AIC 2016
SANTIAGO
DE CHILE
COLOR IN URBAN LIFE
Interim Meeting • October 18th - 21st

AIC2016 INTERIM MEETING COLOR IN URBAN LIFE: IMAGES, OBJECTS AND SPACES

SANTIAGO DE CHILE, OCTOBER 18-22, 2016

BOOK OF PROCEEDINGS

(with USB Flash Drive enclosed)

Edited by Ingrid Calvo Ivanovic
Published by Asociación Chilena del Color

Santiago de Chile, October 2016

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This publication includes lectures, papers and posters presented in AIC2016 Interim Meeting, Color in Urban Life: Images, Objects and Spaces, held in Santiago de Chile, 18-22 October, 2016. This meeting is organized by the Chilean Color Association, more info in: www.aic2016.org

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AIC PRESIDENT'S MESSAGE: NICK HARKNESS

It is a true reflection of the global presence of the AIC that an AIC meeting is being held for the first time in Chile in the dynamic city of Santiago de Chile. This is my third visit to Chile and I have wonderful and colourful memories of the natural and rugged landscape of Patagonia and Torres del Paine plus the strident blues of the Grey Glacier and the turquoise of Lake Pehoe. The urban environment is equally colourful with the amazing trompe l'oeil of Punta Arenas and the World Heritage City of Valparaiso.

What better a location than Chile for hosting an AIC Interim Meeting on Colour in the Urban Life.

On behalf of the AIC Executive Committee and AIC family, I would like to thank Co-chairs Ingrid Calvo Ivanovic , Maria Rosa Domper, Paz Cox Irarrázaval, Mariana Kaplun and the team at Asociación Chilena del Color who have put together an outstanding programme in which to absorb ourselves for three colourful days.

Highlighting the global significance of the AIC there are more than 100 oral and poster presentations at AIC 2016 from twenty seven countries from Asia, Europe, North and South America, the Middle East and the Sub-Continent. AIC membership now stands at 26 regular members, 20 individual members and three associate members.

I would like to thank and congratulate Asao Komachiya, Hirohisa Yaguchi and their colleagues from the Color Science Association of Japan for hosting a very successful Mid-Term AIC Meeting 2015 in Tokyo in May last year.

Future AIC meetings are scheduled for Jeju Korea AIC Congress 2017, Portugal AIC 2018 and Argentina AIC 2019. Please check the dates and plan your schedules. There are three candidates to host the AIC 2021 Congress.

The AIC Executive Committee has been working on a number of initiatives this year including the establishment of an AIC Student Award to encourage the next generation of colour researchers.

I should also mention and thank others who actively support the AIC and the Executive Committee:

Berit Bergstrom who in addition to working with Maria João Durão in obtaining UNESCO recognition for the ICD is also responsible for reviewing the AIC logo.

Jose Caivano who does an enormous amount of work behind the scenes keeping the AIC Website up to date; most recently overseeing the transfer of our domain name to a new home together with Frank Rochow and Dimitris Mylonas. Jose Caivano has also worked with Vien Cheung Associate Editor of JAIC to include the JAIC onto the main AIC website. JAIC is now live on www.aic-color.org

Stephen Westland, Vien Cheung and Kevin Laycock do a fantastic job as Editors of JAIC as do the technical review committee in creating a very high quality journal of which the AIC can be proud.

There are four active AIC Colour Study Groups in which you are invite to participate:

Study Group on Colour Education chaired by Robert Hirschler
Study Group on Environmental Colour Design chaired by Verena M Schindler
Study Group on Colour Vision and Psychophysics chaired by Katsunori Okajima
Study Group on The Language of Color chaired by Dimitris Mylonas

I look forward to meeting you in Santiago and wish you all a very successful, enjoyable and creative AIC 2016

NICK HARKNESS
President
International Colour Association

AIC PAST-PRESIDENT'S MESSAGE: JAVIER ROMERO

The International Color Association (AIC) together with the Chilean Color Association (ACC) has developed an ambitious project for 2016: to hold the annual meeting of the AIC in Santiago, capital of Chile. This event –that will be held between the 18 and 22 of October– will gather 26 color associations and individual members from more than 30 countries.

The ACC is a Chilean nonprofit organization associated with the AIC. It was founded in 2008 in order to share, create, promote, coordinate and disseminate initiatives that support topics related to color. These initiatives may be applied –through education, extension and research– in different areas such as sciences, humanities, art and crafts.

The main topic of this event, *Color in Urban Life: Images, Objects, and Spaces* as decided in relation to the characteristics of the hosting city, a big and complex urban place with a population over seven million habitants. Santiago presents the common dynamics of contemporary Latin Americans' megalopolis, and it is marked by a rapid urban growth. It is therefore an excellent scenario to bring together experts from different disciplines and backgrounds, looking to contribute to the Santiago urgent challenges by providing greater physical and emotional well being to its habitants.

The resulting work of this event, based on the lectures of outstanding specialists, technical conferences, and workshops proposed by the Chilean Association of Color and both the University of Chile and Pontifical Catholic University, will be reflected in subsequent publications and transmitted by different broadcast channels.

Being able to receive in Santiago academics, researchers, artists and professionals of different areas, is a big opportunity to share and celebrate; it is a party in the broadest sense of the word, a meeting of chromatic experiences!

JAVIER ROMERO
Past President
International Colour Association

ACC PRESIDENT'S MESSAGE: PAZ COX

This book is the evidence of the great interest produced around the AIC2016 conference main theme, *Color in Urban Life: Images, Objects and Spaces,* within the international community dedicated to the study of color, both academically and professionally. The contributions presented here, cover a wide range of topics related to the conference theme: environmental color, architectural color design, urban color, color perception and vision, color and culture, color in design, color psychology, color science and materials, color health and wellness, color education, aesthetics, among many others. As it can be seen, the list of papers is extensive and each of the topics will provide the reader, through the interesting scientific papers, an idea of the contributions made to the color field around the world.

The conference main theme couldn't have been better chosen, because color impregnates every aspect of our daily lives especially where we live: the city. Color is in the streets, inside buildings, in objects and so on. More than ever, the use of color has to be thoughful and the color itself is critical for object design and connotation. Color gives life to our visual sensations and incites expected and unexpected emotions. Some expected and some not.

Color not only accounts for the present and future of our actions, but also has been part of the previous experiences of humanity, it helped founding what we call culture. Therefore, is important to emphasize that this conference has devoted special attention to color issues related to design, health, culture, and education on the knowledge and use of color, which ensures a scientific and cultural enrichment for generations to come.

Personally, I believe that the organizing and scientific committees of the *AIC2016 Interim Meeting, Color in Urban Life,* have done a remarkable work selecting the papers and editing this book, which will be corroborated by rewarding discussions during the conference. Congratulations to all of them and to the Chilean Association of Color, they have been constantly working through the years promoting and encouraging studies of Color in Chile with great international projection.

PAZ COX
President
Asociación Chilena del Color

AIC2016 COMMITTEES

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AIC2016 INTERNATIONAL SCIENTIFIC COMMITTEE

AIC2016 CONFERENCE THEME:
COLOR IN URBAN LIFE: IMAGES, OBJECTS AND SPACES

The aim of AIC2016 Interim Meeting is to share experiences regarding the use of color in images, objects and spaces, from different perspectives and disciplines. All of these to contribute to a better user experience and to improve life quality in our cities.

This meeting will provide an opportunity for the presentation and further discussion of the latest findings in the following topics, from both theoretical and practical points of view:

Color & Environment: environmental color design; landscaping; colorful neighborhoods & cities; color in planning, designing, and realizing the built environment; sustainability, urban agriculture; color as affected by geography, geology, and climate

Architectural Color Design: interior design; architecture; urban planning & design; innovative projects

Color Perception & Vision: color vision, deficiencies, abnormalities, synaesthesia

Color & Culture: color & identity; graffiti; color interventions & installations; cultural heritage; conservation; preservation

Color in Design: branding; color in wayfinding systems & signage; communication design & digital data visualization; color trends; usability; graphic design; typography; marketing, materiality, texture & surface; transparency and translucency; reflection and glossiness; ergonomics; customer behavior; street furniture; product design; packaging

Color Psychology: perception, chromatic harmonies; emotional interactions; perceptual illusions; color combination, palettes & schemes; color & form; phenomenology of color

Color, Health & Wellness: well-being, visual comfort, lifestyle, chromotherapy, biodiversity, waste, pollution; the design of hospitals, assisted living facilities, medical offices, laboratories

Color Education: didactics, methodology & theory; teaching aids; color naming and categorization; static and electronic media applied to color teaching; color order systems

Color, Materials & Science: color constancy, color adaptation, color appearance models, lighting design, LEDs, color rendering indices, metamerism, shadow, night vision, color measurement, photometry, quality control, digital color management, reproduction, image processing, color imaging, computer graphics, virtual reality, color in 3D printing

Color Aesthetics: art; arts & crafts; visual culture & studies; photography; performance; museology; scenography; music & sound; virtual & media projects; fashion; textiles; cosmetics; food

ORAL PAPERS,
IN ORDER OF PRESENTATION

From Two-Dimensional Monochrome to Environment Colour in Art

Renata POMPAS[1]
[1] *www.color-and-colors.it*

1. INTRODUCTION

This work is a reflection on the choice by some artists to use a colour that is free from any objective reference, a Monochrome, painting on the surface, installing it in the space, and finally transformed it in a space viewers can walk through.

1.1 The colour of Thought-Forms

The premise of monochrome should be traced back to the first decade of the twentieth century, when important technological, scientific, industrial and social revolutions have produced, as a reaction, the research of existential answers, to counterbalance these predominance. Some people found this in esoteric movements. Amongst these groups are the Theosophy of Helena P. Blavatskyi and Annie Besant, and the Anthroposophy of Rudolf Steiner. These mystic groups, associate particular spiritual properties to colours, generative of Thought-Forms, as materialization of mental energies, as they are described into the homonymous book of Annie Besant e C. W. Leadbeater. These energies are originated from thoughts and emotions that assume significant pattern and colours into space visible only to clairvoyants. Like this, a high spirituality was expressed from lapis lazuli blue, a strong mind from ochre yellow, and depression from dark grey. Furthermore the book also describes the relationship between colour and form.

1.2 The autonomous colour

Spiritual and spiritualistic fervor influences the artists path, during the first decade of the 20th century, towards the artistic direction, after the invention and spreading of photography, which paving way that was not necessarily figurative and realistic, yet driving them to subjective or abstract expressions, in which colour assumes a self-sufficient meaning, as the writings of the first generation of artists shows. These considerations lead to radicalization of absolute monochrome.
Among the masters of new theoretic and artistic colour concepts, the Russian Wassily Kandinsky, (1866-1944) when in 1911 reduces the figurativeness of painting to its essence and produces a theoretic corpus in which colour has a very important role, even if he doesn't reach the Colour Field. He is an artist with an international relevance and a cultivated culture who, as many of his compatriots, is involved in the Theosophy, also taking part directly in some of Rudolf Steiner's conferences. After his move in 1911 to the new Bauhaus headquarters in Weimar, he publishes On the Spiritual in Art, and theorizes a relationship between form and colour, assigning to these, some moral and mystic properties, also being conscious of Goethe's lesson.

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(1) Massimo Introvigne, www.cesnur.org/2014/artemagicabiella.pdf. Helena Petrovna Blavatsky (1831-1891), in turn influenced by the thought of Annie Besant. Rudolf Steiner (1861-1925) published Theosophy in 1904, then held a series of lectures on color between 1914 and 1924, which were short handed and published posthumously.
(2) H.P. Blavatsky said: "The seven Principles (of the universe and of man) are derived from the seven large hierarchies of Angels, which are associated with the seven colors and sounds and form collectively the Logos manifested". www.teosofica.org/all/Corso_di_Teosofia_19.pdf. Annie Besant e C. Leadbeater, Osservare le Forme Pensiero, IBIS Edizioni, 2011, Cesena (FC). Annie Besant (1847-1933) was the founder of the Mystic Order of the Rosy Cross, and in 1891 she succeeded H.P. Blavatsky in the direction of the Theosophical Society.

The compatriot Kazimir Severinovič Malevič (1879-1935), who is involved in eastern philosophy and in theosophy, in 1915 founds the Suprematism group, which promotes an anti-naturalistic and anti-sentimental art, based on pure sensibility, on the freedom of art from objective references, on the use of pure colour and elementary geometric forms. He publishes a thesis on the text From Cubism to Suprematism: the New Realism in painting. In 1915 Malevič paints the famous Black Square on white background, in which the black is the inflexible colour against of brightness of the round sun, which is the symbol of sentimental and conformist tradition. This canvas represents the zero degree of figurative painting; and in 1919 he paints a work, that is even more extreme: the monochrome White on White, after which he devotes himself to teaching and spreading his ideas amongst his loyal students.
Even the Dutch painter Piet Mondrian (1872-1944) chooses a radical path. He takes part at the Dutch Theosophic Society, elaborates an original social-philosophical thought about the relationship between shape and colour. He paints using three colours with flat coats into orthogonal spaces organized in numerical relationships of values, dimension and position, separated by orthogonal black lines on white background. This chromatic reduction is based both on contemporaneous theories about colour and on that of Steiner's, who divides the chromatic manifestation in 7 esoteric colours: 3 splendor colours and 4 image colours. His ideas are published on magazines and books, conducting an important affect on art over the 20th century.
Two other important abstract colour theorists convened in Germany to teach at the Bauhaus School (in 1919 and in 1925), whose teachings are followed even today.
The first is Johann Itten (1888-1967), who ascribes a value based on the brightness to each of the 6 basic colours derived from Goethe: 9 to yellow, 8 to orange, 6 to red, 3 to violet, 4 to blue, 6 to green. He then establishes the optical laws, formal and expressive, of 7 different kinds of contrast, affecting generations of artists.
The second is Josef Albers (1888 – 1976), student of Itten, who teaches the materials expressivity, the perceptual laws of vision and the effects of optic ambiguity: how the perception of colour is affected by quantity, form, matter, distance, volume and interaction with the environment. Albers creates some exercises based on the use of colour and its geometrical space, and excludes completely the subjectivity and the sensitivity.

2. THE BIDEMENSIONAL MONOCHROME

Towards the end of the Forties, in the United States and Europe the adoption of colour as the unique subject of painting is affirmed, as denial of paintings as spiritual and mystic demand of art, which transcends representation and temporariness of emotions and sentiments, in the absolute.

(3) Wassily Kandinsky, Lo spirituale nell'arte, SE, 2005, Milano. Renata Pompas, I colori esoterici di Kandinsky. http://www.karmanews.it/1224/i-colori-esoterici-di-kandinsky/
(4) J. Wolfgang Goethe, La Teoria dei colori, Il Saggiatore, Milano, 1979. J. Wolfgang Goethe, La storia dei colori, Luni Editrice, 2013, Milano.
(5) K. Malevitch, Manifesto del Suprematismo, Micheli De M. Le avanguardie artistiche del 900, MI, 1966.
Renata Pompas, Kazimir Malevič: il colore suprematista. http://www.karmanews.it/10252/kazimir-malevic-il-colore-suprematista. Jolanda Nigro Covre, Malevič, Art e Dossier, Giunti Editore, Milano, 2004. B. D'Emilio, Dal visibile all'invisibile: Malevič. (see): ww.abafg.it/wp-content/uploads/20112012/2012/01/PARTE-2-Malevic.pdf
(6) Six years later, in 1921, it will be the Russian colleague Aleksandr Rodchenko to exhibit three monochrome canvases - "Pure Red", "Pure Yellow" and "Pure Blue", declaring: "it 's all exhausted. The basic colors: each floor is flat and there is no representation". http://nuovo.fotoit.it/php/upload/storia_fotografia_parte06.pdf
(7) Piet Mondrian, op. cit.; Jolanda Nigro Covre, Mondrian e De Stijl, Art e Dossier, Giunti Editore, Milano, 2008.
(8) Rudolf Steiner, L'essenza dei colori, Editrice Antroposofica, Milano, 1977. Renata Pompas, Rudolf Steiner: il pensiero, il colore, l'arte. http://www.karmanews.it/71/rudolf-steiner-il-pensiero-il-colore-larte/
(9) J. Wolfgang Goethe, op. cit.

Towards the end of the Forties, in the United States and Europe the adoption of colour as the unique subject of painting is affirmed, as denial of paintings as spiritual and mystic demand of art, which transcends representation and temporariness of emotions and sentiments, in the absolute.

2.1 The monochrome of silence

Robert Rauschenberg (1925-2008) exhibits in 1951, at the age of 26 years, some large white panels titled: White Panels, painted with wall roller paint, inspired by the aesthetic suggestions proposed by the composer John Cage, who had theorized White Paints as an expression of waiting and emptiness. After this experience Rauschenberg abandons the monochrome.

2.2 The self-hypnotic monochrome

The compatriot painter Barnett Newman (1905 – 1970) devotes himself to painting after studying philosophy, and chooses the monochrome permanently. He paint with acrylic pigments mixed with oil colours, creating flat and homogeneous coats of colour, passed over by a vertical stripe in contrasting colour that he calls zip, and which, in his intentions blends the two parts of canvas, representing the connection between the Divine and the Earth, the transcendent and the sublime.

2.3 The contemplative monochrome

The American Ad Reinhardt (1913-1967), considered the precursor of Minimalism, abolishes painting and colour, in the drafting of an all-encompassing black. Reinhardt is interested in mysticism, he assumes an artistic position in which he wants to overcome any reference to reality, excluding every narrative or emotional appeal. He attains to all-black in the series of Black Paintings, where darkness expresses the image and denial of colour are the absolute zero of art.

2.4 The dissolved Monochrome

The Californian David Simpson (1928) after the commercial diffusion of acrylic colorants devotes himself to Monochrome, experiencing the interference quality of pigments mixed with mica and getting special iridescent effects. His paintings indeed change hue, according to the angle of observation and play with light on not a completely flat surface, but enlivened by colour coating. It is a vibrating and changing colour, which seems to dissolve the surface with its kinetic movement.

3. THREE-DIMENSIONAL MONOCHROME

At a certain point, the colour overtakes some works of art on canvas, breaking through the background, or assuming a three-dimensional texture.

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(10) Johannes Itten, Arte del colore. Esperienza oggettiva come vie per l'arte, Il Saggiatore, Milano, 1982.
(11) Interazione del colore, Il Saggiatore, Milano, 2009. Josef Albers, Sublime Optics, Catalog edited by Nicholas Fox Weber, © 2013 Josef and Anni Albers Foundation. Renata Pompas, I colori radiosi di Joseph Albers. http://www.karmanews.it/559/i-colori-radiosi-di-joseph-albers/
(12) Elio Grazioli, La polvere nell'arte. Bruno Mondadori, Milano, 2004.
(13) The Ideas of Arts, Six Opinion on What is Sublimein Art? Tiger's Eye, December 1948. (see): www.theartstory.org/artist-newman-barnett.htm
(14)He declares: "The Sublime is now". http://elisabethcondon.blogspot.it/2013/05/barnett-newman-sublime-is-now-1948.html

3.1 The spatial Monochrome

In Europe the spatial monochromes are by the Italian-Argentinian Lucio Fontana (1899-1968). In 1948 he signs the Manifesto of Spatialism, which supports the need to overcome the Art from the past. Fontana splits the canvas with clear cuts, constellations of holes, rips and graffiti, giving the monochrome a three-dimensional effect. In 1963 he says: "To me they mean the infinite, the inconceivable, the end of figuration, the principle of nowhere."

3.2 The New-Dada Monochrome

The Italian artist Piero Manzoni (1933-1963) creates some Monochromes, entitled Achrome, begins by coating the canvas with chalk strokes or kaolin, then wrinkling the fabric to obtain corrugations, bulges and grooves; lastly he creates white three-dimensional New-Dada Monochromes with which he derides conformism with the humour.

4. THE MONOCHROME AS INSTALLATION

Within the installations, the colour, the light or the substance defines the space.

4.1 The emotional monochrome

The aim of Mark Rothko (1903-1970) is to paint vibrating, pulsating colours that, as he himself declares, to transport the viewer into a metaphysical sacred reality of pure emotion. He writes: "The people must have the same religious experience I had when I painted them". For the Rothko Chapel in Houston he creating 14 monochromes of large format, in very dark hues, which immersing the viewer into the vision of darkness and transforms the monochrome, from two-dimensional canvas to environmental colour.

4.2 The esoteric monochrome

The Frenchman Yves Klein (1928-1962) opens (1952) and closes his artistic career with a contemplative triad of monochromes (1952) respectively ultramarine blue, white and carmine pink. For Klein the colours "are living beings", the essence of art, that leads to the divine energy that permeates the universe, in which merges with ourselves.

4.3 The optical monochrome

The Italian Paolo Scheggi (1940-1971) investigates issues related to visual perception and produces multilayer monochromes, in which the surface of the canvas shows the multiple underlying layers, obtaining a sense of depth. Each layer displays the

(15) Interview by Carlo Cisventi 1963. (see) http://www.fondazioneluciofontana.it
(16) LIBERA DIMENSIONE. In: Azimuth 2, Milano, 1960.
(17) https://en.wikipedia.org/wiki/Mark_Rothko. www.avvenire.it/Cultura/Pagine/rothko-le-lacrime-della-pittura.aspx
(18) In 1956 Yves Klein patented a synthetic resin that allows to the pigment to retain its brilliance and intensity, and he called it: International Klein Blue (IKB).
(19) Yves Klein, verso l'immateriale dell'arte, O barra O edizioni, Milano, 2009. Renata Pompas, I colori cosmici di Yves Klein. http://www.karmanews.it/5111/i-colori-cosmici-di-yves-klein/

one below and transforms the work into an object, the same two-dimensional and three-dimensional time, geometrically static and dynamically optical; then create rooms where to pass through.

4.4 The corporeal monochrome

The Irish artist Sean Shanahan (1960) impregnates the porous and absorbent wood fiber panels with colour, until they themselves become substance, after he places them, suspended at head height in space, fixed on the wall suspended or trimmed sideways. His monochromes have therefore physicality in itself.

4.5 The living monochrome

The German artist Wolfgang Laib (1950) produces living monochromes in the famous artworks Pollen, which are installations composed by thousands and thousands of pollen collected in the fields surrounding his home, which Laib poses on the ground to obtain an intense and dazzling yellow colour, ethereal and fragrant, with which he forms precise areas of space, arranged with regular symmetry.

4. THE MONOCHROME AS INSTALLATION

Then the colour becomes environment, envelops the viewer and builds large spaces.

5.1 The fluorescent monochrome

The New Yorker Dan Flavin (1933-1996) replaces brushes and colours with linear fluorescent tubes - according to one palette of nine colours - whit which he immerses the viewer in coloured light environments, monochrome or with intense and brilliant colour combinations. Giuseppe Panza di Biumo wrote: "The art of Flavin is made with light. Light is pure energy, it is radiation (...) The result is a feeling of sacredness".

5.2 The hallucinatory monochrome

The Californian James Turrell (1943) conducts experiments on the Ganzfeld effect and sensory deprivation. The viewer enters a space closed only by three walls, saturated with some coloured radiation: continuing into this space, devoid of shadows and references, the cancellation of the feeling of depth and spatiality disorients the visitor, who becomes one with the coloured light.

5.3 The totalizing monochrome

Finally the Anglo-Indian artist Anish Kapoor (1954) works on a large scale, exploring the laws of spatial perception. The colossal Leviathan that Kapoor installs at the Grand Palais in Paris in 2011, is a construction formed by three big balls made in a dark purple soft rubbery membrane, interconnected at 35 meters of height, within it,

(20) http://www.associazionepaoloscheggi.com/
(21) Renata Pompas, Sean Shanahan: il corpo vivente, http://www.karmanews.it/12373/sean-shanahan-il-corpo-del-colore/
(22) https://www.youtube.com/watch?v=e-_92MYcANk
(23) Renata Pompas, Il colore della luce. http://www.karmanews.it/2876/il-colore-della-luce/
(24) Renata Pompas, Il colore della luce. op. cit.
(25) Leviathan is the Old Testament sea monster, symbol of chaos and divine power.

the visitor is enveloped into a visceral space, in a translucent red colour, which tone changes depending on the intensity of the filtered light. It is the red that transmits the sensation of being in the belly of the Sleeping Beast, where time and space are suspended. The artist describes his artwork: “I want that the viewers live a moment of aesthetic and physical shock”.

CONCLUSIONS

Many are the artists who from the mid-twentieth century to today have dedicated themselves to the monochrome colour, with different expressive and meaningful contents, in this report I have chosen only a few, representative of a journey that led from the two-dimensional canvas space to the colour environment.

