, the network's weights are adjusted so that M is predicted from the L and S. The training converges to a low average error. The network's LMS output is then converted back to sRGB for display. Visually, the results are surprisingly believable. In other words, one does not easily recognize that a colourized dichromatic image is, in fact, 'dichromatic' (i.e., in the sense that it is derived from only two channels of colour information), and not a regular full-colour image.

Keywords: *Colour blindness, dichromat, computational colour vision, colourization*

Colour Constancy by Machine Learning using Physics Based Rendering Images

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Abstract

This study proposes a method that realizes the colour constancy by machine learning using physically based rendering images. The colour constancy is one of a human colour perception which the perceived colours of objects remain constant under changed illumination colour. Light that reaches human vision from an object is the light that illumination light is reflected by the object. Although spectral power distribution of light that reaches human eye changes when spectral power distribution of illumination light turns, the colour of the object that we perceive does not change. The mechanism of the colour constancy has not been elucidated yet. It should be helpful for elucidation of the colour constancy if the colour constancy was realized on computer. Convolutional Neural Networks (CNN) simulate the structure of human receptive field and human visual cortex. It is expected that CNN helps clarify the mechanism of human visual systems by reproducing it on CNN.

This research attempts to construct a model that reproduces the colour constancy with CNN. CG images in which the colours of the light sources are randomly set are generated by physically based rendering. We use paired CG images of same objects lighted by coloured and white light source as input and training images, and Physically Based Rendering (PBRT) considering physical phenomena such as spectral distribution and spectral reflectance to generate CG images of training data. We prepared 20 kinds of 3D model objects which given surface parameters of material and reflectance factors. The parameters of objects are set for each scene. And the objects are randomly arranged in the scenes. Several different CG images are rendering for each scene by changing the light source. The spectral distributions of the coloured light sources are set randomly, and the white light source is set to blackbody radiation of 6500K. We applied a Generative Adversarial Network (GAN) as a generation model which realizes the colour constancy, the model is constructed with the use of pix2pix. We quantitatively evaluate a difference between the output image of the network when inputting an image of coloured light source and the image of white light source as the grand truth. The images are converted into the CIE Lab colour space, and pixel values are used to evaluation by Root Mean Squared Error (RMSE). Subjective evaluation experiment was conducted to compare with human colour constancy. CG images of input image, output image, and grand truth image were presented to the subjects, and the colour name of the object in the image was answered from the categorical colour of 11 colours. As a result, it was confirmed that colour constancy was realized roughly by using CNN.

Keywords: *Colour constancy, Physics based rendering, Machine learning, Convolutional Neural Network, Generative adversarial network*

Multispectral Measurement System of Oil Paintings for Digital Archiving

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Abstract

In recent years, a digital archive for preserving the historical and artistic heritage in the digital image information has attracted attention. In the digital archive of art paintings, the key technology is the image acquisition by a digital camera and the image reproduction to render the realistic appearance on a display device. In order to preserve paintings digitally, information on the painting surface must be precisely recorded, and the technology of multispectral imaging is quite effective. Since a multispectral imaging system has high wavelength resolution compared with colour cameras, colorimetric accuracy in the acquired image is certainly improved. Therefore, the authors so far have developed multispectral imaging systems for image acquisition for the purpose of digital archiving of art paintings.

However, our previous methods have several problems. In our method, the camera is fixed and the light source is moved in a plurality of directions to acquire a painting image. This light source is composed of a wagon and a slide projector, and it is relatively large. Therefore, the first problem is that a sufficiently wide space is required for image acquisition by a digital camera. The second problem is that the camera must be frequently touched to change the shutter speed and change the filter at image acquiring. Moreover, these tasks such as light source movement and camera operation must be performed in the darkroom, and it is also a problem that measurement errors tend to occur easily.

The present paper proposes an improved multispectral measurement system for the purpose of estimating the detailed characteristics of an art painting surface. By using the RGB camera and two gelatine filters, it realizes a multispectral imaging system of six channels. These camera and light source are fixed to measurement system framed with plastic-coated steel pipes and joints. The light source is installed around the painting in eight directions (45 degree intervals) and one direction in the upper part of the painting. The size of the painting measurement system is about 70 cm × 70 cm × 60 cm, which makes it possible to work in a very small space as compared with the conventional method. In addition, by realizing remote operation of the camera, the number of contacts with the camera decreases dramatically. Furthermore, by fixing the light source, it becomes possible to drastically change the image acquisition procedure of the conventional method. This change also greatly contributes to the decrease in the number of contacts of the camera. In the proposed method, the number of camera contacts is only one for filter change.

Next, measurement and rendering of oil paintings are performed based on the present measurement system. The realistic images of the paintings are rendered under arbitrary conditions of viewing and illumination. We evaluate all the estimated surface characteristics and compare with the conventional method. The feasibility of the proposed method is shown on experiments using real painting objects.