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The Use of Environmental Color in Hotels: A Case Study on Ceta Ecotel Macapá, Brazil

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ABSTRACT

The aim of this article is to present a study on how the use of colors on the internal and external environments of a Brazilian hotel affected consumer and employee behavior. The results are analyzed in terms of model Sens|Org|Int, which differentiates physiological aspects of color human response from cultural and interpretive aspects (Csillag, 2008). The study was conducted at CETA ECOTEL, an ecological hotel at the city of Macapá on the northeastern coast of Brazil. The methodology was of a case study (Yin, 2004), using a triangulation process, crossing information obtained from three points of view: the researchers' analysis of the environment, a qualitative & quantitative questionnaire with 50 employees of the hotel, and a qualitative & quantitative questionnaire with 640 consumers (visitors of the hotel). Results show consumers' and employees' most and least preferred colors for the environment. These results were triangulated for analysis using Model Sens|Org|Int indicating, among other conclusions, that visitors preferred colors that have a specific physiological response (Org) which is related to the hotel's market niche being it an ecological Brazilian hotel (Int). Employees preferred a different physiological response of colors, considering that their choices are for the work environment (Org). It is observed that their choice is correlated to their motivation for a good work environment (Int).

1. INTRODUCTION

The aim of this article is to present a study on how the use of colors on the internal and external environments of a Brazilian hotel affected consumer and employee behavior. The results are analyzed in terms of model Sens|Org|Int, which differentiates physiological aspects of color human response from cultural and interpretive aspects (Csillag, 2008). The study was conducted at CETA ECOTEL, an ecological hotel at the city of Macapá on the northeastern coast of Brazil.

Sens|Org|Int Model (Fig. 1) differentiates three processes that occur in human perception: sensory impressions, organizing processes, and interpretive processes of visual perception. The model was devised in an attempt to differentiate which principles of design tend to be common to all human beings with normal eyesight from the concepts that don't. Those that are not common therefore are learned or otherwise acquired. Therefore, this model unites the synthetic approach (Hering, 1964[1878]; Gibson, 1979), and the analytical approaches (Berkeley, 1709; Helmholtz, 1925; Bruce, Green & Georgeson, 2003), neuroscientific explanations (Chalupa & Werner, 2004; Knoblauch & Shevell, 2004; Pinna & Spillman, 2001; Shimojo, Kamitani & Nishida, 2001; Spillman & Levine, 1971; Zeki, 2000) on how the brain works, and relates them to design principles. With this framework, we are then able to tell, from the classical design "laws," which ones can truly be considered a principle that tend to be valid for all human beings from those that don't.

Sens variable (sensory impressions) is related to the sensory information received through the pupil in our visual sensory organ. This aspect of perception is a phenomenon that occurs in the eye only, still in the form of light, before it becomes neural signs in the retina.

Org variable (organizing processes) is related to organizing aspects of perception that occur starting in the retina, including what is considered the primary visual cortex, mostly in area V1 of the striate cortex. Org is related to the bottom-up approaches of visual perception in psychology. The phenomena of perception that occur as Org are what tend to be considered as principles of design.

Int variable (interpretive processes) refers to the elaboration of Org in the extrastriate visual cortex, including approximately areas V2, V3, V4 and V5 of the brain, and moving on to other areas of the brain. This variable refers to the top-down approaches to visual perception in psychology. It is in this moment of perception, that neural cascades occur, which undergo the interference of motivation, emotion, personality, culture, knowledge, etc. This aspect of perception causes variation and interpretation in design and in the proposed model, is called interpretive processes.

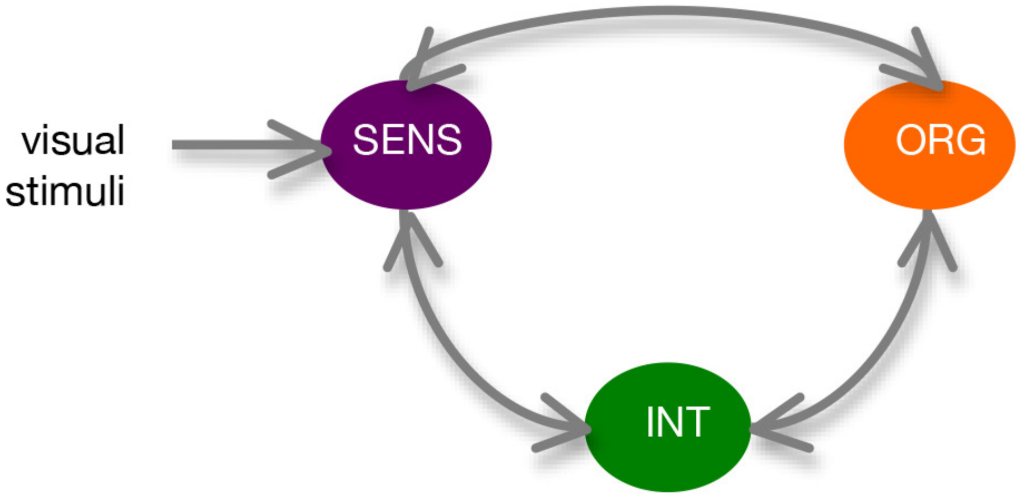


Figure 1. Sens/Org/Int Model

2. METHOD

This study was conducted at CETA ECOTEL, an ecological hotel at the city of Macapá on the northeastern coast of Brazil. This hotel was chosen since it was designed chromatically, and had the colors of each part thought in detail and chosen purposely. The methodology was of a case study (Yin, 2004), using a triangulation process, crossing information obtained from three points of view: the researchers' analysis of the environment, a qualitative & quantitative questionnaire with 50 employees of the hotel, and a qualitative & quantitative questionnaire with 640 consumers (visitors of the hotel).

3. RESULT AND DISCUSSION

The hotel consists of 20 separate guesthouses each of which colored externally and internally with one of eight colors. Also, not only colors are used internally on the walls, but also on the beddings, curtains, blankets and decoration elements. Figures 2 and 3 show examples of colored guesthouses.

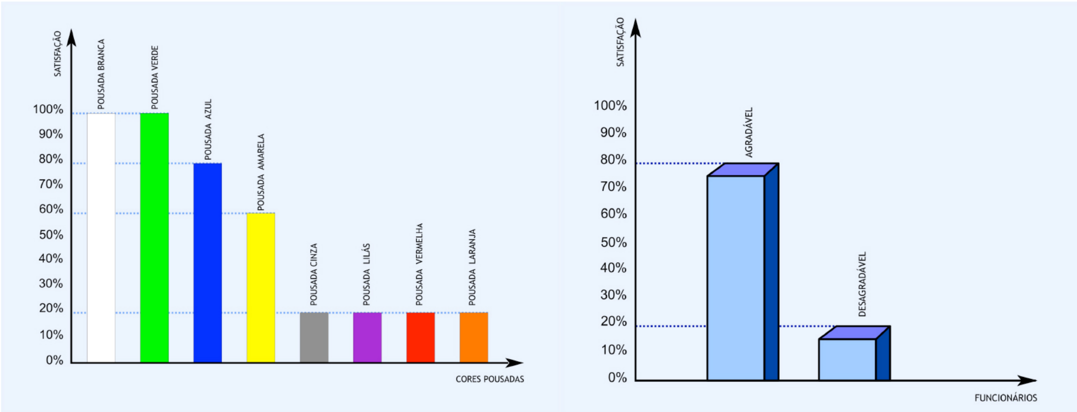
The questionnaires that were applied to guests and hotel employees were analyzed and illustrated consumers' and employees' most and least preferred colors for the environment. Results showed that the preferred colors for guesthouses, according to guests' preferences were white, green and blue. The employee areas, which are white and blue, showed results of 80% satisfaction.

The quantitative questions of the questionnaire were analyzed in charts, whereas Tables 1 and 2 show main results. Apart from the quantitative questions, qualitative questions addressed consumer and employee preference and well being with certain colored environments.

The researchers used the Sens|Org|Int framework to further analyze the results obtained from the questionnaires. This framework offers the possibility of understanding the origins of the color preferences, if physiological or cultural, triangulated with questionnaire responses.

Figure 2: Orange Guest House

Figure 3: Blue Guest House



Tables 1 and 2. Preferred colors for guesthouses (1); Percentage of employee satisfaction with colors blue and white on employee area (2).

4. CONCLUSION

Results showed that the preferred colors for guesthouses, according to guests' preferences were white, green and blue. The employee areas, which are white and blue, showed results of 80% satisfaction. These results were triangulated for analysis using Model Sens|Org|Int indicating that visitors preferred colors that have a calming and relaxing physiological response (Org). In terms of Int variable, the color green is associated to environmental aspects, which is related to the hotel's market niche being it an ecological Brazilian hotel (Int). Employees preferred white and blue, which in terms of Org produces a calming work environment. These results confirm aspects of environmental color design (Caivano, 2006; Schindler, 2005; Kwallek, Soon & Lewis, 2007; Küller, Mikellides, & Janssens, 2009) addressing the importance of color on environmental design, not as a complement of the architectural process, but instead as a primary design issue. Sens|Org|Int framework helps to understand different aspects of color preferences, being useful, with empirical information as this case study, for future architectural projects. Due to space limitation, oral presentation will contain more details.

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Urban Space and The Quest for Color Harmony

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ABSTRACT

The idea about the necessity of harmonious colour sets seems popular and is at least one of the reasons for the reglamentations on color application in the urban environment. My contemplations were caused by the cognition that spatial objects like buildings, parks, streets etc. create relatively harmonious colour combinations disregarding the kinds of visual properties they actually possess. There are several external factors, which influence the quality and of information obtained by spatial observation such as the intensity of light, the angle of reflection, the distance of observation, the density of atmosphere, and, at the end, the internal ability of an individual to perceive. Systemic color schemes are the basic codes of thinking yet they cannot be used as an operative tool for visual orientation in the spatial environment because of their two-dimensional character, the fixed condition of colors and use of a neutral, static light. Two observational principles derived from the concept of the optical axis determine the balanced color relations in the external environment and color harmony seems to be the by-effect of spatial observation – an interpretation of the world of visual things rather than the evaluation of the visual properties of objects themselves.

ARTICLE

The idea of color harmony still seems popular enough to function as one of the reasons for the reglamentations on colour use in the urban environment. The ideal color order could be the desirable aim of both the planner and the aesthetically tended observer yet this standpoint would contradict the individual experiments with new forms of creative expression, new kinds of materials or technologies or simply with unusual ideas created by anxious minds. Novel materials open numerous possibilities to manipulate with visual effects and the interaction between color and physical substance seemingly become stronger. Color is no longer that something on the surface of a thing what makes it appearing, for example, 'green' but probably a representation of a certain material or even a deep intrinsic property of a physical object. In this sense, the assumptions on the world of things collected by the snapshots of visual observation such as 'red brick' or 'green glass' becomes substantiated at a higher degree and the virtual existence of a colour may become more closely unified with the nature of a real palpable object.

Although the entire idea about harmonizing the colors in our surroundings does not seem to be the actual driving force, the traditional color concepts continue to persist in our educated imagination thus influencing the conclusions on the relations of visual objects and styles. A number of principal questions shall be asked therefore: can colours of the urban environment appear harmonious just as they are without any relations to systemic principles of the color theory? Does it mean that even the visual structures of intentionally non-relational character may seem to be harmonious when observed as a part of the urban (or any other) environment? How can any pleasing sensations be formed in the circumstances where no harmonious color sets are planned and the initial observation is made from the occasional positions and distances? Is there a good reason to explore the concept of harmony in the functional order and aesthetic chaos of an urban environment?

The creation of harmonious color sets in spatial environment requires evaluation on a complex of conditions, which exceed the application of elementary principles of color theory. I have to clarify here that this discourse explores only the case of natural environment and natural light, i.e., sunlight. The fact that a mass of color signals in an open environment reaches our vision instantly and in the most of situations is uneven in its strength is to be consider as well. There are numerous factors which influence the quality and reliability of information obtained by spatial observation such as the intensity of light, the angle of reflection, the distance of observation, the density of atmosphere, and, at the end, the ability of an individual to see, recognize and compose the light signal into an intelligible image.

COLOR SCHEMES AND SPACE

My contemplations were caused by the cognition that spatial objects like buildings, parks, streets etc. create relatively harmonious or visually pleasing color combinations disregarding the kinds of visual properties they actually possess. Apparently, this phenomenon cannot be simply explained by the correct color organization because we have to account that coloring of the several man-made objects in the evolutional urban environment is neither synchronously planned nor implemented. In general, the coloring of buildings is mainly planned to stress the values of the object itself rather than to coincide with the visual values of the objects nearby. The antithesis is the case of artificially planned environment with building complexes or districts, which is not the matter of this discourse.

The assumption that even partially organized color appearances may cause sensations of color harmony require the explanation on the nature of colors – here they are understood as an intrinsic property of physical objects and, secondly, in the context of their spatial relationships. Thus the term color is used in its dispositional sense (Maund and Zalta) and includes all possible color modulations created by the effects of light and shades characteristic to all three-dimensional objects. Consequently, colors of the urban environment should be discussed in a broader sense in accordance with the definition of the environment describing it as 'a sum of conditions ... including physical surroundings.'(Webster's. 1993)

The fundamental principles of color concordance are based on the intelligible color evaluation systems and established assumptions on the stylistically correct color relationships as well. The recognition of conformable color relations require awareness on their parameters and schematic principles of interaction, e.g., complementary, analogue to name the most typical. The definite position of colors in a model allows us to draw regular diagrams and establish the explicit systems of color relations, and preventively know and decide which colors are compatible or which combinations could create a contradictious outcome. Systemic color schemes provide us with the basic codes of thinking yet they cannot be used as an operative tool for visual orientation in the spatial environment. The reason for non-compliance with the spatial view is the two-dimensional character of these schemes, the fixed condition of colors and use of a neutral, static light. Color appearance in a spatial environment, on the contrary, is constantly modified by the distances and angles of observation, and changing nature of light itself. In general, the main deficiency of these schemes is their formal exclusiveness – schematic color models have neither distinctive visual environment around them nor visible objects in close proximity what is characteristic to the natural view – no color sets can stay unchanged and colors cannot be appropriately perceived as they naturally are in the real open space.

THE ROLE OF OBSERVATION

Spatiality as a visual condition always concerns the presence of at least several objects and typically several colors around them to be observed and contemplated at once. Color combinations manifest themselves as complex and simultaneous projections of the reflected light in the mechanism of our vision. This perceptual principle reflects the original properties of a spatial view (not the colors themselves) as it appears to us, however it does not specify the topographic location of the objects – the distant objects in the projection may appear as approaching and vice-versa.

There should be a different kind of conceptual tools to explore the properties of colored objects in a spatial environment instead of application of the color schemes. First of all, I propose the concept of optical axis (or so called sight-line) that characterizes the visual observation as such and select the object of attraction. The optical axis automatically generates the focal area (or perceptual field) and its center, and is the core element of the optical tunnel through which the comprehensible color signal available in the actual moment is perceived. This is a deeply authentic process of observation as such and can create unpredictable kinds of perceived sights based on sporadically found visual accents or points of attraction. The second concept is the 3-D color theory, which describes 'how colour reacts and behaves in our external environment' (Drew and Meyer. 2005: 90). In this discourse I use the principles of the 3-D color theory as a systemic model of spatial observation which explores complete set of 'elements' necessary for the color perception and recognition – the light source, the object, and the observer. The 3D system determines the notion of distance between its elements and angle of visual observation – both aspects are of utmost importance to explain the possibility of appearance of color harmony in the open space. There is also a concept of reasonable distance separating the observer from the object to provide ability to locate the whole object or group of objects in the optical field of observation. Although the 3-D theory does not prioritize any of its elements, I attribute the 'object' with the central role in the system because of the following reason: if colors are an intrinsic property of an object (as stated in the paragraph one) the object's functional role (Maund. 1995: 54) is to act as the true source of information. Processes of observation and also the lighting therefore refer and are systemically subordinated to the object – I recognize the odd context of this spatial construction, which obviously contradicts to the general heliocentric principles.
There are two universal observational principles derived from the concept of the optical axis determining the existence of the variety of balanced color relations. Firstly, the case with focused object (e.g., a monument) in the middle of the focal area, which attracts the observer's main attention. It is typically balanced by several visually neutral objects in the periphery of the focal area and corresponds to the centric compositional model. Second case is when the center of focal area contains a relatively neutral or non-attractive element (e.g., a street) with formally attractive elements in the exterior part of the area. This is a controversial statement because it contradicts to the functional concept of the optical attraction. However I assume that spatial phenomenon such as the sensation of increasing depth can be attractive enough to trigger the visual concentration and involve our mind as well. In each case the color balance can be estimated in its direct relation towards the center of focal area. Balanced relations of colors can also progress towards the wider area of the visible space if the focal area would extend because of increase of the distance. It is reasonable here to draw attention to the fact that the notion of a spatial balancing point resembles the balancing centre (or potential sum of color mixtures) of the color models – an achromatic value that fulfills the function of the systemic point of reference.

CONCLUSIONS

As intelligent human beings we are inclined to understand the properties of visual environment and manage the spatial surroundings so the thought about the possibility of harmonious visual structures in urban environment seems to be a by-effect of the overall tendency to plan and organize and consciously reflect the achievements of the past. The opposite case is the visual chaos as an organic form of creation of the sights, which eliminates every attempt to foresee the outcome or maintain control over the methods of observation, or sequence of events. The spontaneous nature of color perception in its turn does not distinguish the intentional qualities from those of organic being – dynamic spatial observation is a governing instrument in finding the attractions and composing the complete spatial view.

The recognition of eventually harmonious color sets is a post-perceptual concept because it transforms spontaneously perceived sight into the intentionally selected visual formation with particular visual properties. Color harmony in the external environment seems to be interconnected with methods of spatial observation – a conscious interpretation of the world of visual things rather than the evaluation of the properties of spatial objects themselves.

I shall conclude that the existence of ideal harmonious color structures is just an assumption built on pre-meditated concepts on the pleasing relations of objects, the sensation of space, and stylistically correct aesthetic conformity.

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Trees of Buenos Aires Changing the Appearance of the City

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ABSTRACT

The color of a city is not limited to the inherent color of the facades of their buildings. It must be considered the perceived color in all its complexity and all the elements, which form the urban landscape, as buildings, equipment, and trees. With regard to vegetation, important areas of Buenos Aires show modified the appearance by the trees in different seasons of the year. These sections refer only to the trees that produce changes in the appearance.

1. INTRODUCTION

Buenos Aires is well known for the cultural value of its trees, part of the urban ecosystem intimately related to the inhabitants life. They grow for the ornamentation of our public spaces and for shade and shelter, differing in size, shape and color, but also by the texture of their trunks and branches, the color of its leaves and flowers According to recent studies, in the streets and squares of Buenos Aires there are more than 423.000 trees, equivalent to one tree every seven inhabitants, when the World Health Organization recommends one every three people in a city, in order to improve air quality.
Census data say there are 51.740 trees in parks and squares and 372.625 on sidewalks. The goal is to reach 100.00 in green spaces and 420,000 in sidewalks. Aesthetic benefits of trees relate to the possibility to see colors, structures, shapes and densities. Most of this aesthetic experience is subjective, and impacts on mental and emotional states of people. (Tyrväinen 2005). Color is initially is a physical effect, but in sensitive people communicate immediately with the senses. (Kandinsky 1946). The visual appearance is that perception and, in many cases, knowledge through which an object is characterized or recognized as having attributes such as size, shape, color, texture, shine, translucency, opacity. (Lozano 2015).

2. SOME HISTORY

In the city of Buenos Aires, throughout history, tree-growing data has been fragmentary. Until 1885 development in streets and squares was scarce. There were about 1,100 units in the city.
By the second half of the nineteenth century Buenos Aires incorporated the idea of green as a healthy city model under an organic notion of urbanism. “The city was considered as living organism breathing through the vegetation, promoting the quality of life of its inhabitants,” said Graciela Benito, curator of the Botanical Garden. This view prevailed in the planning of the Buenos Aires public spaces, where the landscape interventions were enhanced by the city’s Directorate of Parks & Walkways. The architect Charles Thays and agronomist Benito Carrasco, between 1891 and 1918 drew up the guiding principles of this work, which not only looked the aesthetic, but also hygiene, leisure and population expansion. The French architect Jules Charles Thays arrived in Argentina in 1889, to design Sarmiento Park in Córdoba. He became captivated by the young country and decided to spend the

rest of his life in Argentina. He was named the city's Director of Parks & Walkways in 1891. At the Competition to qualify in this position wrote: "Man, especially one that works, has need of distraction. There is something healthier, noble, true, that in contemplation of trees, beautiful flowers, when they are ordered with taste? The spirit then rests, and the appearance of beauty, purity, produces an immediate effect on the heart". (Berjman 2002).

This position gave him significant influence over the design of the city's open spaces, and his legacy is still strongly felt in the city's open spaces today. Thays worked most extensively in Buenos Aires precisely at a period where the city was growing extremely fast as a result of immigration, especially from Spain and Italy. He traveled around the country looking for species that would serve to decorate streets, parks and squares. From the north and northeast of Argentina brought several species as Pink Lapacho, Floss-Silk Tree, Tipa tree and Jacaranda, including some exotic ones.

3. TREES OF BUENOS AIRES

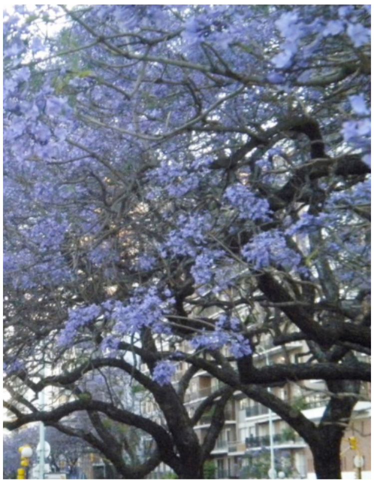
Lapacho, Tabebuia avellanedae, or Pink Lapacho (1) (Family Bignoniaceae), is a native tree of America, distributed from northern Mexico to northern Argentina, naturally found in the wild of Central to South American forests. It is widely planted as ornamental tree in public squares and boulevards due to its impressive and colorful appearance of it magenta flowers. Its corolla is pink or magenta, though exceptionally seen white. As soon initiated the spring in Buenos Aires, as an announcer of that, still without foliage, the tree spreads its thousands of pink flowers that dazzles with its extraordinary beauty. Flowering season is in early spring, in September, before the new leaves appear, but the ephemeral spectacle lasts only a few days. (ref. NCS S1040-R30B)*

Palo Borracho (Drunk Sticks), Chorisia speciosa or Floss-Silk Tree (2), (Family Bombacacea) is a deciduous tree native to Argentina and Brazil (Dalgas Frisch 1995). It grows fast when water is abundant, and sometimes reaches up to 25 meters in height, with broad crown, hemispheric. Its trunk is bottle-shaped, generally bulging in its lower third, measuring up to 2 meters in girth. It is studded with thick conical prickles. It bloom in December, lasting to May or more, there are specimens that bloom early as October. The pink flowers, very showy, open before the leaves show and then remain for a long period. It is a very special tree. In autumn some keep their flowers and others already have their fruits, very big caplets in green color. Decorative species in all its stages, for their flowers and for their fruits. When they open show the silky whitecotton, which surrounds the seeds. (ref. NCS S0540-R30B)*. The Chorisia insignis is the variety with cream white flowers (ref. NCS S0505-Y)*

Paraiso, Melia azedarach, commonly called “paradise” in our country, is a deciduous tree, native to India and Pakistan but is now grown in all the warmer parts of the world. It that can reach a height of 20 to 40 meters. Flowers are showy, fragrant, numerous on slender stalks, white to lilac in color. In winter, no leaves remain, just theses “China Berries” fruit, small, yellow, olive-like drupe, in cluster that are also very ornamental. (3) (ref. flower NCS S1020-R80B, fruit S1020-Y20R)*

Tipa Tree, Tipuana tipu (4), known as Rosewood, is a South American tree that can reach 40 meters high, providing shade and cooling effect in the summer heat. Notable for his size and elegance of the port, it is one of the most conspicuous and well-known trees of our flora. Very parasol like shaped and highly branched. It is appreciate also for its magnificent blooming yellow. They bloom only briefly in December when the yellow of the flowers mix with the green of the leaves, and upholster then with gold, the lawns, driveways and sidewalks. They are also called ‘the daughters of Thays” because before this landscape architect started to redesign the green areas in Buenos Aires, there were only 3 of them. He recommended the use of this tree in the city and now it is found everywhere. Tipa tree line many of the broad avenues where they grow in their normal development, spreading their branches, that meet in the middle, making us imagine within a green cathedral with high vaults. (ref. NCS S1060-Y10R)*

Jacaranda, Jacaranda mimosifolia (5), a sub-tropical tree native to South America that has been widely planted because of its beautiful and long-lasting blue flowers in bloom all over the city. The flowers appear in spring and early summer, before the new leaves appear, and last for up to two months or more. The profuse flowering of these trees grace the plazas, parks, lines the major avenues. You can’t avoid finding yourself with jacarandas wherever you may be.” People are aware of the benefits they receive from this beautiful gift of colour”. (Messore 2011) In winter, when it loses its leaves, fruits, large flat caps, decorate the branches. (ref. NCS S1040-R70B)*



Fresno Americano (White Ash), Fraxinus Americana (6), is a tree from the temperate forests of North America, Asia and Europe. Tree providing a good and cool shade, reaches 15-20 meters in height. The foliage, glossy green turns to bright yellow in autumn. The Fresno female have fruits provided with a wing, forming abundant clusters, that is green in spring and brown in autumn. The Fresno male is heavy, very green and robust tree. Unlike the female, not loading seeds and cup has twice the size. It is the species with the largest presence in the streets of the city, with more than 143.000 trees.

Liquidambar, Lyquidambar styraciflua (7), is a tree from Southern USA, Mexico and Guatemala, reaching 8 to 15 meters in height. The leaves, bright dark green have five to seven lobules sharp. In autumn they turn yellow to red and burgundy coloring the streets. The fruit is a spherical pendulum 2.5 to 4 cms in diameter and with numerous (20 to 50) capsules and each capsule is still open in the tree when the seeds are dispersed.

Plátano, Platanus acerifolia (8), it is considered a hybrid between two species: Platanus orientalis of Eurasian origin and Platanus occidentalis, of American origin. It is a deciduous tree that can reach above 40 meters high, providing a dense shade. The crust is light grayish-brown color. Subsequently, very thin lamina come off leaving spots of lighter color. The leaves are arranged alternately, green, lighter and pubescent underside fixing atmospheric dust particles, so that their action is significant decontaminant. The fruits are small and numerous, globular, hanging from long stalks and have a size close to 4 cm in diameter but the pollen from its fruits produces allergies. It bright green foliage turns to light brown in autumn.

4. CONCLUSIONS

Buenos Aires is a green city. It is very impressive how the color of flowers, leaves, trunks and its branches modifies the urban environment in different seasons of the year. There is a sense on the need to enjoy the color in nature that surrounds us, even in a big city like Buenos Aires.

ACKNOWLEDGEMENTS

*The NCS colours mentioned are only referential. The colour that we perceive is influenced by the intensity, angle and composition of the illumination, by the surrounding colours and by other factors that vary with the situation as for instance date and time. Colours perceived in complex situations depend on many other things

than the physical radiation and the reflection qualities of the surface. (Fridell Anter 1996/ Gibson 1966). In the case of these flowers, differs also from flower to flower, from tree to tree of the same species, the site where they grow.

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[Colour Studies] Re:Placing Colours. Evaluation of the Chromatic Interventions on the Blocks of Flats in Bucharest, Romania

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ABSTRACT

The communist era left Bucharest, and Romania in general, with hundreds, thousands of grey concrete blocks of flats (4 to 11 story high). In the early 2000 the City Council together with the Ministry of Regional Development decided to rehabilitate these blocks of flats by financing the entire project or just parts of it. The intention was to improve the city's image by removing the grey damaged envelope of the blocks of flats and by replacing the monotonous and uniform colour with colours appropriate for the contemporary urban environment. Thus, after 2007 scaffolds were mounted and rehabilitation began. This article aims to evaluate the outcome of the interventions on the envelope of the blocks of flats in terms of colour and also in terms of the impact at the urban space level. The assessment is based on colour mapping of several main streets of Bucharest, streets bordered by rehabilitated blocks of flats by highlighting the chromatic palette used in these cases. The colour mapping method used was based, on the one hand, on the pictures produced in situ and, on the other hand, on the comparison of colours with a reference colour chart. The results of the evaluation of the chromatic interventions for the blocks of flats show that the used colours, the applied chromatic schemes and the association of colours were arbitrary chosen, without taking into consideration the laws of colour harmony. At the urbanscape level the impact of these chromatic rehabilitations was disastrous, creating a cacophonic urban image, a colorful cocktail. Each block of flats was designed separately and was not put into context. The findings of this research highlight the need of creating a colour atlas and a colour plan for the city. The lacks in legislation need to be filled in order to create and maintain a coherent chromatic urbanscape.

1. INTRODUCTION

The Golden Era, as the former communist leader Nicolae Ceausescu called it, was, in terms of the image of the cities, a substantial transformation: the individual houses or the small collective houses were replaced with high-rise blocks of flats (about 10 storeys high) in which it were crammed as many people as possible. The important avenues have been closed with such construction built using type-projects. All gray, all monotonous. Gradually, people have tried to turn them into "home", to make them consistent with their needs. So they closed balconies with metal joinery and the resulting spaces were either integrated into the living space (living-room extensions) or were converted into storage spaces.The influence of these interventions on the boulevards and the city as a whole was not been a part of the concerns of the local communist authorities. Only in the cases of avenues that the communist couple, Nicolae and Elena Ceausescu, could have passed by, these transformations have been banned. After the fall of communism, those blocks that were already built for about 20 years, underwent further transformation. The euphoria of the possibility to change the old and thermal innefficient wooden joinery swept the apartment owners. Gradually the vast majority of the wooden and of the metal joinery was replaced with white PVC joinery (due to economic accessibility) or brown PVC joinery (in a few cases). The façades of the blocks of flats (gray plaster) was damaged in most cases. In addition, high maintenance costs (resulting from an inadequate thermal protection) began to be a serious problem for many of the residents. In this context, in the early 2000s, the Bucharest City Hall and the Ministry of Public Works decided to rehabilitate the housing blocks both thermally (by changing the joinery of the windows and of the exterior doors, by closing the balconies using white PVC joinery and by insulating the exterior walls with Polystyrene) and chromatically (exterior walls, insulated with polystyrene, will receive a new and more adequate plaster). In the initial phase, for financing of these rehabilitations works both apartment owners and local authorities had to participate. But because it was found that the population, in most cases, did not have the financial resources required for such transformations, it was subsequently decided, at least in Bucharest, that the financing of this intervention would have to be paid by the local authorities alone. So it was passed to the next step: the enrolling in this program of the homeowners' associations (each block section with its association of tenants / owners). This step was followed by the auction phase, each block of flats or section of block of flats was going to be rehabilitated in the order of registration into this program. The local authorities wanted to involve the homeowners' associations in choosing the colours and the colour schemes that were to be used. The deadline for the consultation of the involved parties was too long, so the consultation of the homeowners' associations was dropped out, the decisions regarding the colours and colouring schemes would had to be taken by the local authorities and, at least in theory, coordinated by them. To ensure a shorter timescale a lot of construction companies were involved in the execution and the packages of the auctioned works were very small (often only a section of the block and not the entire block). After 2007, the constructions began and gradually, by 2012, have been completed.

2. METHOD

This article aims to evaluate the outcome of the interventions on the envelope of the blocks of flats in terms of colour and also in terms of the impact at the urban space level. The method that was used is that of field research, with the aid of photographs and of colour palettes, in order to create a colour mapping of the analyzed urbanscape of Bucharest. The findings are analyzed and they are combined with an interview conducted on 60 residents, for each selected area.

3. SURVEY

The first phase of the investigation was the selection of areas that were to be analyzed. This selection was based on the number of existing rehabilitated buildings in those areas and on the importance of the areas in relation to the city. Thermal rehabilitation began mainly in the 1st District, where the number of rehabilitated blocks is very high. Therefore the study was focused on this district, and the areas that entered in the selection are a part of it. After this step, there were selected three areas in the 1st District (Ion Mihalache, Grivita and Aviatiei), areas where exist a large number of thermally and chromatically rehabilitated blocks, blocks of flats that are situated especially on the important avenues. These areas were part of the first areas in the 1st District that were rehabilitated. The thermal and chromatic rehabilitation in these areas ended up more than 5 years ago so it is possible to make a fair assessment of the impact on both the residents and the pedestrians. The next stage meant the photographic documentation of these blocks, including details of façades and an ongoing photographic action at the level of boulevards. During the fourth stage the colour palette was chartered and there were inventoried the colour schemes that were used. The fifth stage included the actual assessment of the chromatic palette, of the colour schemes as well as of the impact of these interventions in the respective areas.

4. ASSESSMENT. FINDINGS

The assessment of the impact of chromatic rehabilitation was carried out on several levels: a) in terms of the assembly (colour - colour scheme used - the relationship with the context); b) in terms of the components of the assembly (including details of the façade); c) the analysis of the used colors (both the inventory and the association – on a single element or across multiple elements); d) the analysis of the color schemes that were used (single elements and parts of the assembly); e) spot assessment of the impact of the used chromatic on the residents and passers-by.

Area 1 - Ion Mihalache: The colour schemes are emphasizing the architectural features but unfortunately the colours that were used are vivid and bright, a unfamiliar aspect for this area, thus creating a chaotic polychromy. The colouring schemes are quite different from a section of block to another, but there are several blocks of flats that have the same colouring pattern. The colours do not relate in any way with the existing context (figure 1). The residents mainly dislike the colours that were used but they appreciate that the blocks have now new plasters. The important underlined feature of this rehabilitation is that there was also a thermal rehabilitation payed by the local authorities.

Figure 1. Ion Mihalache boulevard (Ion Mihalache - area 1)

Area 2 - Grivita: The colours used are bright, but the colouring schemes are similar to each other. That is why the general chromatic aspect is not disturbing (figure 2). The residents are indifferent to the colours applied and to the colour schemes.

Figure 2. Calea Grivitei boulevard (Grivita - area 2)

Area 3 - Aviatiei: The colour schemes that were used are completely unfamiliar with the city and they do not relate in any way with the context. The colours are pastel but there is a large number of colours that are used. Several different colouring schemes are applied (figure 3). The residents mainly appreciate the thermal rehabilitation and are mostly indifferent to the created image.

Figure 3. Alexandru Serbanescu boulevard (Aviatiei - area 3)

The results of this research show that it has been used a fairly extensive colour palette, the vivid bright colours being dominant. The colours that were used completely ignore both the close context (immediate vicinity) and the wider context of area / neighbourhood. The colour schemes that were used are completely new and foreign to the context and falsify, in many cases, the volumetry of blocks focusing on areas that are insignificant for the whole. A earlier study (Zybaczynski, 2014) showed that the colours and colouring schemes specific for Bucharest are pastel colours, the architecture of the buildings being put in value through the use of contrasting colors to emphasize the architectural details. The colour combinations are, in many cases, inappropriate. Regarding the colouring of several sections of a block it was found that it is not done uniformly and consistently, the colours can vary for a single block, both in intensity and hue or chroma, and also in the coloring scheme that was used. Regarding the opinions of the inhabitants, these vary from indifference (approx. 70%) to rejection (30%).

5. CONCLUSIONS

With the thermal rehabilitation, in Bucharest appeared a whole range of colours (from pink to green of leeks or purple) and a variety of colour schemes that had no connection with the substrate (blocks) and which turned them in poster type objects. When scaffoldings were removed, the inhabitants could noticed with astonishment that rehabilitations were not based on a unified concept even at the level of the entire block, more over at the level of the boulevard or of the city. Reactions were immediate both among the inhabitants, the media and at the level of Architects' Order in Romania, but the district city halls remained opaque to these signals of the civil society. At this point, for a long period of time (10-15 years) they can no longer intervene in the chromatic works already executed but might act on the works ready to start (a new thermal rehabilitation program expanded to the individual housing). This procedure involves the completion of the legislative framework and the development of a unified Colour Plan at the level of the city (after a thorough analysis of the existing situation). The downside of this interventions is the delay of the thermal rehabilitation for a quite long period of time. But the impact of a chromatic regulation on the urban landscape and on the inhabitants will be beneficial, generating coherence and unity at the level of the city. The choice of colours and of colouring schemes do not have to be a choice left to the reach of a construction company but should be part of a unitary and coherent strategy for the development of the city.

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Analysis of Korean Underpasses, Spaces under Overpasses, and Passage Boxes with Low Lighting Ratios and Proposal for Environmental Colors. Focused on the Underpass at Seokgye Station

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ABSTRACT

Today, people are highly satisfied with their lives. However, they are exposed to many natural disasters and various crimes. To solve these problems, people try to improve the surrounding environment. In fact, it is possible to create a safe and stable environment through the use of colors.
Color improvement is economical in that a color change does not require the addition or removal of environmental and design factors. Besides, color can provide safety through its visibility and attractiveness; it can also foster psychological stability and a sense of historical identity and aesthetic appeal. Thus, color can play various roles as an effective tool for environmental improvement.
These days, among public spaces in Korea, spaces under bridges (used by both vehicles and people) and overpasses, underpasses, and passage boxes have low lighting ratios that are linked to an increase in crimes. Further, the visual aesthetic impression of these spaces is poor. Therefore, people are requesting that nearby public facilities and underpasses become brighter and more attractive.
Accordingly, this study promotes the use of safe colors in the design of surrounding environments in order to improve the negative image of underpasses and their safety and stability.
A color plan has been proposed in this study based on an environmental factor analysis of the underpass at Seokgye Station, located in densely populated Seoul. Subway lines 1 and 6 connect there, so the number of people passing through is high. The underpass, however, is old and without color (unlike other underpasses nearby). For the underpass at Seokgye Station, this researcher used yellow-based light gray as the dominant color, orange as the accent color, and blue as a secondary harmonizing color for psychological stability, aesthetic impression, and a local historical identity. It is expected that these colors will help provide a public space characterized by increased safety, psychological stability, historical identity, and convenience.

1. INTRODUCTION

The weakest factor associated with people's ability to enjoy life satisfactorily is safety. People are exposed to natural disasters including floods, yellow dust, and earthquakes, as well as crimes. Thus, various efforts are required to solve problems. One such effort is the improvement of surrounding environments for safer lifestyles. In fact, such improvements can be achieved through the use of color.
Color improvement is economical in that a change in color does not require the addition or removal of environmental and design factors. Besides, a new color can promote safety because of its visibility and attractiveness; further, it fosters psychological stability, historical identity, and aesthetic appeal of the environment. Therefore, color is an effective tool for environmental improvement.

These days, among public spaces in Korea, dark spaces under bridges (used by both vehicles and people), overpasses, underpasses, and passage boxes have become hot spots for crimes. Therefore, people are requesting that nearby public facilities and underpasses become brighter and more beautiful. Thus, this study promotes the use of safe colors in the design of surrounding environments to improve the negative image of underpasses as well as their safety and stability.

1.1 Background of Study and Purpose

In Korea, most of the low underpasses and spaces under overpasses and passage boxes are characterized by low lighting ratios. In particular, the underpass at Seokgyeo Station—in densely populated Seoul—that serves as the connection center for subway lines 1 and 6 is old enough to have the pier of the old railway remaining until now. Unlike other nearby underpasses, the one at Seokgyeo Station has no color.

1.2 Theoretical Study

Uneasiness is triggered in an alley or a pathway that has a narrow space, high ceiling, or straightaway. Such are the features found in the underpass at Seokgye Station.
Usually, the color that triggers uneasiness most frequently is red, whereas colors that are most effective for promoting psychological stability are blue and yellow.

1.3 Case Study

There are domestic and foreign cases of improvements to underpasses. In particular, some cases involve color changes to improve psychological stability and safety.
Improvements have been made to underpasses at Doil Market, Jurewang, and Deokpo-dong, Sasang-gu, Busan. The underpass at Doil Market was a farm road 20 years ago; now, it is a connection passage for visitors to Doil Market. In the late summer of 2014, residents, artists, and city hall and community center employees performed color improvement work to make the underpass more convenient for visitors to Doil Market.
The underpass at Jureywang is characterized by heavy traffic and a large floating population. However, its lighting facilities were inadequate, fostering a dismal mood and feelings of disharmony among pedestrians and drivers. Consequently, it was damaging the urban image. As a result, the underpass was redesigned to highlight the natural environment with flowers and trees and an installation of LED sculptures.
The underpass at Deokpo-dong, Sasang-gu, Busan that connects Baekyang-daero and Samdeok Sasang-ro had also deteriorated. Many voiced opinions that it damaged the urban landscape. Consequently, the underpass was improved with the installation of LED sculptures, Korean azaleas, and royal azaleas.

2. METHODS

2.1 Research Object

Seokgyeo Station has a high population density regionally and environmentally. Despite the large floating population, Seokgye Station has poor facilities. The lower side of the underpass is an overall gray color that seems dark and desolate, and the concrete wall of the underpass is exposed. Moreover, the accumulation of dust causes displeasure.
The structures (columns) of the underpass have been covered with leaflets and flyers

so that they look dirty. The floor pavement is so uneven that it causes inconvenience when walking. Its dominant color is achromatic, creating a bleak feeling.

2.2 Research Method

Based on previous studies regarding safe colors and the cases of underpass improvements, various aspects of the underpass at Seokgye Station—regional characteristics, the floating population, and historical identity—were analyzed in this study. Additionally, the spaces under a nearby overpass and a passage box were examined. The methodology included an environmental analysis and a research approach directed toward the three aspects of historical identity, locality, and safety.
First, colors of the existing subway lines were extracted. Then, contents that reflected the historical identity, locality, and safety of the underpass at Seokgye Station and the safety of nearby existing spaces were taken into consideration. Then, the colors of the underpass at Seokgye Station were redesigned.

3. RESULTS AND DISCUSSION

3.1 Environmental Factor Analysis

The underpass at Seokgye Station was built next to a bridge with a 100-year history (established in 1915). It is located in Seoul's Nowon District. The name "Seokgye" is a compound word for seok (stone) of Seokgwan-dong and gye (stream) of Wolkye-dong. Near the station, there are many universities, such as Sahmyook University, Seoul Women's University, Seoul National University of Science and Technology, and Kwangwoon University. Regarding the daily average floating population, half of it passes through the station before noon. The population is especially dense during rush hours.

3.2 Color Factor Analysis

From the color of line number 1, blue can be extracted; from the color of line number 6, orange can be extracted.

3.3 Comprehensive Proposal

Historical identity	Locality	Safety
Traces of the old railway with its 100-year history left in the underpass at Seokgye Station are meaningful in that the railway serves as the medium to connect the past and present.	Seokgye Station is a transfer zone for lines 1 and 6. Therefore, blue and orange were extracted from the colors for these lines.	Blue is expected to prevent crimes that often occur where a dark mood is present. Therefore, it was selected as a dominant color.

Table 1. Analysis of the environmental factors of the study subject (underpass at Seokgye Station)

Figure 1. Proposal of environmental color based on underpass at Seokgye Station

In this study, an underpass was designed with yellow-based light gray as the dominant color and blue as harmonizing accent color.
The soft tone of the blue accent color increases attractiveness and implies safety and reliability. A deep-toned blue symbolic of line number 1 and water suggests trust and reliability.
In addition, a basic orange color is symbolic of line number 6 and the soil. The color

is similar to yellow and contrasts with blue. It is used to increase visibility and attractiveness. Further, it highlights the accent color by changing its brightness.
Finally, a soft bluish-gray color serves as a separation color, increasing attractiveness by providing a contrast for the background color.

4. CONCLUSION

The subject of this study was the underpass at Seokgye Station. Accordingly, a design proposal for the underpass was presented that took into account its historical identity, locality, and safety. Adding symbolic colors based on the existing subway line numbers was performed. Through color planning based on an environmental factor analysis, this study incorporated the design of a public space for increased safety, psychological stability, historical identity, and convenience.

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Sustainable Design: Colour Technologies for Static Façades with Dynamic Effect

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ABSTRACT

As we all know, colour combination and contrasts can confer specific effects to an object. You can highlight some parts of it, you can smooth other parts, you can make it vanish in the context, etc. There are a lot of "colour strategies" used by the designers to obtain certain effects. In the specific field of the architectural façade design the majority of the research seems to be directed towards the study of adaptive systems. As it can be easily guessed dynamic façade technologies are quite complex and relatively expensive, depending - of course - by the complexity of the whole building design. Sometimes the customer doesn't really need a dynamic façade but he wants to pursue a dynamic effect through other means. In these days we see more and more buildings' façades that exploit colour technologies to obtain a chromatic effect of movement or dynamism even than they are built with static elements.

The aim of this paper is to propose a classification of the chromatic strategies used by the designers to achieve dynamic effects in static façades. The dissertation will make use also of significant examples of buildings.

1. INTRODUCTION

Adaptive systems are necessary to create a building envelope, which is able to react to external environmental stimuli. The building itself has to be able to adapt to different environmental conditions to optimize its performances. As we know: different weather conditions can mean different façade configuration. In the most technologically advanced buildings this goal seems to be achieved mainly with the façade design. One of the most frequent solutions is represented by "dynamic façades". Dynamic façades are characterized by moving elements of different shape, material and colour that can be put in action by different technologies: electrical, mechanical, smart etc., many times combined together. The effect perceived by the observer is a surface in constant change. Elements of different colours, depending on their combinations, may increase the complexity of the façade. This can be very important, for example, in peripheral or industrial contexts, where the gray tones dominate the environment. A proper sustainable colour design must deal with this problem, creating man-made artifacts able to enhance environmental quality trough the use of special colour strategies.

Sometimes, to reduce costs, it is necessary to adopt less complex technological solutions, trying to maintain the perception of movement and dynamism. The effect of movement (or dynamic effect) can be very important because it can bring "life" into grey neighborhoods, many times using quite cheap technological solutions. In these kind of façades colour design and the shape of the cladding elements are the most important things. As we know colour combinations can create vibrant contrasts that are able to generate effects of dynamism. This can be viewed both in 2D (flat) surfaces and in 3D configurations. The cultural references for this type of design solutions seem to be Optical Art (Op art) and Kinetic Art. Many of the effects that are used today, were tested on the Sixties of the Twentieth Century. Designers can use contrast of dark and grey to generate images or tensions like in Bridget Riley's works. They can use colour contrasts to enhance shapes like Victor Vasarely. They can use

particular shapes combinations to simulate movement like Manfredo Massironi or Getulio Alviani and so on (Popper, 1968).
The research concentrated on the analysis of examples of static façades with the aim of finding a sort of classification of the effects of movement that can be obtained by the designers.

2. METHOD: THE ANALYSIS OF CASE HISTORIES

Different architectural projects have been analyzed following a precise scheme: façade technology, components, pattern, colour strategy (use of contrasts, agreements etc.), final effect.
The first example is the Parking Structure Art Façade designed by Urbana Studio, located in Indianapolis, USA (2014). It is a shading façade with a regular geometric pattern, but created with a very complex scheme. The peculiarity of Eskenazi Hospital Parking Structure Façade lies in having a dynamic appearance despite being made up of static elements. The goal of the project was to transform the typical appearance of the multi-storey car park - generally not appreciated by the community - through the use of Binary Terrain, a technology that was developed for DEM: a digital elevation model that allows the representation of the distribution of the altitudes of a territory, or another surface, in digital format. This technology was helpful to the design of the façade. The surface is constituted by 6,500 inclined metal plates designed according to a colour strategy that is articulated on an east-west axis, creating a perceptually dynamic façade system that provides the observers with an original visual experience depending on their point of view and the pace at which they move through the site. In this way, pedestrians and slow vehicles in the immediate vicinity of the hospital, moving through the front gardens, experience a varied change of brindle colour (from blue to yellow and vice versa), while motorists traveling on W. Michigan Street experience a change of faster and different chromatic gradient according to the direction of travel. From the chromatic point of view, the colour scheme is relatively simple since the west side has a deep blue colour, while the east side has a golden yellow colour. The different angle of the panels is already sufficient to create the illusion of other shades (Figure 1). To achieve the desired effect the designers had to work on the repeatability of the pattern or through combinations of the same which allowed creating the right alternation, necessary to the perception from various angles (Figure 2). From the perceptual point of view, the main façade when viewed from only one side appears completely yellow or completely blue. As the viewer moves from the yellow side to the blue side he has the perception of a domino effect: first the metal plates appear blue, then yellow and then they seem to disappear against the dark background of the building.