Keywords: *Digital archiving, multispectral imaging systems, Painting measuring system, Colour image rendering*

All the Colours of a Film: a study on the Chromatic Variation of Movies

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Abstract

The advent of colours in cinema lead to a real revolution and opened the doors for new ways to communicate emotions and narrate stories. The colours of landscapes, costumes and the post production filters are all addressed to the improvement of the narration and help the public to feel the mood of the drama. Since its origin, cinema has tried to use colours to give movies a powerful and meaningful relevance and the analysis of movie's colours is important to understand their distributions in the scenes and to focus on their variations in the drama's development.

In this work, we employ different technique for movies colours representation that could lead to a preliminary colorimetric study. The aim of this project is to combine the frames of a selection of different videos, reducing them to just one image of chromatic significance. This elaboration is made through two different methods: the "movie barcodes" and the acquisition of long exposure images.

Movie barcodes are obtained through the acquisition of the dominant colours of a frame, that are subsequently condensed to a column of single pixels. In this way, the new image is formed joining the columns of pixels of every frame to obtain a new image that represents the chromatic changes through the duration of the whole video.

Long exposure images are complementary to the first methods, in fact, aim to condense a whole video into one picture, as if it was a long-exposure photograph. Due to its nature, this method gives us a single picture that includes all the spatial variations of colours in the video, providing a spatial analysis, as a kind of average colour spatial histogram.

Due to their nature, those concise images have two aims: an artistical one, that expresses an impression of the video in just one image, and a metrological one. In fact, them can be considered as a chromatic synthesis of an entire movie and can be used to detect possible colour dominants or other type of chromatic checks.

In this work, we present two different applications. The first is on two videos from the Pixar Animation Studios' short animation movies: "Presto" and "La Luna". In this first case the obtained images describe synthetically the trend of the film and the use of colours in different scenes for different purposes. The second application is on the frames of a short homemade video altered in three different ways. In this latter case the purposed methods are useful to display the altered videos and to identify the modifications together with the relative visual and numerical results.

Keywords: *Colour movies, Colour histogram, Video Analysis, Image Analysis, Image Processing*

Colour Management in Virtual Reality applied to Lighting Simulations

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Abstract

The measurement of the quality of light in both indoor and outdoor environments is a relevant topic that has gained attention due to its multiple applications. Recently, two colour rendering measurement recommendations have been approved, one sponsored by the Illuminating Engineering Society IES T-30 and the other by the International Commission on Illumination CIE 224:2017. These two standards allow us to measure the quality of light sources in terms of their colour reproduction properties. In addition to the concept of colour rendering, there are other important concepts related to the quality of a light source, such as the colour discrimination capability, colour rendering capacity, visual clarity, feeling of contrast, colour preference, or harmony. However, the effects of using a specific light source is difficult to simulate in terms of colour reproduction. There are few computer applications that allow spectral treatment of light sources and even less in real time.

Recently, Virtual Reality (VR) has experienced a great development. Several commercial devices oriented to virtual reality have been developed by different companies such as Google, Oculus, and HTC. These Head Mounted Displays (HMD) allow visual immersive experiences in virtual environments.

In this work, we studied the chromatic characterization of these HMD devices with the purpose of obtaining a better colour fidelity reproduction. We used two of the latest commercial version of HMD: Oculus Rift virtual reality glasses (CV1) and HTV Vive.

Both HMDs were used through Unity, a game development platform in which we have defined a 3D scene. In this scene, we displayed an image with an embedded ICC profile which allows us to easily check if the colour management is performed by the system. It was verified that no type of colour management is performed by default. Moreover, in the same 3D scene we defined a uniform cube whose colour can be freely changed using RGB coordinates. We made the chromatic characterization of both HMDs by changing the colour of the cube and measuring the spectral radiance of the HMD through its lens.

We defined and programmed a colour management system applied only to light sources. This colour management system allows us to use spectral power distribution associated to each light source and render the scene properly.

Results showed that it is possible to apply a chromatic characterization method to this type of display and it is also possible to define a colour management system to this type of virtual scene in real-time computing.

In future works, we have planned to introduce the spectral behaviour of surface colour in the chain of chromatics transformations done by the colour management system through the surface texture associated to each 3D object.