Figure 1. Parking Structure Art Façade by Urbana Studio, Indianapolis. Photo © Serge Hoeltschi

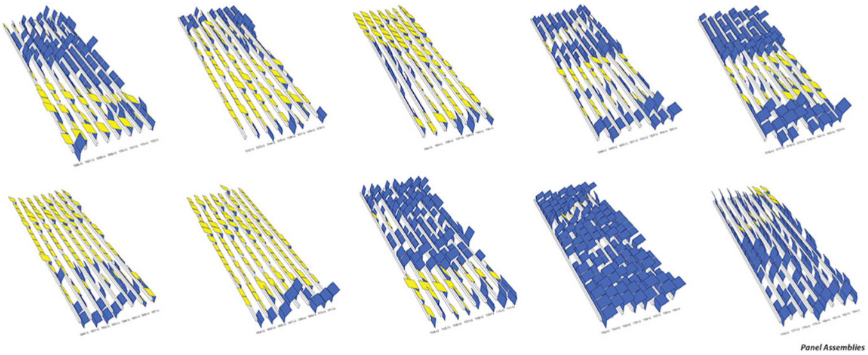

Figure 2. Parking Structure Art Façade: façade design process. © Rob Ley (Urbana Studio)

Another case study is the Swanston Square Apartment Tower designed by ARM Architecture, located in Melbourne, AU, (2015). The peculiarity of this building is the face-façade: a face is represented on the façade. It is the face of William Barak, the last traditional ngurungaeta (Elder) of the Wurundjeri-willam clan. The face curves from the southern to the eastern façade and it looks clearest if you directly face the corner that points along Swanston Street. "The image comes from a photograph of a sculpture of Barak by contemporary artist Peter Schipperheyn. First, we reduced the photo to a binary black-and-white image. Adobe Photoshop turned the image into horizontal bands of black and white varying in vertical thickness. Next, we converted the bands into vector-based line work to import into 2D and 3D CAD files to determine the measurements for fabrication" the authors said (ARM Architecture, 2015). The image on the façade is realized with white panels bolted onto black balcony slabs. The panels (up to 6 meters long and 2 meters high) are an engineered surfboard-like composite material 140mm thick: a PET foam core with fibre mesh and vinyl-ester external wrapping. The scheme is an image created by the contrast of black and white lines. The northern and western façades are an interpretation of a topographic map.
The third example is the Museum at Prairie Fire (American Museum of Natural History) designed by VernerJohnson Architects at Overland Park, KS, USA (2014). The great stone envelope is faced by another envelope that simulates fire. In fact, the architects wanted to create an envelope that embodied the colour, movement and regenerative power of fire. VernerJohnson Architects paired dichroic glass with a second shape-shifting material: Light Interference Coated (LIC) iridescent stainless steel, ultimately applying panels in a variety of colour and finish combinations. Glass panels are integrated with a dichroic film produced by 3M. The façade pattern is divided into large trapezoidal pieces (transparent and dichroic glass) and small rectangular pieces (iridescent stainless steel) on top. The colours are yellow, orange, green, blue and violet but they vary during the day, the changing of light conditions and the point of view of the observer: this is the typical effect created by dichroic technologies. Put together they create a contrast of hot and cold colours that simulates the flames of fire and create a dynamic effect of movement.
The last case study example is the "Pietro Barilla" Children's Hospital in Parma, IT, (2013), designed by Open Building Research. The double-skin façade pairs a colourful exterior layer with a simple, performance-driven interior layer. The outside layer features a series of 14-meter tall aluminum fins, spaced a meter apart along the hospital's north, east, and west elevations. The 250-millimeter deep faces of each aluminum fin are laminated in complementary hues, covering the full spectrum of a rain-

bow. When viewed from the exterior, the chromatic palette on the right sides of the fins shifts from warm to cool: red to purple to blue. On the left sides, the palette runs from cool to warm: blue to green to yellow. About 1,000 single-glazed, security-laminated, tempered lites, mounted both flush to and recessed from the outer edge of the fins, reflect the changing display of trees and foliage to the patient rooms on the building perimeter. The final effect is a façade that changes its colour depending on the point of view of the observer.

3. RESULTS: THE CLASSIFICATION

During the research process, following the analysis of case histories, we were able to find a series of strategies used to obtain a dynamic effect on static façades:
- images created by contrast of black and white or light and dark;
- patterns created by contrast of black and white;
- patterns created by colour contrasts;
- shapes created by colour contrasts;
- shapes created by variation of lightness and saturation;
- changes of colour gradient made with elements of different shape;
- movement simulated by particular shapes combined together;
- movement simulated by gradient of reflection.

Another parameter is the form of the façade: we may deal with 2D façades (flat façades) or with 3D façades where the complexity of the form is another element that affects the overall design and perception of the building itself.

4. CONCLUSIONS

It seems that the colour strategies to create a static façade with dynamic effect can be inferred from Op Art and Kinetic Art of the Twentieth Century. They consist in reproducing designs using pattern and light-and-dark contrasts, but also in creating very strong colour contrasts that enhances some forms and give a sensation of movement. In general, we can confirm once again the contemporary desire to oppose static things and play the flux of our liquid society (Bauman, 2000).

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Color Universes for the Regional Heritage

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ABSTRACT

A color universe is a conceptual arrangement of colors related to its origin, ownership, culture, and space, among others. It differs from a color palette and a color chart because of its metaphorical reference. We used this type of chromatic order in two architectural projects in the Region of Libertador, Chile. The first one is an interpretation center that will shelter the 11,000 year old archaeological and paleontological site in Tagua Tagua lagoon. The second one is another interpretation center related to the work of the famous chamanto poncho weavers, high-quality and beautiful woven pieces. Both of them add value to the cultural heritage of the region. A comprehensive color study was conducted in each site, including field visits, interviews, photographs, watercolor paintings, samplings and color surveying. The colors found were arranged into a color universe specially created for each project. The application of these colors to different supports, keeping a consistent project image, was a major challenge. We hereby present the full study, covering from the field visits to develop the color study and the data collection methods which were applied to the creation of color universes and, finally, their application to the project's global image: architecture, museography, graphic design and merchandising.

1. INTRODUCTION

The Regional Government of the O'Higgins Region has sought to highlight the value of its cultural heritage through the design of two new interpretation centers for the area.
The first one is intended for housing an 11,000 year old archaeological and paleontological site, where mastodon bones, as well as skeletal remains of smaller mammals such as deer, horse and rodents have been found. Human remains were also found in the place, which belonged to a culture now extinct. The site is in the same place where Tagua Tagua lagoon was located in the past, until it was artificially dried in the 19th century by a landowner of the area, in order to add hectares to his lands.
The second project will host the work of the famous weavers of chamantos, high-quality and beautiful woven pieces that were awarded by UNESCO with the Seal of Excellence in 2011.
The team in charge of the projects was comprised by more than 30 professionals and it was lead by the Architecture and Urban Planning Institute of Universidad Austral de Chile . They commissioned a color study for each of the centers, which included the creation of color palettes to be used in the architecture design, museography, graphic design and merchandising. The colors selected in the research were organized in what we have called "color universe", which is a conceptual-spatial structure of colors related to an origin, belonging and culture. The subsequent implementation of these colors to different supports, keeping a consistent project image, was a major challenge.

2. METHOD

A comprehensive color study for each project was carried out, which included more than two visits to both places, photographic records and watercolor sketches, on-site sample collection (natural elements and objects), and chromatic study with Natural Color System (NCS) of elements as the architecture, the chamantos, bones and arrowheads (in the case of Tagua Tagua), which was developed in the Natural History Museum and the Anthropology and Archaeology School of Universidad de Chile . In the case of the chamantos project, participant observation and in-depth interviews with several chamanteras were carried out. The elements which were not collected, such as sky, plants, shrubs, flowers and waters, were chromatically identified on screen as similar to reality as possible and trying to assure consistency in the final color chart.

3. RESULTS AND DISCUSSION

3.1 Color study for the "Tagua Tagua Paleontological Interpretation Center"

The architecture team worked with the concept of finding an "abyss of the colossal" ("abismo de lo colosal") when "breaking the mirror" ("romperse el espejo"), referring to the ancient bones found on the bottom of Tagua Tagua lagoon (the mirror) when it was broken or dried. The color study defines Tagua Tagua as a universe in itself, which is contained in its peripheral limits and is possible to be crossed through its rural roads. The sky above our heads, the earth under our feet. In the middle the distant horizon with its summits and mountains, and the near horizon of vegetation and architecture. This organization is not only spatial, but also symbolic. The sky is light blue (celeste in Spanish language), as the celestial. The human world is beneath the celestial. And under the human, the abyss of the colossal is hidden; there where the bones (witnesses), the arrowheads (treasures), the soils and, finally, the darkness and the black are. The color of the absent lake -the blue- is lacking in this cosmos but, nevertheless, it emerges transformed in everyday objects in the near horizon. In the region around Tagua Tagua, the blue color is unexpectedly present in such objects.

Figure 1: Color universe based on the vertical spatial organization of the colors found in former Tagua Tagua lagoon

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(2) Escuela de Antropología y Arqueología de la Universidad de Chile.

In their corresponding projects, the architecture team and the corporate design team apply this color universe coherently in relation to the proposed spatiality.

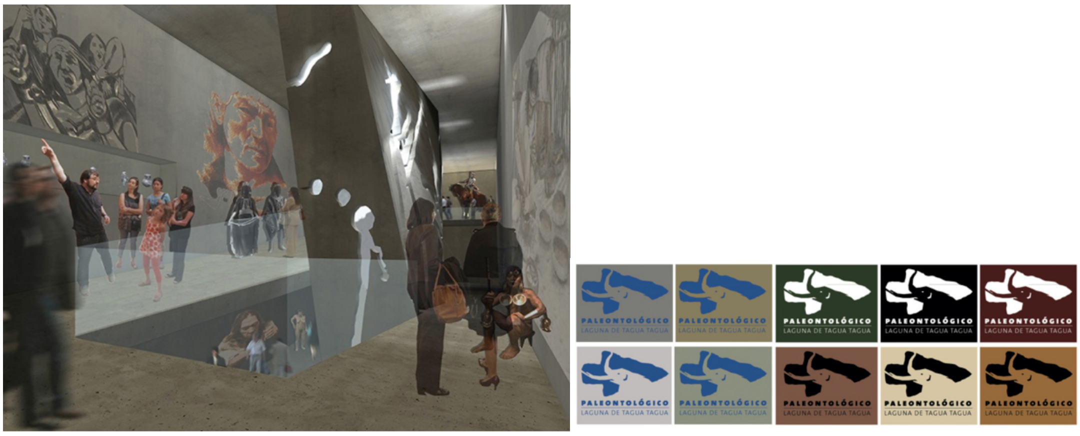

Figure 1: Color universe based on the vertical spatial orgaa Figure 2: On the left, interior of the architecture project. On the right, the logo of the Center. The color universe was used in both. nization of the colors found in former Tagua Tagua lagoon

3.2 Color study for the "Chamantos de Doñihue Interpretation Center"

The architecture team worked with the concept of "gardens in the sky" ("los jardines del cielo"), making reference to the Chilean country house, which is built around a central courtyard. Based on the imaginary related to the landscape of the chamantos and the colors found in the woven pieces themselves, a color universe was developed. This process was also based on the geographic orientation of light north-south and east-west, where a group of colors was assigned to each cardinal point as follows: north-light warm-yellows, south-light cold-blues, east-born the white-light, west-dies the black-light. The greens and the soils from the central valley were placed between the day and the night, crossed from north to south by a stripe of reds from wines and flowers

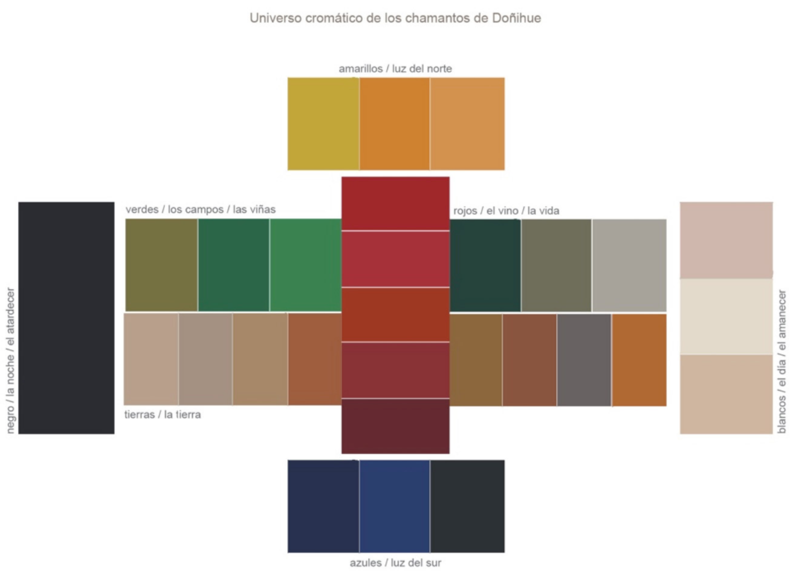

Figure 3: Color universe based on the spatial geographical organization of the colors found in the chamantos.

Figure 4: On the left, north facade of the architecture project. On the right, logo of the Center. The color universe was applied to both.

4. CONCLUSIONS

The color universes of both projects present a spatial organization that enables their placement in relation to the specificity of each project and place. Both universes include certain basic colors, which are found and selected from the research developed. However, each of these colors can be extended in palettes, according to the requirements of the architecture, museographic or design projects. The interesting aspect of utilizing a color universe in an architecture project, instead of using a color palette only, is that the universe has the same internal consistency as the project.

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Colours of a Neighborhood: Methodological Questions and Challenges

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ABSTRACT

This paper addresses methodological questions that arise from large-scale architectural colour research. The paper will discuss some preliminary findings of my ongoing PhD. The PhD project represents a practice-led study concerning the colour planning six residential areas built during the last twenty years in the greater Helsinki metropolitan area in Finland.
The paper will focus on one of these sites, Aurinkolahti, which is situated in the eastern part of Helsinki and was built between 2000¬–2016. In this pilot study, I tested two research methods, for enabling architects, artists and colour designers to conceptualize their experience of architectural colours, particularly in terms of the design process. The first method referred to as colour walk, is an ethnographic walking method. Colour walk allows the designer to provide words for non-verbal experience of colours in architecture and to create concepts for the artistic colour design process. The second method, visual ethnographic photography is both a method for documentation and an approach for conducting artistic research concerning the atmosphere of architecture focusing on colours. Designer-photographers act with their own perceptions and knowledge documents and photographs the area in order to visualize their thoughts.

1. INTRODUCTION

In Finland, the colours of a new neighborhood are specified by the building description stipulated in a city plan. The architects Hannunkari and Mäkipaja designed a specific, detailed colour plan for the east side of Aurinkolahti in 2002–2003.
The paper will present and discuss the methodology used in my practice-led PhD on large-scale colour design. In this pilot study, I use two new methods for studying, conceptualizing and visualizing an actual architectural colour experience.

Figure 1. A view of Aurinkolahti. The facades of the buildings near the canal in Aurinkolahti are yellow and white. The left side of the canal forms the border of the neighborhood, with the right side being covered by a park grows behind which lies a pine forest.

2. METHOD

The methods presented in this paper are visual ethnographic photography and the colour walk method. The photography method is based on Pink's visual ethnographic method (2013), where the photographers' own knowledge and perception are involved in the photographic process.

2.1 The Colour walk

The colour walk is an ethnographic walking method that can involve 3-6 colour or architectural professionals in a documented, open discussion and guided through ten open questions while walking along a pre-determined route on the site. The conversation is recorded by a video camera and digital voice recorder. The participants consisted of a selected group of architects, colour researchers, colour planners and artists, who have existing professional knowledge about colour and architecture. Four professionals participated in this pilot study.

The methodology used in this study is based on Kusenbach's (2003) street phenomenology, a "go-along" ethnographic research tool. A similar method has also been used in cultural anthropology by Suopajärvi (2014), who used a "walk-along" ethnographic method to understand how senior citizens experience their daily surroundings in a city.

This paper focuses on colour design as a design process, not only on the experience of an inhabitant. For this reason, it is essential that the colour walkers be professionals in order to conceptualize these perceptions, experiences and the design process in professional terms. The atmosphere during the walk and discussion is important. It is not a critique about the architecture or compositions, but rather aims to understand the built environment through their role as a colour designer or architect. For example, some solutions may not have resulted from the colour decisions of designers. Instead, it could simply be a question of money or a narrow palette of colours imposed by the building materials.

2.2 The photography method

In light of my background as a landscape architect, it is not surprising that the second method involves taking photographs of buildings during all four seasons within a landscape of different colours. This method gives equal emphasis to both the buildings and the environment into which the buildings have been placed.

This photographic method is based on the work of colour designers and researchers, such as the colour analysis of Lenclos and Lenclos (1990) as well as the results of a study by Fridell Anter (2000: 40), who explored the factors involved in our perception of colour. Another study influencing my work is the well-documented colour design process developed by Smedal (2001), which showed the impact of only two colours, only white (snow) and black (darkness) backgrounds, on the potential colours for buildings in Spritsbergen, Norway. A similar climate and landscape as that found in Aurinkolahti was studied by Fridell Anter (2000: 198). Her research focused on a single building in the Uppsala region of Sweden, whose backdrop changed with the seasons from winter brown to spring green, summer green, autumn green and winter white.

Figures 2 – 6 show examples of my photographic method used in Aurinkolahti, Finland. The effect of seasonal changes in the background are shown in Figures 2 and 3, while the series of photographs in Figure 4 highlight the importance of the colours of other buildings in the background. The influence of the atmosphere created by entrances and a sequence of space are demonstrated in Figures 5 and 6.

Figure 2 and 3. The relationship between the colours of the landscape, buildings and the older surrounding architecture: Winter white and summer green.

Figure 4. The colours of the facades influenced by neighboring buildings

Figure 5. The atmosphere created by the colours of entrances.

Figure 6. The impact of the sequence of spaces on the atmosphere of Aurinkolahti (Finland).

3. RESULTS AND DISCUSSION

This pilot case study of Aurinkolahti demonstrate not final results, only preliminary findings. During the colour walk, the four professional participants in colour and architecture discussed their perceptions and formed numerous concepts concerning the connection between colour and architecture, including the colour and volume of buildings, the atmosphere, colour of the materials, aging of the building materials, landmarks, colour in the four seasons, homogeneity or variety of colour, and sequence of spaces.

Although colour design is typically a non-verbal artistic process, walking around allows designers the opportunity to open and decode actual concepts. After coding the colour walks of six neighborhoods, it will become possible to expose the hidden, non-verbalized concepts common to the four professions represented by the participants. The following observations demonstrate discussion of colour walk:

"The facades have a two-dimensional composition, what continues perhaps around the corner."

"All the buildings have the same volume. Colour has a role as a decoration, and colour have used to break up the volume of the building."

"I have visited this area during the winter and leafless time. The colours worked well, though yellow and grey were too dominant in the white wintertime."

"The landmark is one floor higher and the only building with brick facades, the others are plastered. The colour solution should be stronger to make the landmark stand out."

"It's difficult when different materials have the same colour, since all the materials will age differently. After a few years those will look ill-conceived."

Photography visualizes the colours of a neighborhood, its architecture, landscape and relationship to older architecture. It is more than documentation. The photographer's own experience and knowledge becomes one part of the photographic process. Lenclos and Lenclos (1990) photographed buildings and simplified the colours of façades, windows, doors and roofs. However, architecture has increasingly become more interested in other elements than windows or doors. (Figure 4.). For example, the entrance to buildings is more than just a door (Figure 5.).

4. CONCLUSIONS

This pilot study provides a new research method to understand a highly complex relationship between the colour, architecture, space, landscape, materials, seasons and distances in urban environments. The two methods proposed in this study give designers tools to verbalize concepts and visual elements. The colour walk provides a method to conceptualize the non-verbal experience of architectural colours on a broader scale of an entire neighborhood. Walking around the site offers researchers vistas as well as sequences of the spaces and atmosphere of an area. The colour walk is enhanced by photography, which visualizes the relationship between colours, landscape, buildings and older architecture in different seasons.

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Analysis of the Urban Landscape to Integrate Architectures with a Visual Impact that are in Close Proximity to Historic Monuments

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ABSTRACT

This study is part of a research project whose aim is to put forward innovative architectural solutions to improve the visual integration of architectures with an impact on the urban landscape, evaluated in a virtual reality environment through immersion. Some buildings in Valencia historic city center have been taken as case studies. In this paper we discuss certain architectural resources that have been useful to develop different landscape integration proposals based on three aspects: a historiographic study of the image from the past, a study of the current formal reality and a study of *other similar contemporary examples.*

1. INTRODUCTION

We have taken certain architectures from the historic centre of Valencia (Spain) as case studies, located in a designated area of protected urban landscape, close to two historic monuments of cultural interest: the Serranos Gate, part of the former high-medieval city walls (1398), and the former Carmen Convent and the Santa Cruz Church (1281) in the Carmen district of the city. The buildings and facilities considered to be visual blights require treatment that ranges "from regulations that require the treatment of visible dividing walls, to not being in compliance with building regulations". The buildings in question are used as communal housing and must be substituted as they are not in keeping with aesthetic characteristics of their surroundings, either because of an excess in the volume built, surplus number of floors, presence of unsuitable elements on their façades or other aesthetic matters. The replacement of these dwellings will take place once the buildings have come to the end of their useful life, something which will not happen for a considerable time, given that we are talking about buildings that were constructed a relatively short time ago. Furthermore, these replacements have very complicated economic and social consequences. We therefore believe that it is feasible to find simpler architectural solutions to the buildings whose façades look out onto public spaces that will improve the appearance of these dwellings and facilitate a certain degree of landscape integration. We will turn to the visual possibilities of colour and material in an attempt to fragment the form to enable it to better blend into its urban surroundings.

2. METHOD

A series of photomontages were created, each with a different architectural solution for the same building to be shown to experts in this field, as well as to the general public. Based on their feedback, we are able to evaluate the degree of satisfaction for each proposed solution and indicate certain design criteria that will facilitate the

(1) "Special Plan for the Protection of areas surrounding Assets of Cultural Interest: the Serranos Gates, Santo Domingo Church and Convent, Museum of Fine Arts (former S. Pío V Convent), El Temple Monastery, Palace of Justice, former Carmen Convent and Santa Cruz Church, and the Condes de Cervellón Palace" (PEP-08)

work of the architect when undertaking urban landscape interventions, which from a heritage perspective, are particularly sensitive. The buildings are observed within a virtual reality environment using 360 sphere panoramas. The ability to direct one's gaze in any spatial direction undoubtedly improves the sense of immersion compared to static photographs that are generally used in Public Participation Plans (PPP). Successfully integrating buildings with a visual impact requires the careful observation of the site together with a thorough understanding of it from a formal, cultural and historical perspective, even more so if we consider that urban landscapes in which we are going to work are conditional on the extent to which one wants to draw attention to the historical monument found there. Obviously, architectural integration should not abandon the use of the visual languages that are particular to contemporary architecture or the latest tendencies and developments.
In our work, we have found certain architectural resources that would facilitate integration based on three aspects: a historiographic study of the image from the past, a study of the current formal reality and a study of other similar contemporary examples.

2.1 A historiographic study

The historiographic study allows us to learn what aspect an urban area had at the historical moment in time to which the protected historic monument belongs. It enables us to discover the formal attributes that relate to the local culture, which could well be significant: historical events, iconic elements for the collective imagination, etc. (Serra et alt. 2016b).

Figure 1. a) Actual condition of the building with visual impact. b) Photograph of the same corner with the previous building during the great flood, Valencia, 1957.

2.2 The study of current formal reality

The study of the current formal reality involves an analysis of the formal attributes that relate to the type of architecture: height of the building, proportion, size of recesses, seriation, hierarchy, ornamental elements, building materials used, textures, etc. (Serra et alt. 2016a).
Some authors distinguish three components of landscape: physical, biotic and human (Escribano et alt. 1991) and define the visual properties of the landscape, understood to be the "set of features that visually characterize a landscape or its components and which can be used for analytical or differentiating purposes". Said characteristics refer to "colour, form, line, texture, scale, dimension and spatial character" (Español-Echaniz 1992). In any case, the colour and materiality are considered to be first-rate aesthetic constraints and are acknowledged as such in international literature, as well as in the subsidiary regulations of most municipal councils (Cañas-Guerrero 1994).

2.3 The study of other similar contemporary examples

The study of other similar contemporary examples involves analyzing questions that relate to the aesthetic language to be used: realism, abstraction, elements of the immediate reality, etc. A vast number of architects have developed interesting colour interventions to establish a dialogue between architecture and its immediate surroundings. Not only do they take into account the similarity between the colours, but also in particular the laws of harmony and the ability of colour to cut across the composition of the architectural form: the perception of geometry, dimensions, visual weight, texture, etc. The early experiments of Albers, later taken up by others such as Swirnoff (1992), showed that colours tend to draw closer or draw apart when placed right next to each other, creating optical illusions which become significant when applied to the surroundings (Billger 1999).
Some of these examples could be described as in coherence with architectural form. In this group and highly acclaimed among the contemporary projects are the works of Friedrich Ernst von Garnier, with colour interventions in already constructed buildings in order to contextualize them within the landscape, without necessarily recurring to the use of mimesis. Also of particular note was the project by Grete Smedal (2009) in the municipality of Longyearbayen (Sweden), virtually at the North Pole, where a study of the colours of the landscape over the course of the year and the participation of the local community were key elements of the proposal.

Fig 02. a) Façade with historicist trompe l'oeil. b) Mirror Façade reflecting the Sta. Cruz church

Some others are incoherent with the architectural form, with no formal relation with the building. In this trend we find not figurative works, which do not refer to any recognizable pattern, generally being a composition with spots, shapes and colours that each viewer can interpret individually. Of the many artists working in this field we should highlight Maya Hayuc, Nuria Mora and Sten&Lex. Some others opt by realistic figurations to emulate a trompe l'oeil, such as Mehdi Ghadyanloov, or other anamorphisms (Felice Varini, Aakash Nihalani, Boa Mistura). And of course there are still outstanding colour proposals on architectures playing with distortion and movement (Fernando Peixoto or Carlos Cruz Díez).
There is also noticeable a tendency towards ecological solutions, with different specific results. In one hand using environmentally friendly materials (recycled, with low carbon footprint, etc.), which provide a natural/ecological aesthetic to link architecture with its environment. On the other hand a remarkable increase of vertical garden solutions, with real green to smooth the visual impact of tough buildings.

4. CONCLUSIONS

Three different studies have been pointed out to reach innovative architectural solutions to improve the visual integration of architectures with visual impact on the urban landscape: a historiographic study of the image from the past, a study of the current formal reality and a study of other similar contemporary examples. With these three resources, we have developed specific solutions for some buildings located in the historic city center of Valencia, and which can be assessed in a 4D virtual reality environment through immersion. An application called "LandArch: evaluación del impacto visual" is available to download for free in AppStore and users may observe the sceneries in their own personal devices, also with the help of Google Cardboard glasses.

Fig 03. a) Garden Façade b) Façade with Brandhosrt Museum solution (Sauerbruch Hutton)

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Paintings on Residential Façades: colouring out change, hope and renewal to the public space

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ABSTRACT

Today, when we think about paintings in public space, possibly due to their strong presence in the urban environment, intensity of their colours and watch words, graffiti is the first thing that comes to our minds. My research is focused on actions that also make use of the wall as support for visibility, and as place for public life (Brighenti, 2009), although they emerge from different processes and generate a distinct visual culture. Thus, three actions in focus and analysis - "Greening and Painting" (Tirana, Albania), "Singing and Painting the Epiphany's Eve" (Meca, Portugal) and "Livecolour Colourinhabiting" (São Cristóvão, Portugal) - building public space by non-disruptive actions to local authorities, involving different authors and inhabitants' participation. Regardless of their very different origins, they have the transposition of a message of change, hope and renewal to the walls in common. Analyzing and comparing the differences among these three actions, I propose to think about levels of peoples' participation, image results, benefits and difficulties, and consequently, to draw attention to the potential of each painted message in the construction of public space.

1. INTRODUCTION AND METHOD

The majority of the research herein presented is part of my PhD in Design, "Co-Design of participatory actions in the painting of residential facades: expression of individual and collective identities in the construction of public space" developed at the FA- University of Lisbon and FADU- University of Buenos Aires.
The present paper aims to reflect on three particular actions of paintings on residential façades, their images and processes, which have a promising message of change and hope in common. Methodologically, after a literature review, studying the actions "Greening and Painting" and "Painting and Singing the Kings", was followed by non-participatory field research, which consisted of a privileged opportunity to collect visual material and local field notes. During the visit to Tirana, Edi Rama (the mayor, artist and author of "Greening and Painting") was interviewed at the City Hall, on 23th March, 2010. The paintings were studied in Meca on two field visits (4th December, 2012 and 5-6th January, 2013). On the second visit to Meca, it was possible to follow and integrate within a group of painters over the night, when the annual one-night-ritual of painting and singing was performed. "Livecolour Colourinhabiting" consisted of action-research in immersion created by me, firstly implemented in the village of São Cristóvão, from October 2011 to September 2012. The process of the action research had four phases, specifically designed to promote different possibilities of participation: Presentation, Negotiation, Paintings and Evaluation, (see a compact description in the theses, Conte (2014). Thus, besides the co-work to produce drawings and paint them on walls, several reflexive interviews with participants and non-participants were performed, along with field notes, in order to evaluate the different features of the process and to make the conclusions herein presented. More recently, from January to August 2015, "Livecolour Colourinhabiting" was replicated in the city of Montemor-o-Novo, in the context of post-doctoral research and of an artist residence (an invitation made from the NGOD Oficinas do Convento) drawing out similar conclusions.

3. THE THREE ACTIONS': RESULTS AND DISCUSSION

3.1 "Greening and Painting" - Tirana, Albania

"Greening and Painting" was presented by its creator Edi Rama (artist and mayor) as a political intervention, involving among other actions the painting of some façades of Tirana. The new colours were a manifesto, they announced the end of the oppressive times, an affirmation of a new political regime, a change from gray to vibrant colours in bright red, blue, lavender, and gold. The first group of paintings was done in 2000, on facades of state buildings in the city center. The mode adopted by Rama was "free-style" in geometric shapes, completely autonomous and detached from the original colours and forms of the architecture. It should also be noted that in some buildings, the paintings were only applied on the front façade, while the inside of the blocks was left unpainted, strengthening the contrast between "before" and "after", suggesting autonomous and spontaneous paintings by its inhabitants. Initially, the process was not participatory at all. Later, after some controversy, (Nesbit, 2004) the population was consulted. Although 40% felt discontent with the paintings, 90% wanted its continuation.
By the time of the field work (2009), the existing paintings, were located mostly in buildings from the dictatorship period, especially in a circular line around the city center. Even if we could see a few buildings spontaneously painted as an inhabitant's way to join the colour movement, we should also ask to what extent inhabitants become alienated from what is happening in the streets? Was the reason for the change always understood, considering that many painted walls were still missing sheetrock? What would be required to have a larger adherence to the colour movement? Nevertheless, Tirana is far from being the "dead city" of 2000, occupied by many illegal constructions, with no pavements on streets, trees, or street lighting. Also, through colours, a sense of hope, and promise of transformation was created. Tirana was on its way to becoming, in the words of Edi Rama (Sala, 2003) "a city not of fate, but of choice."

3.2 "Singing and Painting the Epiphany's Eve", Serra de Montejunto, Portugal

"Singing and Painting the Epiphany's Eve" is an enrooted regional popular ritual, an ethnographic manifestation that ends the Christmas cycle, evoking the arrival of the Three Wise Men at the birthplace of Jesus (still existing in some villages of Serra de Montejunto, with its strongest expression in the Portuguese village of Meca). During the Eve of the Epiphany (January 5th to 6th), a group of hooded men gather spontaneously to walk the streets of the village, going from door to door to paint drawings on the white façades and sing to the Kings. Drawings are composed mostly of naive hearts and pots, with bundles of flowers, symbolizing the couple and the number of family members (corresponding number of flowers). Near the drawings the date is carefully placed, as well as, the initials F.R. (from Felizes Reis /Happy Kings), or V.R. (before Viva o Rei /Long Live the King and now Viva a Républica /Long Live the Republic). It has to be noted that during the dictatorship times, choosing V.R. instead of F.R. was considered a hidden political affirmation.
These drawings are mainly done in two colours as a symbolic code (Chevalier & Gheerbrant, 1982): red ochre for joy, passion, and life, and indigo blue representing sadness and death, (all blue drawings are just used if the family is mourning and all red drawings if the couple is newly-wed. (Melo, Guapo, & Martins, 1991). The very act of painting is also ritualized in the painters' movements, with no stencil-masks or guide lines, just helped by memory and visual culture. The information to compose

the drawings (number of flowers, hearts, colours) is given there and then by a family member working as a kind of "census on the spot" The performance is only carried out by groups of men, called the "reizeiros". In the days before the ritual, some owners carefully prepare the wall for the new paintings, "cleaning up" the old ones. The ritual whose origin takes us back to the Middle Ages, or even to the Romans, possibly linked to the festivities in honor of Janus, still evokes the principles and purposes of the cycles and the arrival of the new year. The symbolic power and importance of giving colour to walls is reaffirmed by a performance with a spiritual, sometimes political role, giving a special public place to life's changes.

3.3. "Livecolour Colourinhabiting", São Cristóvão and Montemor-o-Novo, Portugal

Based on the idea that, a participative construction of the space in which we live, is crucial for our quality of life, the participatory action research, "Livecolour Colourinhabiting" challenged the inhabitants of São Cristóvão and Montemor-o-Novo, to paint pictures and local verbal expressions on their door-frames, windows, chimneys and skirtings of the front façade. The starting point proposed for these drawings were significant personal objects, expressions of oral tradition or individual thoughts evocative of emotions or aesthetic meaning for the participants. After the public presentation of the action, several encounters between the participants and myself were taken, corresponding to the negotiation phase. During those encounters – pointed out by the participants as the most difficult and important part of the action - as objects and phrases were being brought in, and the desires for the facades were "confessed", the meaning and the form of the drawings were molded in a co-authorship. Later on, the majority of the participants cooperated both in the paintings, as in cutting stencils, in calligraphic design and final field changes and decisions. The paintings were intentionally done at the same time as the preparations for the annual festivities, which involves the local ancient annual act of white washing the façade. Recognizing the constant care of the image of the house as part of the local visual culture, in the same way, "Livecolour Colourinhabiting" could not leave people indifferent, despite the weight of the traditional "pure white" facades.
Thus, 19 façades were painted according to the village's existing colours, resulting in participants' own words such as "beautiful", "subtle", "appropriate interventions for the humble local architecture" something that "expresses the soul of who lives in the houses". After the evaluation phase, it became explicit that participants and non-participants identify themselves with the "new image" of the village, and feel a personal recognition with the painted drawings and phrases. To understand this wide appreciation, recognition and participation, we have to remember the process, the time given to introduce the action, to listen before drawing, to wait for the participant's trust, enabling them to bring truly personal objects, which were mostly associated with the place, or handicrafts produced by a family member and / or kept with care. In the same way as objects, selected phrases consisted of special poems, sayings used within the family, popular sayings, and ideals, many of which focused on human values and family.
The participation in "Livecolour Colourinhabiting" made it possible to interweave practical actions with the participants' personal lives and memories in the construction of a public space, interlinking the "doing", "being" and "living" aspects of the self. Through this, a creation of a participant's genuine message, made by their own singularities was enabled, surprising those who live there, and who come to see it. Without this complex multi-layered involvement of the participants, these results

would not have been possible. The world view of the participants, combined with local realities, common values, ideals and affections, propose a new message of hope throughout a construction of a more human society. “Livecolour Colourinhabiting”, although respecting and integrating memory and tradition, seems to leave a contribution to the future ability of dreaming and aspiration in people and on their walls.

4. CONCLUSIONS

We have seen three original processes which give colour and visibility to a message of change in the public space, by means of paintings on the walls. Returning to the manifesto “Greening and Painting”, even if it had had high visibility by using the large painted surfaces with surprising colours, and high dissemination and projection among artists and the political community, it is also true, that this process compared with the other two studied cases, would have led to a greater distance between the population and its proponents. “Painting and Singing the Kings”, on the other hand, shows an emancipated action made by inhabitants in total autonomy. The painters-reizeiros update the messages through codified colours and drawings, similar among each other, strongly encrypted for centuries, where it is difficult to introduce novelty. If the first brings change, the latter points out that change exists, and it is renewed every cycle. If the first paintings trigger a discussion about public space, the second paintings live it and follow a ritual, a convivial party, a moment for reaffirming ties. The beauty of the action “Livecolour Colourinhabiting” is that it lies somewere between these two actions. While it is neither a tradition, nor a disruption to the local culture, it embraces both innovation and inclusivity. It is a proposal to involve and guide participants in the construction of a new image and message for their public space. “Livecolour” goes along with an annual ritual of painting the façade in white, which rescues local cultural elements, and occupies forgotten aesthetic places (such as chimneys) but also introduces poetry to construct a novelty, a collectively painted message, through participants’ voices to all inhabitants and visitors. The process was an exercise for public participation and care of the public space, enabling the visibility of relational and affective values, expressed by the individual messages, opening doors to the ability to dream of a more humanised world.
Some important final questions can now be posed. Is it possible to have a truly inclusive construction of public space, when the message of its change is alien to the users? On the other hand, when the rules follow an established code, becoming predictable among painters and inhabitants, how can they escape from the stagnation or impoverishment of the images and messages? The answer to those questions seems to be somewhere in between: the work oriented by professionals of pubic space, giving new tools and power to participants, the compromise between originality, surprise, shapes, colours and innovation, the way to achieve a more sustainable construction of images, places, and broad sense of public space. It is worth the long investment of time and care to give shape to individual singularities, to culture, and to the “comum” Silva (2011) by fully participated processes. This seems to be the answer to make participants real co-authors and actors of change and aspiration.

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Analysis of Visual Ecology and Environmental Strategy by Color in the Towns and Cities. Chromatic Study of Architecture and Urban Planning

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ABSTRACT

The color image of the city is rooted in its geographical space, but changes over time: its modifications have always been due to the evolution of architectural and urban planning of the city and are still constantly changing. If all the visual elements of urban space and land territory compose the integral image of the city, the color remains an essential part of the architectural, cultural and social heritage. Today, a city, a town, aspire to offer their inhabitants a high quality of living environment while respecting its geographical properties, landscape and architectural culture of their own. This is why the debate on the sustainable town must include a chromatic environmental strategy. At present, designing color in the towns & cities is part of new planning ideas and urban innovations.

1. INTRODUCTION

The intelligence in the choice of color codes and chromatic harmonies can revitalize urban space by promoting a sense of security and serenity among citizens. It results to the ecology of color as a major constituent of the environmental project to be included in the global project of sustainable development of the town & city. This approach earns the esteem of architects and designers for whom it seems obvious. It allows updating of knowledge on the visual qualities of the city and its local characteristics with the "in situ" study of existing colors, their synergy, also through the analysis of key harmonies of each place, and environmental design that study a color interaction with architectural forms and urban composition. It identifies the "genetic heritage" and creates visual pallets respecting the "spirit of the place".

This approach is also social because it takes into account the preferences of the population of the city. The harmonization of city centers with their peripheral and industrial areas and their landscape, the development of their dominants or visual accents can break the feeling of isolation and of disproportion. This environmental strategy allows the continuity in the perception of the town or city: to analyze the overall image of the city and of each of its neighborhoods, and of its districts and their buildings, and even the design of street furniture, landscape qualities and setting of artificial lighting. All this should have a color consistency in order to form a harmonious urban area. As the image of an ecological system, this strategy will prevent cases of visual pollution (which makes no less damage than those of air, water or noise pollution), but also this programme will help restore some past mistakes and to upgrade the ancient heritage by harmonizing it with contemporary interventions. It will create an environment of good chromatic quality for new neighborhoods by integrating new national and international cultural contributions, and therefore leaving the door open to creation. Urban color, rich and complex, lively and full of meaning will participate in the image of the town/city of the XXI century, thus becoming more sensitive and human.

2. METHOD

Chromatic study of inhabited spaces as well as knowledge of the local historical heritage is fundamental to developing a strategy in reconstruction, restoration or rehabilitation. The method and the results of investigations devoted to the color image of the city will be an indispensable part of the training of architects, urban and landscape designers and artists. The mission of the colorist is to conceptualize a chromatic scale plan of the city that responds to the request of the town center revitalization and allow the renovation of the existing façades that respects existing geographical and landscape context. The proposed color palette will reveal a specific local character of the territory and take into account the architectural features of previous epochs. It will become an important complement to the revision of the Local Plan of Urbanism with the obligation to use existing local materials while strengthening the characteristics of the place.
This mission includes three main areas:
1.1. Analysis of urban and historical part of the city (Figure 1).
1.2. Regional and landscape analysis (Figure 2).
2. Conceptualization of urban morphologies: Operational Plan (Figure 3).
3. Definitions of chromatic harmonies and presentation of the work.

Figure 1. The experimental diagnostic of existing colour palette

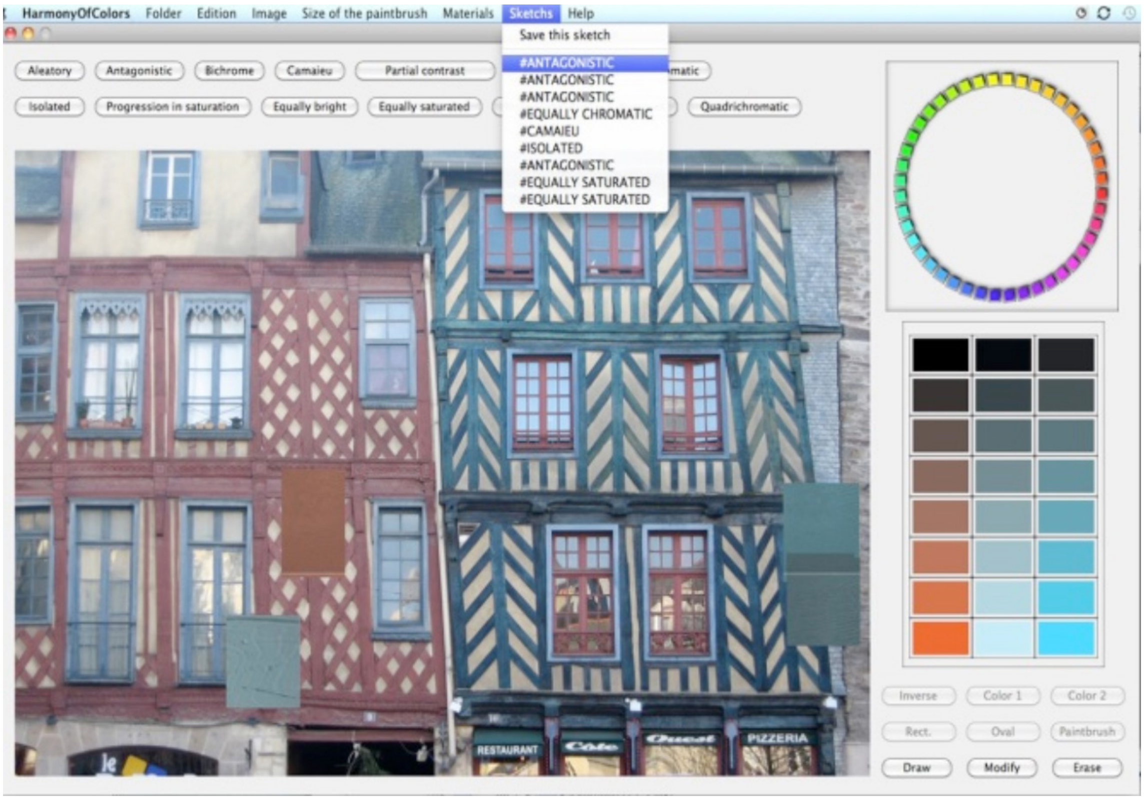

Figure 2: The process of regional architecture and landscape visual analysis with help of "Harmony of Colours" software

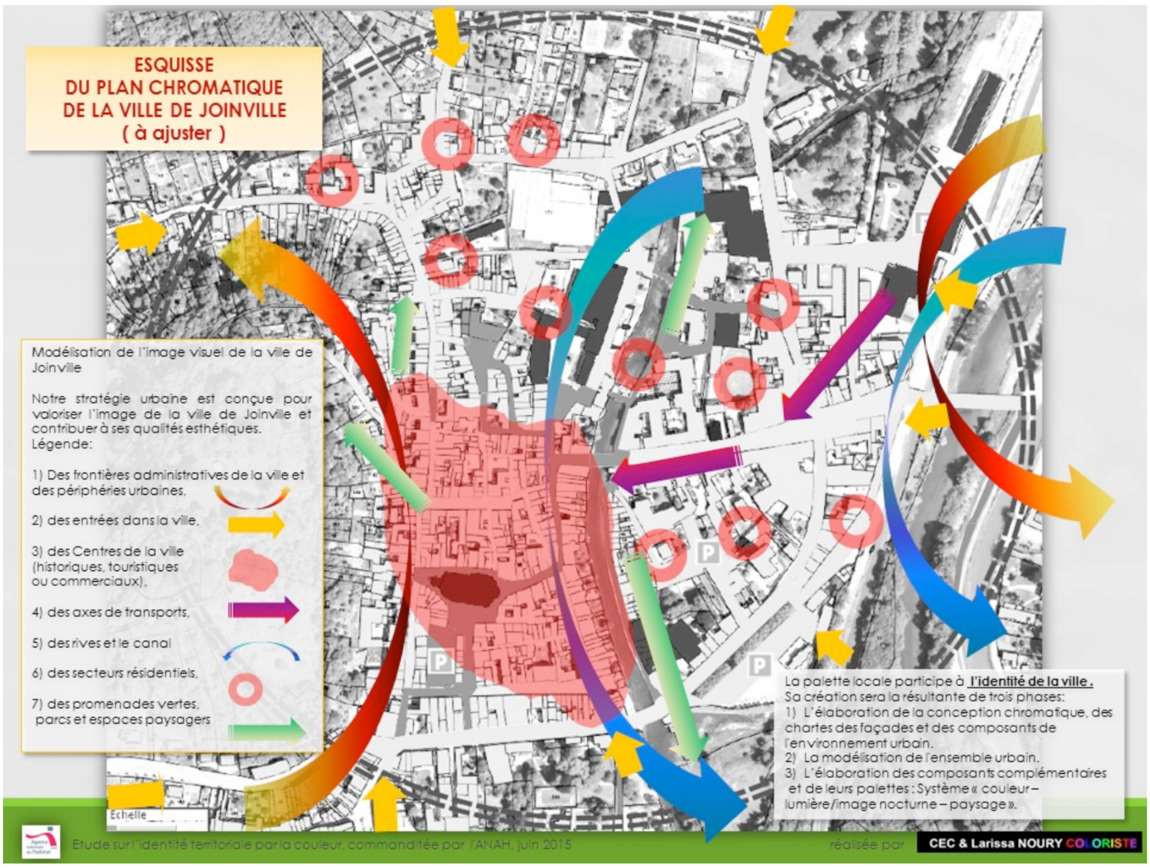

Figure 3: The Conceptualization of urban morphologies: Operational Plan

3. CONCLUSIONS

The search for a visual balance provides a specific identity, context and an atmosphere that are able to create a unique image and make the city attractive. The analysis of visual ecology and colors of environmental strategy will be part of an overall investment programme in the development of territories and enhancement of the urban fabric as a whole.

The results of chromatic study on the entire territory of the city carried out in sectors in the different neighborhoods based on the environment of urban and landscape analysis will:
- Improve the quality of architecture in the growing development of the city;
- Help architects, designers and investors understand the wishes and objectives of the Region and its people regarding the qualities of the new developments;
- Provide a database, tools and means to make an analysis of the existing state and to make proposals to improve the quality of environmental design and ensure more effective urban planning;
- Maintaining in the long term this planning.

An urban colour reflection will allow not only a global vision of city's territorial but also the harmonization of its centers with devices and industrial areas. The harmony of the urban landscape and its color consistency will be composed of various elements - architecture, landscape features and the "fifth facade", street design and lighting at night - to form an entity. The synthesis resulting from the chromatic study of the city will offer specialized and streamlined pallets and become a simple and fundamental tool of work to be able to form a harmonious whole while respecting freedom of expression and the choices of the owners. The determination of chromatic harmonies as an essential stage in each project will offer to architects and residents a wide variety of solutions whenever new diverse ideas and proposals will give a creative, innovative and personified character to the image of the city.

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Perceived Colour and Colour Perception

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ABSTRACT

The nominal colour of a façade is rarely perceived as the exact same colour, as the hue and nuance will be perceived differently depending on different variables, e.g. observer and surface properties, distance and angle, surrounding colours and light conditions. Whereas the nominal colour of a façade in a built environment can be measured and registered, the perceived colour –and how the façade colour is perceived in the overall gestalt– is rarely documented. The identities of the majority of Norwegian towns and cities are foremost associated with painted façades, with chromatic colours in combination with façades in nuances of neutral colours. However, counter to this long tradition of chromatic and achromatic variation, Norwegian architecture points to a dramatic change in the colour pallet towards a perceived uniform, achromatic pallet and/or use of strong chromatic colours. As a countermeasure to these tendencies, The Municipality of Trondheim co-operated with NTNU in a pilot project to do a colour registration of façades in the historic city center. The driver for the pilot project was to create a colour archive and to identify a more specific colour pallet for the city in general. This study aims to make practical use of established and published research and colour methodology by Karin Fridell Anter and Grete Smedal to form a general colour guideline. The overall aim for the general colour guideline is to be publicly accessible, and to be of practical use for developers, architects, homeowners, etc.