Keywords: *Colour Management, Lighting, Virtual Reality, Head-Mounted Displays, Colour Rendering*

Colour and Landscape



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Lightness, chroma and hue distribution on Papilionidae butterflies

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Abstract

Beautiful colour combinations in nature have been applied to a variety of designs. Nevertheless, unveiling their system is still an active endeavour. To quantitatively determine this system would improve colour understanding and design. Among colourful creatures, humans are attracted to butterflies which have a high artistic value and are used as ornaments or motifs on various artefacts. In particular, Papilionidae family of butterflies comprises many beautiful and large sized specimens. In this study, we aimed to determine the colour combination system and distribution of lightness, chroma, hue on butterflies from the Papilionidae family by automatic clustering. To this end, we created histograms of each attribute and combination of CIELCh from the 118 images. These images were retrieved from the iDigBio (This database recommends calibrating images and taking pictures in the illuminants D65 or D50 to contributors.) and based on 47 species of the Papilionidae appearing in more than two visual books. Then, we calculated the similarity among every pair of images by applying histogram intersection on the four histograms corresponding to lightness, chroma, hue, and their combination and considered one minus the similarity as the distance matrices. Next, we performed hierarchical cluster analysis using the Ward's method and four distance matrices created from the similarities for the four histograms. Finally, we generated the histograms of each CIELCh attribute and four-dimensional scatterplots of CIELCh combination for colour analysis from the images in each cluster. As a result, we employed 8, 8, 7, and 12 clusters according to the similarity in lightness, chroma, hue, and their combination, respectively. In The distribution of L^* , the bimodal histograms showed peaks ranging between 0 and 40 and between 75 and 90, with ΔL^* ranging between 45 and 90. In The distribution of C^*ab , the peaks with lower chroma were dominant with values from 0 to 45, whereas the higher peaks had values from 70 to 90 with colour difference ΔC^*ab ranging between 20 and 85. In The distribution of Hab , the dominant peaks were mainly located between 30 and 135°. The colour difference ΔHab ranged between 45 and 135°. These results suggested that where the 118 images showed dominant low (high for some clusters) lightness with high contrast, dominant low chroma with different contrast, and dominant red–yellow (yellow–green to green for some clusters) hue with different contrast. Furthermore, in the attribute combinations, the dominant distributions ranges were 0–60, 0–40, and 0–135° for L^* , C^*ab , and Hab , respectively. Several other ranges of L^* were 60–100. Ranges for C^*ab included 60–80. Ranges for Hab included 90–225°. In conclusion, we determined that the 118 analysed images of papilionidae can have contrast in lightness (i.e., similar chroma and hue), lightness and chroma (i.e., similar hue), or lightness and hue (i.e., similar chroma). This study represents the first step to unveil the colour combination laws of the Papilionidae family of butterflies. Future studies will be focused on the analysis considering human perception by examining the differences between perceptual and automatic clustering.

Keywords: colour analysis, papilionidae, hierarchical clustering, histogram intersection, CIELCh

Natural colours and aesthetics in the human brain

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Abstract

The colours of paintings and natural scenes are closely related: several spatial and chromatic properties of paintings mimic natural scene statistics (Montagner et al, 2016, JOSA A). It is unclear, however, what the perceptual relationship of natural colours to aesthetics is. One hypothesis is that aesthetic preference for colours might be related to how natural the colours are perceived. We tested this possibility with one psychophysical experiment and one functional Magnetic Resonance Imaging (fMRI) experiment.

We asked participants (N = 19) to rate images of natural scenes, obtained from hyperspectral imaging, on aesthetic preference and naturalness. The degree of naturalness and beauty was manipulated by rotating the colour gamut of the images around the L* axis in CIELAB, thus preserving lightness and saturation but changing hue. The images were presented in a calibrated display either in their original form, or spatially manipulated using a modified version of the 'Eidolon factory' (Koenderink et al, 2017, JoV) to remove their semantic content, but preserving the original colour statistics.

In the behavioural experiment participants performed pairwise comparisons on images of the same scene but with different gamut angles. We obtained individual scaling curves of naturalness and preference for the same images as a function of the angle of rotation, using maximum likelihood difference scaling. For all conditions the maxima of the two types of curves were close, on average within 20°, to the gamut orientation of the original image. The naturalness and preference scaling curves were largely similar, with an overlap of, on average, 79% for the original images and 73% for the altered images. For scenes with vegetation the similarities were stronger than for scenes of urban images with artificial elements.

In the fMRI experiment, the same images were presented one by one in an event-related paradigm and the same participants rated them again for naturalness and preference. Unscrambled scenes with natural colours revealed modulation with naturalness in a prefrontal cortex region corresponding to Caudate Nucleus, Insula and ACC, implicated in amongst others in cognitive control, goal-directed behaviour, saliency and working memory.

These results suggest that aesthetic preference is closely related to how natural the colours are perceived. Furthermore, activity in certain brain areas correlates with the perception of naturalness.

Keywords: *paintings, aesthetics, fMRI, colour vision, natural colours*

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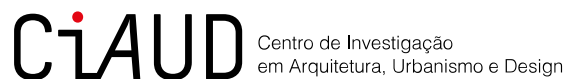
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