1. INTRODUCTION

In a cityscape, we never experience a façade colour isolated from its surroundings, and the nominal colour of a façade may be experienced very differently depending on building criteria, location and time of observation. Colour regulations or guidelines in cities – if any - are based on nominal colours alone. This may work well for repainting or rebuilding in a specific location, but the nominal colours might be misguiding if taken out of the original context and used as a general colour guideline for a city.
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 in the colour pallet towards a perceived uniform, achromatic pallet . As a countermeasure to this tendency towards greyness, The Municipality of Trondheim co-operated with NTNU in a pilot project to perform a colour registration of façades in the historic city center. The colour palette in the city center is characteristic for the region, and as the city center contains the majority of buildings protected by regulation governed by law2, the drift towards greyness1 that is evident in other parts of the city is less apparent.
Traditionally, the limited pigments available were chosen and mixed on the building

site by experienced and qualified professionals. New technology and the introduction of synthetic pigments, the wide range of colour choice is today often in the hands of more unexperienced consumers. As less than ten percent of the city's total building mass is under colour regulation governed by law , there is a need for a guideline that appeals to the public of a more general, practical use.
The aim for the pilot project was to create a colour archive and to identify a more specific colour pallet for the city in general, and to find a way to communicate this to make the guideline generally accessible. The guideline aims to be on a need to know basis, and to inform as well as inspire. The methodology chosen are research by Karin Fridell Anter and by Grete Smedal.

2. METHOD – NOMINAL AND PERCEIVED COLOURS

The nominal and the perceived colours of the facades were determined by the use of the Natural Color System (NCS) , and based on determination methods developed by Swedish researcher and architect Karin Fridell Anter . Similarities in culture, climate and building materials suggested this method to be potentially valid also for Trondheim, and if so, the results from the extensive research of 3600 facades could be of valuable use in forming a general guideline for the city. The registration contains mostly facades in traditional façade materials of painted timber cladding and rendering, but includes facades in the more modern, commonly used materials such as brick or façade panels. Out of the 400 buildings registered for determining approximate nominal colours, 40 buildings were chosen as reference buildings for determining perceived façade colours.

2.1 Nominal Colours of Trondheim

Short definition of nominal colour (also known as inherent colour): the colour if it was observed under standardized viewing conditions3.
Nominal colours of approximately 400 buildings were determined by using the NCS Index, placing the colour sample directly on the surface and visually assessing the approximate NCS notation for the façade (Figure 1). The reliability of this method is not designed to provide accurate colour notations, but to determine approximate nominal colours. The collect data of nominal colours were additionally used to assess tendencies of perceived colours.

2.2 Perceived Colours of Trondheim

Short definition of perceived colour: the colour the observer perceives at any given time and in any given light and viewing condition3.
Perceived colours were determined by comparing the façade colour to the NCS atlas, visually assessing the approximate perceived façade colour (Figure 1). The 40 chosen facades all had timber cladding with vertical panels of similar width and depth, and they were all observed in three light situations; direct sunlight, partially overcast and overcast. The viewing conditions, such as distance, orientation, light direction, sun elevation and angle, etc. were the same in all viewings. The main purpose of the study was to validate if the tendencies identified in Fridell Anters work could be used in the colour guideline for Trondheim.

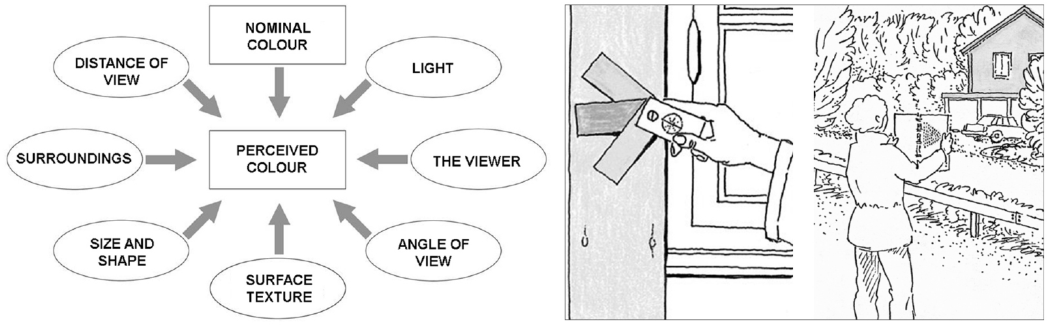

Figure 1. Left: Factors influencing the perceived colour. Right: Method for determining nominal with NCD Index and perceived colours with NCS Atlas. Courtesy of Karin Fridell Anter.

2.3. A general colour guideline

In the colour guideline, the registered façades are presented with specific location, picture of the façade, approximate NCS notations for nominal and perceived colours, and description of façade material and surface texture. The aim is to provide the public information about what approximate colours are used on a specific façade and how the colour is approximately perceived.

3. RESULTS AND DISCUSSION

3.1. Identifying a more specific colour pallet for Trondheim.

Analyses of the nominal colours shows a very clear tendency for the use of specific hues and nuances in the city center. Analyses of the colours in relation to surface texture and building type also shows clear tendencies as to what colour characteristics are used for certain types of buildings (Figure 2). For example, the chromatic façade colours on buildings with timber cladding and smaller buildings with rendering were identified to hues between NCS G30Y–Y90R, and in nuances that are "typically untypical" (i.e. nuances with more or less equal likeness to whiteness, blackness and chromaticness).
Buildings with facades of stone, and larger building volumes of rendering, typically have more neutral façade colours in hues between NCS Y10 –Y90R, and in nuances of 10–50 % blackness and 2–20 % chromaticness. The exceptions from the rule were rare façades in façade panels of marble, glass or composites, and façades painted blue. Traditional colours from natural pigments, e.g. colours known as Dodenkopf, English Red, Burnt Umbra or Earth Green, corresponds more or less perfectly with the registered hues and nuances of the current colour palette. This strongly indicates that the city's current colour pallet is of traditional origin (Figure 2, left and middle).

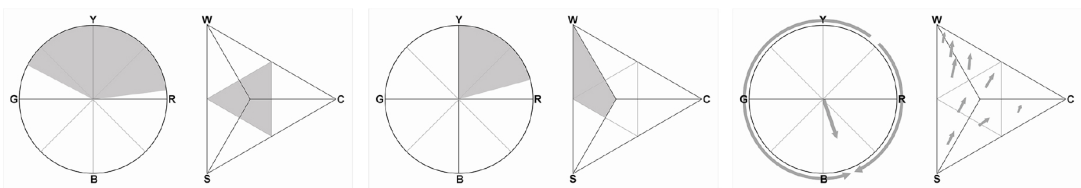

Figure 2. Left: Typical colours for timber and smaller rendered facades. Middle: Typical colours for stone and larger rendered facades. Right: Recurring tendencies for shift in nuance and hue, where the arrow points from nominal to perceived colour

3.2. The perceived colours of Trondheim.

Comparisons with observations by Fridell Anter shows similar patterns for hue shifts , where the hues shift in anti-clockwise for reddish yellows, greens and blues, or in a clockwise direction for hues for yellowish to bluish reds. Achromatic and neutral colours tend to acquire a faint bluish hue. Comparisons also shows similar pattern for nuance shifts in the perceived colours, i.e. a clear tendency for less blackness in the perceived colour, and similar patterns for corresponding increase in chromaticness and/or whiteness. It also showed the same pattern in nuance shifts in all observations, regardless of light condition. (Figure 2).

4. CONCLUSIONS

Contradictory to the tendency of drift towards greyness or use of very chromatic colours, the identified colour palette of Trondheim's is but rarely achromatic or has a chromaticness over 50%. In addition, if the general colour guideline is to be successfully implemented by the public, in a new location and in a different context, it is necessary to communicate the factors involved in the perception of the colours, and include perceived colours in addition to nominal colours.
The scope of this paper was to identify general tendencies for colours in Trondheim. To be of fully practical use for the public, additional information on the factors influencing the colour perception. The next step has been to identifying to what extent the different façade materials and surface texture influences the perceived colours. New, modern building materials and exterior paints usually have less texture and higher gloss than the facades observed in this study, and will need further studies.

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Urban Chromatic Moods. Relationships Between Light – Material – Colour - Culture

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[1] *Isis Colour*
[2] *Atelier France et Michel Cler*

ABSTRACT

The Urban Chromatic Moods in Auckland, Brisbane and Paris are strikingly distinctive. Analytical studies of the "Géochromie" and "Biochromie" of each city led to three very different projects. All three are marked by a strong presence of water traversing the cityscape, bringing to life a constant play of the interaction of light, water and material in urban space. Reflections, reverberations and refractions dancing through very different climates and cultures on opposite sides of the planet.
To discover and rediscover a land is to interpret its characteristics and feel "a spirit of place" while analyzing the potential of the natural world and its evolution, shaped by the transformations of time and human intervention. Each site emanates a certain presence, a specific resonance revealing different collective memories and visible layers of urban space development. "Géochromie" is the concept that the interdependent relationships between geography, climate, history, culture and socio-economy take part together in the development of our environment.
"Biochromie" is the concept of living colour revealed by the energy of light and associated to the fundamental elements of our biosphere: air – light – water – plants – minerals. "Biochromie" is the fusion of the chromatic diversity in the creation of the mood of an environment. The interactive energy between light, material and colour varies depending on each context and the vibrations through space.
Our approach to site analysis is based upon an annual cycle observing seasonal variations in the environment related to qualities of the light and evolution of the plant world. This analysis phase includes colour annotations of the existing mineral, vegetable and aquatic sites, presented by line and watercolour sketches, colour chart documents and photographic essays. These observations enrich material references compatible with the existing environment while remaining aligned to the planning scheme.

THE LIGHT OF THE SEINE, EMERALD FROM UPSTREAM TO DOWNSTREAM

Commissioned by architects, SRA and JL Chassais, the Urban Chromatic Mood was drawn from seven sites along the banks of the river Seine in Paris and based on varied urban scales of perspective. Wide panoramic vision with breadth and the presence of the sky as well as the scale of the immediate environment showing articulations between different spaces. Lastly, a residential scale looking at use, circulation and facilities, moods experienced, notions of comfort and appropriation, appreciation of detail.
Sequential bridges connect the banks of the Seine creating rhythms of perspectives. Arches as meeting places, from upstream to downstream, moving through significant historic urban areas each with different characters. The Seine reflects the movement of light with passing time, seasons and moods of the sky. In response to the dominance of the emerald water is the presence of diverse green metal bridges and parallel linear blocks of dark green boxes owned by booksellers. A space of light, the river is present as an opalescent and pearly fluidity. The iridescence of the moving

water, emerald and turquoise showing variations from pale to dark deep green. The sparkling gold and the sheen of the copper patina of the cupolas and roof forms are significant symbols of Paris. The wealth of greens of bronze and copper playing and mingling with gold gilded details on street furniture, street lighting and statues. The dominance of subtle blond coloured limestone, wall coating shades range from white to soft ochre. The rhythmic textures of the brick facades in multiple nuances. Refined satin and gloss decorative ceramics in the architectural details.
Facing the Beaugrenelle bridge is the tower bearing the same name, seated in a landscape of wild plants to encourage birds and bees. The surrounding Charles Michel neighborhood, shows a dominance of ochre coloured wall coverings, red and brown brick, ceramic details and the soft moss green of the primary school.

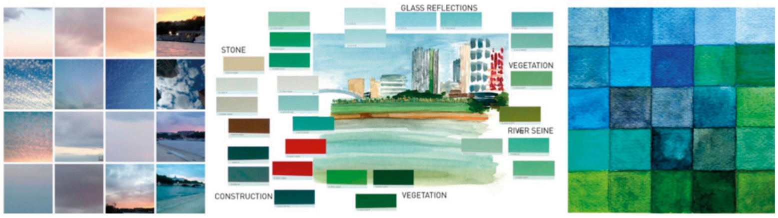

Figure 1: Night-day-night-day variations, Urban colour mood with references Paris · Quay louis bleriot · France, Sky · Water · Vegetation

BEAUGRENELLE

The renovation of the Beaugrenelle was initiated for energy and security reasons. The synthesis of the colour study led to the concept of transforming the high-rise into a tower of light acting as a dynamic signal, a non-rigid sculpture, striking but delicate in permanent visual transformation with the movement of light and the circulation of the viewer. The pigments within the surface of the metal cladding engender colours to appear and disappear, changing from one hue to another while at moments becoming brighter and more reflective. The apparent primary red turns to gold, copper and brown with the kinetic movement of light. The association of nuances in camaieu responds to the orientation of the tower related to the movement of light, the river and the surrounding environment. The tower's vertical dynamic is accentuated by fine lines of coloured metal cladding interlaced with silver bands, which vary in texture and aspect. The tower is in constant flux, emerging and vibrating.

THE LIGHT OF THE BRISBANE, FROM THE MOUNTAINS TO THE VALLEY

The Urban Chromatic Mood was drawn from sites from the mountain ranges to Fortitude Valley and the Brisbane river. The mountain ranges shift from blue to what seems like a blanket of dark and light silver greens, punctuated by yellow-greens. On closer observation, the bush reveals flashes of highly saturated colours of flowers, eye-catching reds, oranges and yellows. The indigenous palette of earth and stone is reddish brown and blue, as well as ochres.
Fortitude Valley pivots around Centenary Square dominated by the presence of historic stonework, varying from light green and pink to yellow and red ochres. Victorian and Art Deco cottages, in weatherboard and brick, cover the slopes of the valley. The Brunswick neighborhood is of a mix historic and contemporary, residential and commercial, structural colours dominated by ochres and warm neutrals, decorated with complex chromatic details. Chinatown, marked an archway in temple red, gold and green, the streetscape, painted in the soft pastels of the Art Deco period.

The Brisbane river runs through the city in a serpentine shape, shifting from yellow-bronze to blue-green bronze and grey-bronze. High rises towers proudly line the river banks, their shimmering reflections dancing on the river surface. The clarity of light intensifies the dark cobalt sky early in the morning, softening to pale blue with scarce silver and white clouds, followed by gentle gold sunsets. The night sky line is illuminated with multitude of coloured lights, redefining the arches of the bridges and the verticality of the towers.

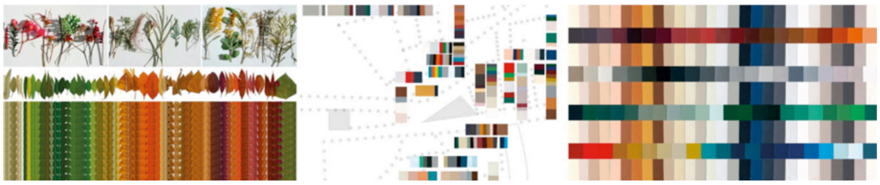

Figure 2: Vegetation, Colour map · fortitude valley, Brisbane · Australia, STR uctural & ocassional colours

100 WICKHAM

The concept for the tower "100 Wickham" creates a dynamic verticality, bringing it into perspective from the river while transforming the massive and static aspect. An expression of counterpoint and a double rhythm is created painting the trumeaux in bright and vibrant tones, modulations of five trichromatic families. To change the silhouette of the building, the banner parapet is transformed into a reflector of the ever-changing light, ephemeral and lightweight in appearance.
The body colour on the textured spanel panels is in close harmony with its environment in transition with the bronze glass and the brick of the adjacent hospital, creating a notion of scale proximity between the new and old buildings. The urban vision of the building is that the columns lengthen the building while the coloured grey lightens in appearance towards the banner parapet. In contrast to this warm grey dominant, a refined green of the bush, creates an extension of the vegetation and lifts the strong horizontal mass of ground floor level. The basement podium recalls the local stone anchoring the building to the ground.

THE LIGHT OF THE WAITEMATA, SPARKLING AQUA TO GREY

Hobsonville Point is surrounded by the unique New Zealand vegetation, which borders the inlets of the sparkling Waitemata harbor. It is a place to reflect on the constantly changing colours of the light on the water and native forests. The dense darkness of the vegetation seen from afar is complex in detail, shifting in colour due to degrees of transparency and angles of light. The mangroves form a line along clay stratifications, built up of tones of white to grey, ochre, purple and an arresting midnight blue. The urban landscape is based on a system of relationships between the sea and the coastal edge of the landform of the Point. A framework of avenues, streets, walkways and squares, set up points of view, activities and coherent architectural entities. The different phases of the development of Hobsonville Point have allowed diverse architectural contributions helping to define and strengthen the character of the urban spaces.
The Urban Chromatic Orientation, commissioned by the Hobsonville Land Company, led to the development of material-colour palettes for each urban space at Hobsonville Point: the Coastal Edge, the Historic Corridor and the High Street. The palettes allow parallel developments to overlap and work harmoniously together, while enhancing different colour identities between different zones. To facilitate memorization, as well as visual and colour-code transfers the colour charts are referenced using the Natural Colour System.

Figure 3: Coastal edge pallete, Colour map · Hobsonville ponit · Auckland · New Zeland, Architectural vocabulary

The Coastal Edge responds to the permanent movement of coloured light amplified by the sea and travelling through the bushscape. Within this area there will be two quite physical characters: one open to the exterior and the other with a sense of interiority. These phenomena have been transcribed into a palette of colours light in intensity, both neutral and cool punctuated with flashes of colour found in the flora.
The Historic Corridor responds to the colours of existing historic architecture, enriched by earth and charcoal tones used to paint early meeting houses. The palette for this urban space reflects the history of architectural colour made up of light, mid and dark tones, which are highly polychromatic in nature.
The High Street has been composed with an emphasis on warm and neutral earth tones both light and deep in intensity. The use of strong chromatic colour will animate and strengthen the character of the activity along Hobsonville Point Road, and focus on the importance of colour at the scale of the pedestrian.
Each urban space palette is made up of primary, secondary and occasional colours accompanied by the building blocks of brick, timber, masonry and joinery. The construction of a streetscape is a play of colour, material and textural harmonies. Rhythms of light and dark, matt, shiny and textured, encompassing subtle variations to create vibrations lead the pedestrian along the vista of each street. The chords present the colours in harmonies suggesting a use of colour in a streetscape while the scales present the colour by family. Moving the eye vertically over the chords, associations may be identified for a single dwelling made up of a primary and secondary colour as well as occasional colours for details or doors. The fifth facade, the roof, is like the cloak or canopy of the natural vegetation, which is predominantly dark in tone with flashes of striking bright colours. The change of profile and texture, from matt to shiny will change the play of light and shadow on the roofscape.
The impermanence of the climate in each of the cities transforms the game of appearances, creating dynamic light and reflective shade, sculpting the depth of sites and enlivening the perception of the quality of mood. The aspect of colour appearance is never inert but actively transforming - fleeting moments appearing and disappearing. The “night-day-night-day” rhythm creates alternating variations of successive and progressive combinations of colour appearances. The active cycle of renewal allows us to move between an ephemeral future drawn from memories of our past. The complex boundaries caused by fluctuations of light, shade and hue in urban space are often the moments of poetry and emotion that we remember.

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Colour Identity as Representation: A Semiotic Approach

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ABSTRACT

The study is a preliminary effort to examine the definition of colour identity and its associational meaning in non-verbal communication. Through interpretation of colour identity, it attempts to decode specific colour symbolic meaning of urban environment. As the result, this paper presents an overview of colour identity as representation in semiotic theory and analysis of some samples of environmental colours. The literature review has shown that through a process of characterizing, and representing the 'true conditions' of content, the colour of an object can be recognized as colour identity. The interpretation of meaning needs a referent. In literature, it suggests the referent should be considered a sociocultural dimension.

1. INTRODUCTION

This paper is part of researcher's first year PhD literature review, which concerns the associational meaning and the way of interpretation of colour identity. In urban environment, the symbolic system is of importance for its identity. Representations of symbols are sensitive to colour conditions. The meaning attached to colour identity may affect people's perception of urban environment. The paper shows the interest in finding the answer of what is the meaning of colour identity? And what are the factors will influence interpretation of colour identity?

2. SIGNIFYING: COLOUR CHARACTERISATION

In semiological theory, the urban environment as sign is an integral of colours, shapes, textures and space for perceiving each of these elements of all the others. Not every colour attached on the sign is necessary to be seen as a signifier. The feature of elements of sign should be only essential and inseparable to the sign. The causal connection between sign and object is the characteristic that the elements imposed upon its sign, and it is this connection that the sign must represent if it is to succeed in signifying the object. For example, if omitted the yellow colour, the cab may not seen as a sign of the New York City. Thus when colour prioritizes its characteristic to the sign, then the colour feature can be recognized as colour identity.

This signifying is a process of characterizing representational context in terms of true-conditions is that it allows us to distinguish between two different aspects of a sign as a representation (Le Poidevin, 2007, p.18). For him, a representation is that which has true-conditions, hence, a sign or a representation occurs two different attributes: content and character. In this sense, when the character is signified from a particular perspective in an environment, it can be understood as a process of characterizing the content of the representation.

Colour is one of the true-conditions of the content, only when the colour is well represented as a character, the colour would be perceived as colour identity. Regardless of the colour, the Eiffel Tower is still a sign is signified as a symbol of France. This means the colour is not the essential property of the Eiffel Tower compared to other elements such as shape. It means that the meanings evoked by the forms or figures of a symbol are stronger than its colour association (Arnkil, 2013, p.146). In this case, the colour of the Eiffel tower was not been seen as colour identity. Therefore the true-conditions provide a cue for identifying certain colour as colour identity.

3. MEANING OF REPRESENTATION

There are two levels of meaning in colour: denotation, which directly response to the visual stimuli from general understanding the other is for those in more associational meaning would be connotation (Barnard, 2001, p.149). Colour identity, in this context, has relevance is that: firstly it would be literally represented the character of a sign; secondly the featured colour associates its connotation meaning, which reflects the cultural perspectives of individuals. In another words, the connotation is more complicated due to the various interpretations from different social groups. Many researchers consider the meaning involves a process of encoding and decoding. Like Hymes (cited in Rapoports, 1982, p.52) considers the sender as an encoder and the receiver as a decoder, both of them register in a form of cultural code. Based on the notion of seeing colour as a form of nonverbal communication colour in urban environment is seen partly as a process of encoding information. If the colour code is not shared or understood, the environment does not communicate.
As Rapoport (1982) points out that meanings are in people, not in objects or things. In this sense, the senders and receivers are both important to accomplish a sufficient exchange and produce the meanings. This stresses the interactive positioning involved in colour through the sending and passive receiving of messages. Piece regards that both the senders and receivers in process of what called interpretants, and the sign determines an interpretant by using certain features of the way the sign signifies its object to generate and shape our understanding (cited in Atkin, 2013).
Jacques Derrida extremely addresses that there is no meaning before that 'receiver' interprets the meaning of message, producing themselves as a member of a cultural group in that interpretation, and the meaning is not separable from the interaction of communication (cited in Barnard, 2005, p.25). Although it emphasizes the importance of interaction in the way of communication, one could argue that the senders generate meanings as well. Designers, for example, are senders who produce the first or original meaning of the sign. On the other hand, the receivers collect information, and may reproduce their own interpretational meaning. Theoretical speaking, if the reproduced meaning is equivalent to the original meaning, the communication in the way is sufficient. If not, then fall in misunderstanding.

4. INTERPRETATION: SOCIALCULTURAL REFERENT

The interpretation of meaning may be differed by personal preferences and affected by many factors. A basis semiological triangle is illustrated by Jon Lang (1998), which includes the important role – referent between signifier and signified. Lang (in Nasar, 1988) further explains that the thoughts, or meanings – the signified – associated with it may vary from individual to individual or from group to group because the referent is different. For example, colours of buildings, surface, and any man-made structure carry symbolic meaning – often by explicit social convention. For him, the meaning thus is by social convention. These conventions differ from society to society (ibid).
On the contrary, Heider's balance theory takes another approach of human behavior related to the interpretation of meaning. He considers individual's attitude about

defining characteristic of a symbol. Much of human behavior is governed by culture – the system of shared attitudes and symbols that characterizes a group of people. Individual social behavior and thinking are shaped by culture. Barnard (2005) considers the cultural position of the referent, as colour in environment is a member of cultural coding system. It suggests the symbolic sign is a production of culture.
The different approach is because the complexity of symbols determines the several of dimension of the referent. Although it has different views of relativity of colour identity, the researcher still argues that both social and cultural dimensions should be considered in analyzing of the referent. Even under same cultural condition, the interpretation of urban environment also involves the ideology from different social class. Without an understanding of particular circumstances of sociocultural structure, it is not possible to decode the associational meaning through colour symbols.

5. SYMBOLISM OF COLOUR IDENTITY

Symbolism (that is, meaning) is central to all environments (Rapoport, 1982, p.44). A city is a synthesis of colour symbols that to represent ideas or qualities, and symbolic meaning attributed to natural objects or facts. Refer back to semiotic theory of sign. The object of the understanding, considered as representations, are symbols, Barnard (2001, p.148) argues it is only possible to define the symbolic colour, which has sometimes been understood as expressing categorical, absolute and permanent signification.
Peter Nas comments that the symbolic structure of a city is of great importance for it identity (Nas, 2011, p.19). The colour scape in urban environment provides rich and complex of colour symbols in meaning. Colour symbolism may often have different meanings depend on context and cultural setting. Many researchers (Arnkil, 2013; Gage, 1999; Lenclos, 2014; Doran, 2013) believe that colour's symbolic meaning is generated by cultural dimensions. For example, the colour of national flags is expressions correlated to cultural units (Blonsky, 1985, p.174). The national colour identity are known and shared by the same nation, and differentiate from other cultural groups. The colour symbolic meaning would elicit the similar responses and resonances.
Pocock and Hudson (1978, p.80) say symbolic response to the sense of place – not to what is but to what it represents. As the urban setting is for particular social activity, the study of human behavior is one of the aspects to reflect first the impact of culture in society and individuals; second how people response to the symbol and the interpretation. The colours provide the cues on human behavior in social conditions that has been often seen in wayfinding system in urban environment. The symbolic meanings of colour are often associated with personal experiences and effected on social behavior base on certain cultural value and beliefs. Colour symbolism forms an extensive and multiple parts of urban life as well as the foundation for the attraction of the city.

6. CONCLUSION

Through a process of characterizing, and representing the 'true conditions' of content, the colour of an object can be recognized as colour identity. The interpretation of meaning needs a referent. In literature, it suggests the referent should be considered a sociocultural dimension. In particular, colour symbolism and urban symbolism both provide the clues of finding the influential factors for colour identity.

In order to decode the symbolic meanings of colour identity, it inquires a sociocultural referent, which embrace an attitude towards personal behavior. The cultural dimensions provide a basis of belief and value of social group and affect the interpretation of colour symbols. Without an understanding of particular circumstances of sociocultural structure, it is not possible to decode the meaning of communication through colour symbols.

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Red on Red. Framework for the Interaction of Color in the Built Environment

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ABSTRACT

This research project is based on a temporary, experimental proposal for the International Garden Festival at Les Jardins de Métis in Grand-Metis, Quebec, Canada. Building upon Josef Albers' seminal primer on color theory, Interaction of Color [1], the garden seeks to establish a new framework to experience color perception and sensation in a larger field (Figure 1).

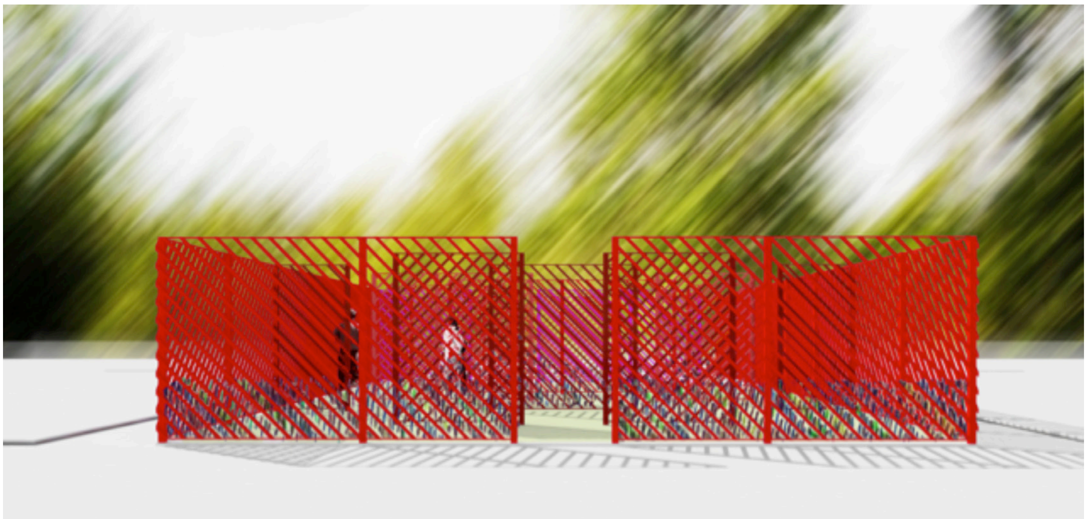

Figure 1. "Red On Red" Garden Entrance Elevation

1. INTRODUCTION - INITIAL GARDEN PROJECT

The garden measures 10x20 m and is surrounded by an open perimeter fence. Within, a series of open fences further organize the plan into eight equal bands, each measuring 2.5x10 m. Countering the geometric rigor, breaks in the fences filter visitors through the garden, loosely define larger spaces, and provide entry points on the east and west sides along the main pathways. Continuous beds of thyme are planted along the organizing bands and are crossed over by visitors. The fences are made of painted wood and are characterized by fine slats oriented at 45 degrees, alternating orientation at each layer. Recalling the common wooden lattice, these diagonals establish a decidedly supergraphic element. The artificial tectonic expression serves to abstract the methods of construction and to articulate a complex set of color effects through minimal means.

2. METHOD

A range of reds was selected for contrast with the greens of the surrounding plantings, underscoring the contrast between natural forms and the graphic tectonic. The perimeter fence is red. Other fences are of varying red hues, some of which are tinted, others toned. Since colors of equal brightness but differing in hue tend to as

sume the same spatial plane, the three dimensional organization of the garden is at times challenged and introduces an element of spatial ambiguity.
The interaction of the painted slats was understood not only as a dynamic condition in and of itself, but was also interested in the interaction with colors in nature which remain in a constant state of flux over the course of the day and seasons of the year. By interspersing areas of color through the slats the project highlights the relativity of color.

2.1 Synopsis

Using the garden proposal as a point of departure, this project delves into color experiments focusing on visual perception and the analysis of color, intensity, flicker and ambience within fields of interaction. The objective of this project is to evaluate a series of multiple and complex visual effects as they occur in the built environment. The project aims to expand upon Albers' experiments and to examine the potency outside of his regulated and abstract color experiments. To what degrees do the experiments in the Interaction of Color translate in architectural spaces- both of interior and exterior conditions? What are the potentials and limits in a complex field? The Interaction of Color is invaluable in aesthetic, architectural, and performative terms. The research focuses on the connection between design principles and color interaction in order to develop understandings as to how to optimize spatial efficiency, performance, and visual comfort. This research conversely looks to find potentials for colors to expand upon, confuse, conceal, and to misrepresent built three-dimensional form.

2.2 Hypothesis

The qualities of color interaction in architecture are neither widely applied nor understood in the field. The color experiments of Joseph Albers represent an untapped potential to further expand upon color interaction as more variables are introduced. This project asks similar questions to those of Albers; what colors recede? What colors advance? What colors appear to share the same spatial plane?
This project anticipates results of color interaction, and will test the interaction of color in space though a battery of empirical tests within a structured exterior construction. To test the hypothesis, the perception of color interaction will be assessed empirically. How does color interact outside of Albers' two-dimensional experiments? What is the dimension of color in space? The research developed a series of scale physical models in order to test the interaction of color within larger spaces and environments. The models explore color interaction by using a range of graphic techniques to maximize the relative appearance of a color in relation to adjacent colors when these fields are interspersed (Bezold effect).

Selected Guiding Research Questions and Experiments:

What is a strategy for color interaction in nature with the plants and the seasons? Building on El Lissitzky and Theo van Duisburg, are there ways to challenge the spatial form? In what ways can the use of color alter or deny three-dimensional space? What are the potentials of the Liebermann effect- where two colors that are of equal brightness but differing in hue assume the spatial plane? What are the ways that built forms can generate the atmospheric effects of a Seurat painting?

3. RESULTS AND DISCUSSION: EVALUATION OF REFLECTIVITY

The Experimental Garden Investigation of these effects will be looked at in a larger context of variables, including daylight, shadow, background conditions and colors (seasons and plants), and the position of the viewer.

The following issues will serve as key points of investigation:
- The outline and definition of space through color.
- The undermining of architectural space through color application.
- Spatial effects of color including compression, extension and resolution of volumes.
- Connection and disconnection of spatial elements by color.
- Contrast effect of color especially in outdoor and/or day lit spaces.
- Experimental measurements to test anecdotal knowledge about the perception of color in space.

3.1 The Experiments

The proposal for the "Red on Red" Garden was designed to observe how color interacts in landscape. Attention was given to background, horizontal and vertical vantage points, and changing light conditions. Further experiments are based on the planometric geometry of the initial proposal- a 10 x 20 m area surrounded by a perimeter fence and then subdivided by a series of open fences into eight equal bands. In the experiments, variables were introduced- color, reflectivity, ordering, height, density of the slats, time, and the relative position of the various viewers.
A set of eight colors may be assigned one color for the perimeter condition and seven colors for the seven interior fences, whereby each plane of the project has a specific color assignment. While the plan geometry was fixed, the position and site of the openings that allow people to pass through could be changed. All fences, however, were to remain equally spaced at 2.5m, parallel with each other and perpendicular to the viewer and direction of movement. The structural support positions were to remain, but the height of the walls could be increased or reduced from the original 2.5m above the ground plane. For the each of the experiments the height of the fences is constant in each configuration. Depending on the eye height of the viewer and the height of the fences, the illusion of spatial advancing, or conversely spatial receding, could be reinforced. The parallel fences form a series of vertical and horizontal transparent planes. If the planes of color generated by the fences form a series of concentric rectangular planes of color, the spatial effects are reduced to a minimum. In the case of the initial proposal, given an average eye height of approximately 1.57m and a fence height of 2.5m, the color sequence appears to advance counter to its plan metric organization or spatial ordering generated by the colors because of the larger areas of color that appear in perspective on the lower boarders.
The dimensions of the individual diagonal slats that comprise the series of parallel fences remained constant. Similar to the proposal, the slats are oriented at 45 de-

(1) The effect of this, as was discovered by Albers and articulated by his former student Lois Swirnoff, was "that the illusion of spatial advancing or receding with perceptually mixed colors can be reinforced or diminished by their placement within the vertical/ horizontal frame of reference. When seen as concentric groupings, with all intermediate areas appearing equal in size, the spatial effect is diminished. When aligned with unequal amounts of areas or bands of color visible in the upper and lower fields, the perspectival spatial placement reinforced the illusion. With a large area of colors visible along the upper boarders, the groupings seemed to recede in space."

grees, alternating orientation at each layer. The spacing of these slats, however, was
grees, alternating orientation at each layer. The spacing of these slats, however, was
permitted to either double or reduced to half the dimension of the original for each wall. The effects produced are known as the von Bezold Spreading Effect and was facilitated by the alternating direction of the slats as well as the staggered positioning of the openings in the fences. Additional variables in the experiments were environmental and perceptual in nature. The time of day was examined for the summer and winter solstice as well as the autumn and spring equinox- both in direct sunlight and under a cloudy sky. The garden was re-oriented from its original position so that one of the entries faced north. Similarly the surrounding forest, garden, and sky reflected typical seasonal and daytime changes. Because these environmental inputs frame the experiment of the fences, the vertical, horizontal, and diagonal boundaries between colors and fields of perceived color may be either strengthened or softened depending on the contrast with the surrounding, based on the weather and time.

A series of cinematic studies involving a series of stills moving though the various test gardens was developed for each of these conditions. Viewer were methodically recorded at eye level starting at one entry and taken at each subsequent fence plane until the other entry was reached. A similar recording was made moving in the opposite direction.

Depending on the colors and the order chosen, the garden as times reinforced its organization, and at other times confounded it. When color and form were in alignment, the garden, or parts of the garden, could be regarded as a functional use of color- color as a means to orient and provide three-dimensional information. However, when moving in the opposite direction in the garden, the same colors could have the potential to take on a more de Stijl approach, especially that of Theo Van Doesburg, to confound, and disrupt space. In these instances color refuses its typically secondary role in architectural space-making as a decorator or informant. Here it is not the artist playing a subversive or perverse role in the relationship between color and space, but rather the viewer.

4. CONCLUSION

These are preliminary experiments and results. The implications were of sufficient interest to continue the work and multiple tests are being conducted. These results will be evaluated to establish guidelines for the interaction or color and for color perception in larger fields. These guidelines will inform design applications for the use of color in architectural spaces and will be pursued further in a larger experiment. These initial experiments showed that color is much more than a paint or a coating- it is rather a dynamic and highly subjective element. Contrary to its often ascribed secondary role in architecture, color has powerful dimensional potential on par with form itself. These experiments underscore the ongoing significance of Albers' body of work and the continuing relevance of his color experiments.

Architects and designers underestimate colors and their dimension to the built environment and can not understand the special quality and characteristics of color and color combinations by looking at colors in isolation or without a larger context and field of color interaction. The implications from the results of these experiments are that designers should not rely on their intuition but need tools to apply color and its interaction in all kinds of spaces- interior architecture, architecture, landscape architecture and urban planning.

Color in interior spaces is well documented, as is the artistic role of the interaction of color. However, the connection between space and the interaction of color and more generally color in the built environment outside needs to be further explored through empirical research. Further testing will be done to determine how position affects the perception of color. Our hypothesis is that the significance of color interaction in both interior and exterior space can be achieved through minimal means and subtle alternation of hue, brightness, reflectivity, and color sequencing.

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Your City, Your Canvas: Colour As a Tool of Transformation to Reimagine and Enrich Urban Space

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ABSTRACT

Colour Your City is a participatory global movement dedicated to reimagining urban space with colour. It invites people to look at their city as their canvas. Through the analysis of four projects, this study explored how colour is a tool of urban transformation. The case studies were: Beware of Colour, a large-scale public art intervention in Johannesburg, South Africa; the prolific Urban Forms Gallery of murals in Lodz, Poland; a Place Performance Evaluation of cultural complex the Southbank Centre, and an overview of the Colour Your City augmented reality mural in Well Street, both in London, UK.

The study revealed the use of colour has the power to bring profound and lasting benefits to city life by changing and revitalizing physical aesthetics, as well as socially by engaging the community. Colour can be used in a diverse array of mediums including paint, light, public art, street furniture and new technology such as AR. Impacts include changing the way people interact with the city landscape and each other, unlocking creativity, creating a dialogue, enhancing placemaking, fostering civic pride, encouraging playfulness, helping to spur political change, improving the sociability of space and even rebranding entire cities.

1. INTRODUCTION

Colour dominates our senses and impacts everything we do. Visual processing accounts for 60% of all cerebral cortex activity, more than all other sensory perceptions combined (Buether 2014: 13). Colour fills our outside world and penetrates our bodies; we respond to it on physical, mental and emotional levels (Gimbell 2001: 18). Everyone 'gets' colour.

"Colour is an important factor in environmental design. People think one is made happier by 'happy' colours and sad by dull colours." (Sivik in Porter & Mikellides 1976: 138)

By 2050 66% of the world's population will be living in urban areas (United Nations 2015). Urban environments are complex ecosystems, multi-authored habitats that require constant renewal and care in order to be most conducive to life and well-being. There are many challenges including designing and maintaining the physical environment, and ensuring there are rich social networks. Cities especially can be anonymous places, and people feel isolated even amidst the crowds.

"The more connected we are to family and community, the less likely we are to experience heart attacks, strokes, cancer and depression. Connected people sleep better at night...live longer...[and] consistently report being happier." (Montgomery 2003)

Social connection is a key focus of the Placemaking movement, which has its roots in the work of urban pioneers Jane Jacobs, Kevin Lynch and William Whyte who first began championing a new way to understand, design and program public spaces by putting people and communities first. Placemaking aims to make places vibrant 'public living rooms' of real value, through sustained community engagement and empowerment.

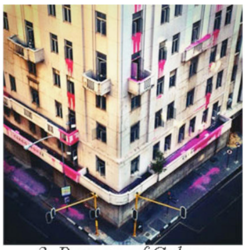
In this study we explore the impact of colour on physical and aesthetic transformation, and social change through community engagement.

2. METHOD

Four case studies from three countries were selected for a global perspective. Research papers, books, placemaking tools and/or impact surveys were utilized. This enabled an analysis of each 'canvas' selected, the colour palette and aesthetics, resources used and civic impact.

1. Southbank Centre, Jeppe Hein

2. Urban Forms Gallery



3. Beware of Colour

4. Well Street Mural

2.1 Southbank Centre – London, UK

The Southbank Centre is one of the UK's most popular cultural destinations. Backing onto the Thames, the sprawling brutalist concrete complex comprises the Royal Festival Hall, Queen Elizabeth Hall, Purcell Room, Hayward Gallery, Poetry Library, and a plethora of restaurants, bars, shops, food trucks and occasional stalls. In July 2016, the site was rated using the 'Place Game', an observational assessment tool from leading placemaking organization the Project for Public Spaces in New York. It scored highly in all areas that define a great place: comfort and image, access and linkages, uses and activities, and sociability.
As pertinent to our study, the canvas was the outdoor surrounds and public space comprising multi-level walkways, outdoor seating, steps, a skate park, signage and branding, public art installations, a water fountain, walls, facades and lighting. The palette used was a bright and varied array of colours, noticeably a consistent use of yellow on signage, hoardings, railings and stairwells (an optimistic highlight colour), yellow and blue up a flight of steps, multi-coloured facade paintings, graffiti, and lighting – which kept the site still looking vibrant after dusk. Other features of note were the playful Modified Social Benches from artist Jeppe Hein (Image 1) in bright neon orange. The Southbank stays true to its Festival of Britain roots, by cultivating a festival vibe year-round with cultural programming, events, performances and rotating public artwork. The impact is evidenced in the huge popularity of the centre, and comments from those interviewed felt it was a friendly, safe and vibrant place to be. It must have been a challenge to improve the image of the grey concrete structures, but the Southbank Centre have done so remarkably well, showing what can be done when viewing such sites as blank canvases and using a wide range of mediums to add colour.

2.2 Urban Forms Foundation – Lodz, Poland

Established in 2008, the Urban Forms Foundation is an independent NGO concerned with urban art in Poland's third-largest city Lodz. Up until the 1990s, Lodz was a major European textile production centre but since declined to one of the poorest cities in the country. Known for its grey drabness, the 'city of chimneys' has industrial buildings spread across the city like veins. The first aims of the Foundation were to use public art to improve the image of the city, reclaim urban space, and give citizens unrestricted access to art. They started with murals, chosen for their impactful large-format, allowing for a high degree of visual intervention. The canvases were

industrial and residential buildings around the city. From 2011 to 2014, the Urban Forms Gallery (Image 2) was created with 37 murals painted by international and local artists, who were given no creative limits except for a ban on ads and logos.
In 2013, the Department of Ethics at the University of Lodz and the Urban Forms Foundation set up an inter-disciplinary team of 9 students to develop a survey to evaluate the social impact of the murals. Each conversation took place next to a mural with local residents. The results found that many now proudly identified themselves directly with Lodz as 'the city of murals' showing that civic pride had been invigorated and even rebranded the city itself (Gralińska-Toborek and Kazimierska-Jerzyk 2014).

2.3 Beware of Colour, Yazmany Arboleda – Johannesburg, South Africa

Yazmany Arboleda is a Colombian American artist based in New York. He focuses on social practice art through co-creative processes and spatial transformation, seeking to build civic leadership and bring joy to dark places (Arboleda & Alibhai 2017).
When visiting the Central Business District (CBD) of Johannesburg in 2014, Yazmany came across many large buildings of 10+ stories; architectural examples of eras from art deco to post-modernism. Both publicly and privately owned, they had been abandoned and were undergoing 'demolition by decay'. With South Africa facing a housing crisis, there was a need for homes for thousands of homeless on the inner city streets, some of whom squatted in these abandoned buildings. The district seemed deeply broken and emblematic of systemic societal problems. Yazmany chose the buildings as his canvas turning them into 'Living Sculptures', using a palette of hot pink, a strong and shocking colour. Over the course of eight nights in August 2014, Yazmany and a team of 'creative agents' – 30+ local artists and friends – tipped 1k+ litres of water-soluble paint out of the windows of nine buildings (Image 3). This 'bleeding colour' effect was deliberately edgy and messy to complement the arresting colour choice and challenging underlying social issues.
Due to the covert nature of the campaign, there was no public engagement before and during. The main conversation came afterwards. There was a Tumblr page to share the experience globally, with local and international media picking it up including the Johannesburg Star and The Guardian. The campaign sparked conversations and questioning; on the streets and online, creating a new dialogue and reconfiguring the way the buildings were viewed. In surveys people from the inner city generally understood and approved of the project because they were aware of the issues, while people from suburbia judged the project negatively. In July 2015 the city created a 5 billion Rand plan to renovate 21 government buildings in the CBD.

2.4 Colour Your City Well Street Mural – London, UK

The Well Street Resident and Traders Association (WESTRA) in Hackney started a grassroots civic crowdfunding campaign – as part of the Mayor's Crowdfund London Initiative – to bring back a historic market, once the birthplace of Tesco in 1919. A collaboration with Colour Your City was formed, to help bring colour and vibrancy to the street. In July 2016 work on an interactive mural (Image 4) began which comprised of a spray-painted mural of the campaign's brand identity, to be layered with augmented reality (AR) content using visual discovery browser and AR platform Blippar. The mural palette was predominantly blue to compliment the wall's existing colour scheme. The colours of some letters were different to match the 'Colour Stories' of local people – mainly business owners on the street ¬– who were asked to sha re their personal history of the street, how they related to it through colour, and their future hopes for the street and market. The interviews were filmed and short videos produced to create the AR content that could be accessed on digital devices such as smart phones when using the Blippar app in front of the mural. Colour Stories included green that reminded one man of shopping at the original market as a boy with his father, for him symbolizing the most powerful and foundational market colour. Another was blue, representing the colour of a local youth group that had provided an ocean of calm for young people in the area.

This project highlights the way in which new tech 'superpowers' such as AR can be used for civic benefit by engaging the community in site-specific ways to create rich and multi-layered experiences that share local stories and history, explore cultural narratives, and help to reveal the 'magic beneath the surface' of places and their communities.

3. RESULTS AND DISCUSSION

Colour can effect physical transformation, often rapidly so, and through a wide variety of mediums. Repetitive and/or large-scale work can have especially high impact by disrupting the visual landscape at-scale, such as with Beware of Colour's 'Living Sculpture' buildings and the murals of the Urban Forms Gallery.

Colour has social impact too. This occurs naturally from the process of triangulation (Whyte, W. H. 1980) where an external stimulus provides a linkage between people, changing the way people interact by prompting conversations between strangers. And colour can bring people together through creative placemaking and social art practice, adding rich layers of civic meaning to spatial transformation, as relating to local history, culture and community such as the personal Colour Stories of the Colour Your City Well Street Mural.

"...[social art] projects demonstrate the ability for artists to elevate consciousness, help communities imagine alternatives, critique current conditions and create shared identity through common memories. They are increasingly able to impact areas generally relegated to sociologists, urban planners and architects." (Arboleda & Alibhai 2017)

One of the challenges of analysis is the lack of impact studies. It would be useful if artistic and civic projects were measured and assessed for impact, despite their often-ephemeral nature. Tools to measure impact could be developed, to help provide clear visual, empirical, observational and other evidence of how colour can transform urban space, and to distill learnings for future protagonists. Here placemaking tools such as the Project for Public Spaces' Place Game would be useful, and the mural impact surveys developed by the Urban Forms Foundation.

4. CONCLUSION

What is clear is that colour can be used very effectively to liven up urban space: give the tired a new lease of life, make it brighter, better, improve the ambience and give ourselves daily delights to enjoy. Colour can also be used to enact civic change by engaging the community and helping to celebrate local identity, creativity and strengthen social dynamics.

It's time we viewed more urban surfaces as canvases for our creativity, and use conscious colour transformation to uplift people and provide richer urban environments.

Your city, your canvas.

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Pulse of a Street: An Urban Streetscape Exercise in Bangalore

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ABSTRACT

To capture an "emotional experience" of a physical space is at the heart of this paper. For a city to be a recognizable, the defining and distinctive characteristics that can be readily identified need be highlighted. These are functional as well as non-functional qualities. These include city appearance comprising of built structures, people, geography etc., and people's experience of the city, and what kind of people inhabits the city.
The project aims to visually document and articulate (as form and colour) the iconic streets in Bangalore.
In a group of three the students were asked to select a street within Bangalore and make a visit to the place and capture the essence of the street with respect to all the five senses in collage.
Simultaneously pictures are taken during the visit. Having experienced a street the designer than penned down the experiences in a brainstorming session with teammates came up with keywords/phrases that aptly describe your experience in the street. Out of all the pictures were taken during your visit to the street 10-12 pictures were selected that are visual representations of that streetscape.
Out of each of the 10-12 pictures extracted were, dominant colours. The term "dominant colours" interpreted as amount of colour, which means a colour present in a situation in large quantities or in small in quantities, however the emotional impact of its presence is undeniable.
Carefully, by process of elimination selected were 8-10 colours describing the place. This would make the final colour palette, supported by keywords/phrases thought of during the brainstorming session.
The design solution was in the form of posters for each street. The format of the poster could be a landscape or portrait or a square format. The decision of format was chosen depending on the mood of the street.
The final artwork is a culmination of multiple sensations, and can be used as a street branding element with the urban landscape.

1. INTRODUCTION

In the curriculum of the MDes program at the National Institute of Design (NID), India the Colour and Form course occurs during the first semester. This course when conducted was a two week module and was taught at the Bengaluru center of NID. Most of the MDes students come with some work experience in the design field, though their formal undergraduate studies may or may not be in design. The course aims at refreshing prior knowledge, which in most instances is basic and sometimes informally acquired while working in a company/industry and also recollecting prior knowledge under a formal framework at the school.
A shopping street offers a rich array of visual stimuli, lots of people, objects/products on sale, vendors, buildings, signages etc. To start the exercise the faculty group identifies experientially rich shopping streets in the city of Bangalore, which can be undertaken by the student group to study. The criteria of selection of a street to be undertaken for study are varied, but the primary criteria would be a coherent visual

character and that a lot of people should be visiting the street to shop.
Over the years this course has be taught many times and many of the iconic markets in Bengaluru have been explored through this exercise such as Brigade Road-a street where youngsters go to “hang out”, Chikpet-a traditional saree market, M M Road-a foodies heaven, 100 feet road Indiranagar-an new market with all the many international brand stores.

2. PROCESS OF ENQUIRY

PHASE:I

It is a question of understanding and experiencing the environment of a given street, creating a colour palette that conveys the essence of that experience and then designing a composition. The students are divided in groups of 3-4 and each group selects a street from the given list of streets selected by the faculties.
The group of students, together, makes a visit to the Street and documents their experiences. Stages of documentation could be look and observe, immerse in the situation-become a buyer, making sketches and taking notes, talking to people and vendors and lastly take pictures.
This humble approach using personal interactions with the common man on a day-to-day basis for around a week, visits to the street and engaging in a personal way with a memory of the environment lasts for about a week within which 2-3 days are spent on the field, collecting photographs (shot by the student teams) (Figure 1) and taking notes (based on colloquial discussions with the vendors, buyers and locals). The idea here is to sensitize the students to the process of understanding, appreciating and dealing with the subject of colour as a means of expression (personally and socially).

Figure 1:Photographs of the streets

Once the photographs have been collated, notes and sketches compiled, the process of theme building starts. Each group sits together collecting their thoughts and comes up with a collage of the streetscape (Figure 1). This collage can consist of keywords, pictures, objects, proverbs, songs, really anything that evokes the sensation of the market the students visited.

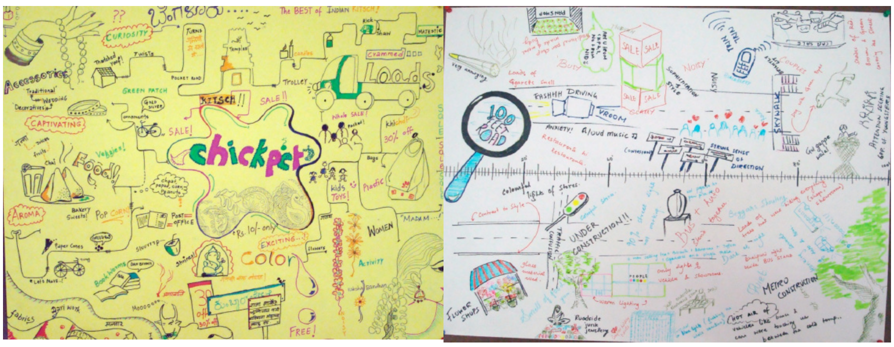

Figure 2:Collage of the street

Post this step starts the selection of colours for the palette. The foremost step is to sort the images and to select about 20-25 images that are truly representative of the street experience. Having selected the images, the students then pick dominant colours from the images. This step is though done digitally, however the final color value is tweaked to color remembered by the group of students. This is important step in training oneself to be sensitive to color as a visual stimulus and not as a CMYK or RGB number. The selection of colours is intuitive. A certain analysis of the scene can be carried out however often the criteria of shortlisting a particular hue from a picture is based on the overall dynamics of the scene and not the amount of the hue present in the picture. Out of each of the selected pictures pull out "dominant colours".
The term "dominant colours" can be interpreted as amount of colour, which means a colour is present in the situation in large quantities or it could be present small in quantities but the visual or emotional impact of its presence is undeniable.
Having carried out this stage for all the selected 20-25 images the student is left with a whole lot of colour swatches (Figure 3). The next stage is to segregate and sort out the color swatches. It is suggested to collate all the color swatches on one sheet and make color families, essentially all reds together, greens together etc.

Figure 3:Extracting colours from pictures

This helps in making an informed decision on what hues to keep and what to discard. The aim is to eventually bring the number of colours down to 12-15, at the same time retaining the essence of the Street experience (Figure 4).

Figure 4: Colour Palettes

PHASE:II

This phase of the exercise can be attempted individually. Out of the keywords brainstormed with the group select one.
Till this stage the entire process is done within the group. From here on the students individual journey starts.
Based on the individual sensorial experiences each student now selects a key word or phrase and designs a composition depicting the feeling of the phrase using minimum of 3 colours from the final colour palette.
The first step to the design of the composition is to select a basic form. It can be a circle, a square, a triangle, a rectangle or even a line. The constraint is that the stu-

dent has to work only with one selected form, while it can be repeated and scaled. The selection of the primary form is based on the inferences that the student draws from the array of experiences across the chosen market, relating these to the qualities of the primary form and its visual expression. The format of the poster could be a landscape or portrait or a square format. The decision of which format to choose would be related to the mood of the street. The learner can reflect back to form exercises and look at the character of vertical/horizontal rectangles and squares to take this decision. (Figure: 5)

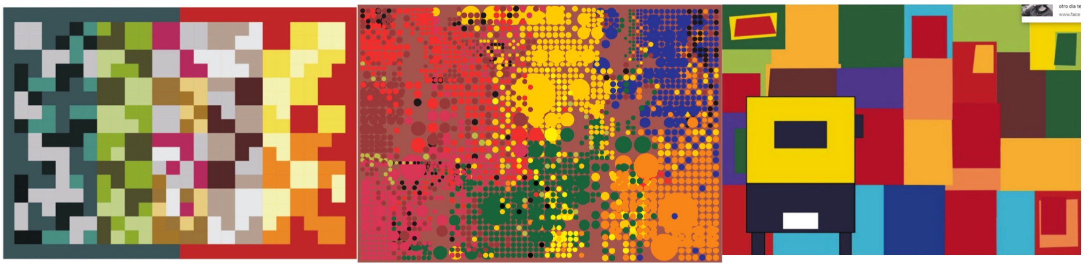

Figure 5: A few compositions made by students

3. DISCUSSION

A sensorial exercise designed to discipline the faculties of discovery and imagination, the process proposes to capture an emotional experience.
The exercise celebrates the uniqueness of India by exploring historical, modern architecture, public spaces, and hidden streets in the city forest. The urban fabric becomes an open classroom for this workshop.
The exercise proposes to satisfy the participants' sensorial curiosity and stimulate it further and encourages sharing the experiences with the other participants who may come from a variety of backgrounds.
Colour inspirations can come from the most unexpected places and can be derived from various sources both internal and external. Essentially the exercise equips the learner with a "colour inspiration tool".

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Urban Environmental Color: Experience, Sense and Identity in the Contemporary City

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ABSTRACT

In the contemporary world, the recent urban transformations represent new material and contextual conditions; therefore, there are new ways to use the urban space that presume a change in its concept and appreciation and as a consequence, of the city as well. The present urban conditions confronted in a game of tensions focus on the nature of the urban experience with the purpose of recovering it in a broad sense, and more specifically, as an essential place for urban life (Mongin 2006). In this context, the role of environmental color is vital since it suggests atmospheres that promote ways of understanding and experiencing the space (Zumthor 2006), being this a primary element in the strengthening of urban life and the idea of the city as a collective space to inhabit.

1. INTRODUCTION

At present, the discussion of the urban space and the city is considered a priority. The combined impact of worldwide phenomena such as the globalization and the development and evolution of technologies plus the local ones, for example the changing socio-economic-cultural context in Latin America, makes us focus on the transformations in the urban space that have taken place specially in the city of Córdoba, Argentina.

The sense of color and the chromatic environment are part of the urban experience and participate in everyday city life. The environmental color, 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.

Within this framework, the intervention of environmental color is essential. The communicative aspect of color has been enhanced by new ways of production and physical and digital resolution systems and these, in turn, have increased its capacity to inform, suggest and develop synesthetic 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.

2. THE CONTEMPORARY URBAN CONDITION

The problem concerning the urban space is the issue of an ongoing debate in different disciplines. The various perspectives and viewpoints as regards the features of the contemporary city focus particularly on the meanings of the urban, the public or collective in societies, among others.

The present urban condition in search of a multidimensional light on the city presents two ways to consider it. On the one hand, an urban condition of corporal and experienced sense exemplified in an ideal kind of city connecting the physical-spatial with the mental-imaginative, such as European cities or the traditional Latin-American one. On the other hand, an urban condition intertwined with new technologies, communications and global deals which place flows before places expressed by the so-called global cities and contemporary megalopolis. In this context the so-called

urban conditions confronted in a game of tensions focus on considering the nature of the urban experience with the purpose of recovering it in a broad sense, and more specifically, as a sense of place that is essential for urban life (Mongin 2006).
There are new ways to use the traditional urban spaces and new collective uses that presume a change in the concept, image and value of the urban space and therefore, of the city. The urban experience and the sense of belonging of the inhabitant with his city are modified by socio-cultural or environmental conflicts, among others (Arroyo 2011). To sum up, 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.

Figure 1. The Chromatic Expression in The Contemporary City. Córdoba, Argentina.

3. URBAN ENVIRONMENTAL COLOR

The color in the city appears as essential information that stimulates the perceptive channels that lead to action, recognition and visual tours that promote different behaviors (Sanz 1993). In the chromatic field this takes on foundation when color 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 (Avila, Polo 1996). In addition, cities are dynamic and as well as their inhabitants, they are changing organisms. Cities remain the same, become deteriorated, are renewed or go through transformations. Moreover, their environmental color 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.
With the aim of interpreting the urban environmental color and verifying the color perceived by the inhabitants of the city of Córdoba, a chromatic survey is carried out using the NCS. On the other hand, work is developed on some chosen study fields with observations, interviews and questionnaires to permanent or occasional inhabitants.
The purpose is to relate the physical-spatial context with the temporary-historical one, which are considered essential in the experience and sense of place of the urban space and confirm the influence of color on the urban experience and city identity.

Figure 2. Chromatic chart of Cordoba urban environmental color from the 80s.

3.1 Method of the chromatic survey

The environmental color, as a psycho-physical phenomenon, is perceived together with other variables such as textures, chromatic contrasts, cesias, the material nature and aspect of limits, the position of the observer and the manner and speed of movement among others.
After recognizing paradigmatic urban places in the city of Cordoba, the environmental color is verified in order to determine the color palette that defines it.
The steps to follow for the chromatic survey are:
- the study fields are chosen, considering a priori those in which it is possible to read and interpret the environmental color and relate it to the urban experience and the sense of place
- color is measured using The Natural Color System (NCS), which has already been used in previous works, to reveal the different hues and shades that shape the urban spaces.
- the chromatic survey is conducted at different times of the day and in different seasons.
- a synthesis matrix is laid out to present the readings of different variables of the physical-spatial context.
- chromatic palettes that define the urban environmental color are devised.

3.2 Record to interpret the interaction between color and chromatic-spatial experience

The original function of colors 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 different components and contexts that take part in it.
Some observations, questionnaires and interviews are carried out to confirm the relationships between environmental color and experience, sense and identity. These actions are aimed at recording the associations, interpretations and meanings inhabitants confer to their chromatic perception by means of the urban spatial experience. The purpose is to confirm that environmental color encourages the experience, fosters the sense of place and stimulates enjoyable atmospheres for the people who perceive and inhabit those environments.
The steps to interpret the interaction between color and urban chromatic experience are as follows:
- an interpretative observation is carried out with the aim of determining the behavior and appropriations in the different selected testing environments. This observation takes place at different times of the day, on different week days and different seasons.
- with the aim of completing the analysis, questions are made to casual users to verify the association and the meaning the inhabitant relates to the perception of chromatic elements influencing public spaces.
- A synthesis matrix is laid out to present the results.

4. CONCLUSION

In accordance with the above mentioned some provisional conclusions are drawn since the research is still under development.
- Environmental color can be defined as the reading of predominant hues and shades that tinge the environment with certain color. In addition, the perception of the chromatic expression of a city does not only depend on the physical-spatial context but it is also influenced by the emotional and cultural condition of the person who perceives it and by the historical-cultural context.
- The environmental color as the reading of predominant hues and shades that are perceived depending on the appearance and material nature of limits is an essential element in the urban experience, recalling atmospheres that encourage ways to inhabit and relate to the space.
- The interventions in the city with emphasis on the chromatic aspect contribute with criteria for the building of urban spaces that prompt the experience of the city, essential for its identity, design and construction.
- The environmental color has been enhanced by new ways of production and physical and digital resolution systems, which increase its capacity to inform, suggest and develop synesthetic associations and create urban environments.

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Color in Urban Design - A Didactic Approach to Restoring Color to the City Planning Process

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COLORFUL LIFE - COLORLESS CITY

City life is bursting with color: people rushing to work, shop window displays, the vibrancy of cafés on the market square. The colors, hues and textures of a city combine in a blur of lights, advertising, cars, treelined boulevards, front yards, parks and gardens. The fabric of buildings that make up streets and squares, the texture of street pavements and the material of roof tiles seen from above are all component parts of a city's color palate. Many cities are indeed famous for their trademark colors: Siena for its earthen tones, Jaipur for its pink facades, Jodhpur's indigo and the limestone buildings of Jerusalem.

Now, imagine a city without color. A city where buildings, streets and trees are of a uniform color. Unthinkable? Not at all, because this is precisely the way many modern cities are imagined in contemporary city planning: through diagrams, line drawings, through mass models of wood, plaster or styrofoam or simply through the one-tone digital mass models that visualize the first ideas.

There is a remarkable dichotomy between the reality of experiencing a city and the urban planning process: a dichotomy between reception and production, and consequently between a world of color perception on the one hand and a design process that only regards atmosphere crafted by color, texture and light as a by-product at the end of the process on the other, if at all.

DESIGN PROCESS SANS COLOR?

Historical urban design plans rarely showed the color of the elements of which a city is composed, but rather at the most they depict atmospheric renderings in tones on a greyscale. However, due to limitations caused by the evolutions of architectural forms in certain cultures, the availability of materials used in particular regions, the traditions of regional craftsmanship and the limited range of pigments before the invention of synthetic colors, a common vocabulary of form, material and color often resulted. And even after the mid 19th century, when a wider range of colors and materials was available, it was often building and zoning codes that determined the range of colors of buildings in urban neighborhoods or entire cities.

Form without color became the hallmark of the architecture of 20th century early modernism. The Weissenhofsiedlung in Stuttgart is the example par excellence of such pure dematerialized stereometry of architectural concepts without any color, texture, or material that would be allowed to acquire any patina over time. While the display of color and material returned to urban design and architecture at the end of the 20th century, the process by which architecture and urban form is designed, has not changed much since the time of early modernism. The design concept is still more important than the experienced atmosphere that results from the reflection of light on surfaces, which consequently show colors.

THE RETURN TO COLOR IN THE DESIGN PROCESS: AN INTEGRATIVE APPROACH

In the education of architects and urban designers, the aspect of color plays rather a marginal role in the planning process; it is often considered a component that is secondary to the design of the plans or the shape and structure of the buildings and spaces.
In the actual experience of space and form however, color is experienced via the materials that make up the surfaces of buildings and spaces, and therefore, as an integral part of the perceptual process. How can this dichotomy between reception and production of architecture be resolved? How can students be taught to imagine the first ideas about architectural shape and space as material ideas right from the start, instead of merely draping a finished design with color, texture and lighting at the end and thus disregarding their role as intrinsic components of the design process?
At the Institute of Spatial Design at Dresden University we have been teaching an integrative approach to design that includes space, color, light and material right from the start as an integrative whole. Instead of envisioning a design as a concept first which then gradually becomes translated into a design through plans, section, construction details, exterior and interior visualizations, which eventually suggest an experience of a perceived atmosphere at a rather late stage in the design process, we start immediately with envisioning the spatial atmosphere of a design, from which we then develop spatial and corporeal form, construction and building technology.

DIDACTIC CONCEPT

How can this integrative approach be realized in teaching and possibly generate new and different ideas for design education? In recent years, the curriculum at the Institute of Spatial Design in Dresden has been considerably revamped in order to better integrate color. Rather than teaching the systematics of color theory, which then become more or less successfully applied to design, we chose to investigate the components of light, color and shape as part of an integrated whole. Students focus primarily on the triad of spatial geometry, colors/surfaces and light and its role in creating atmosphere as an immanent part of the architectural concept. All three criteria are examined with varying emphasis in different exercises.

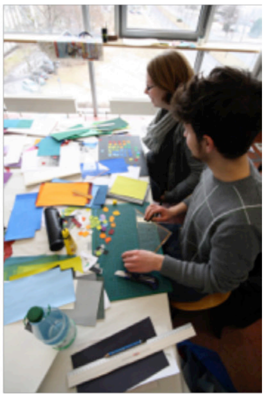

Figure 1. Introductory week: students manufacture their own colors from different pigments

The students are first familiarized with color as a material. They learn to understand the systematics of color as a result of experimentation and reflective thinking. Beginning with the manufacturing of their own colors from various natural materials and the production of a multitude of large color swatches they learn to value color as a sensual medium. By analyzing colors in nature and in architectural surfaces, the students begin to understand the many facets of color and their importance in architecture. We call this aspect Material Color. Exercises that deal with the interplay between color and light in space are subsumed under the heading Immaterial Color. In addition to color hues and shades, surface qualities such as luminosity, texture and transparency are explored directly in 3D space. Finally, the category of Contextual Color broadens the spectrum of exercises to the level of symbolism and the role of color in the arts and other areas of everyday life.

COLORING FACADES - METHODOLOGICAL STRUCTURE

Using these preparatory exercises as a basis, students spend one more entire week working in groups on a case study applying color to urban design projects. Students work in groups and design the color scheme for the area as a whole as well as work on smaller clusters of buildings in depth.
Common to the studies is a stepwise procedure. A point of departure for these urban color exercises is usually finding a common theme and a title which expresses the mood or the atmosphere that the particular region of the city possess or ought to posses. Students begin finding a theme through color collages and other similar means. This theme then is condensed by developing alternative compositional color cords, which are produced from the color swatches the students, produced during the preceding introductory week. These cords form the basis for tectonic color compositions, again in three alternatives for comparison. After deciding on a preferential version, students apply their color swatches to perspective delineations of the buildings of the area as a whole. At this point students have a final opportunity to adjust the individual color concept of their buildings to the neighboring buildings. In a final stage, one selected field of the facade will be detailed including a large scale of representation.

Figure 2. Finding a theme and producing tectonic color cords

At this AIC meeting we will exemplify this design process with two case studies: the first involves redesigning the color scheme of an old village core within the city of Dresden, the second, a cluster of farm houses in a rural area. About 850 years ago the city of Dresden evolved from a merger of ca. 35 rural villages. Many of the original centers of these farming villages still exist today within the surrounding larger urban fabric of the city. Each has an individual character of open spaces and buildings. Often the colors of the individual building no longer show their historical colors and the colors of the individual buildings do not harmonize with one another to form an urban whole. The students' task in these exercises was to find a common theme, which binds the variety of individual buildings together into a unity of one space.

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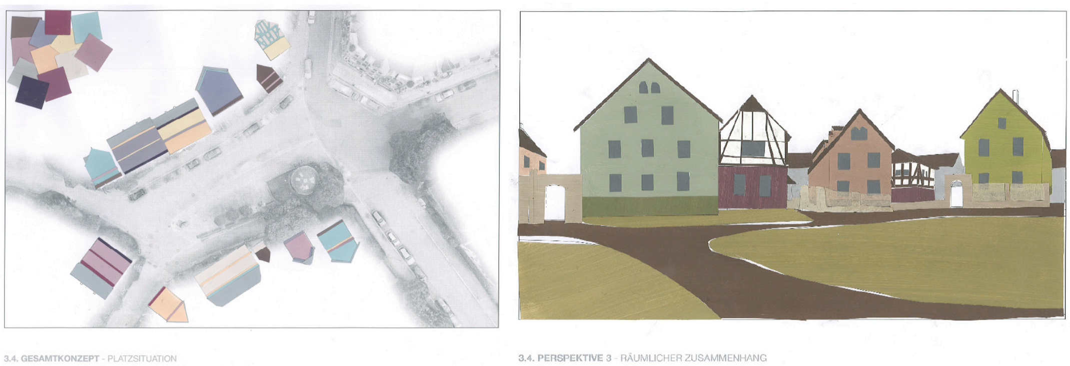

Figure 3. Exploring the color schema in site plan and perspectives for an old village in Dresden

Figure 4. Exploring the color schema in selected areas of the facade

Figure 5. Individual color designs for facades for a cluster of farmhouses near Dresden

These one week long urban color exercises have had a considerable impact on the way students approach color in urban design. Color is no longer considered a merely accidental byproduct of design, but an integral part of the experience of the city as a whole.

** This paper contains no bibliographical footnotes, because there was no previous model for this kind of procedure to teach color in urban design. Of course, the teaching of color in architecture has a long tradition with many individual facets that can be traced back nearly 250 years. However, the process described in this presentation has been developed ca. five years ago and has been slightly modified each year. My assistants: Thomas Kanthak, Claudia Scheffler, Anne Sevenich, Thomas Kohl, Martin Brucks, and Matheusz Ploch have taught this class of ca. 150 students per semester with me ever since. Without their common effort we would not have been able to motivate and excite such a large number of students each year for the topic of color in architecture.*

Adapting to a Chromatic Environment

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ABSTRACT

An art installation in a room filled with white smoke and illuminated by coloured lights (magenta, yellow and cyan) provided an ideal visual environment to explore chromatic adaptation. Although measurements of the spectral power distribution of the illumination showed that it was not highly saturated, we were able to observe the Helson-Judd effect, especially under the cyan illumination.

1. INTRODUCTION

As part of its States of Mind series, the Wellcome Collection in London hosted an installation titled ‘yellowbluepink’, by Ann Veronica Janssens, from 15 October 2015 to 3 January 2016. The stated aim was to explore “what happens at the edges of human consciousness, where expectations are confounded and perception is skewed”. The installation consisted of a large rectangular gallery room, approximately 25 by 10 metres, with white-painted walls. The illumination was by fluorescent lights in ceiling luminaires, filtered in three groups to give the subtractive primaries magenta, yellow and cyan. What was extraordinary was that the room was filled with a dense white smoke, which limited the visible range everywhere to about 1.5 metre (Fig. 1 right). Admission was restricted so that no more than 20 people were in the room at any time, but they were free to walk freely anywhere and collisions were easily avoided as others loomed out of the fog.

Figure 1. (left) Waiting area outside exhibition. The magenta lights were nearest the entrance; (right) Veiling effect of smoke inside the room: the person on left was about 1m distant.

In terms of visual colour perception, the room presented an ideal immersive environment in which to experience and investigate chromatic adaptation. The Guardian critic described it as “like being inside a painting by Monet or Turner” and noted “the glowing mist gently creates twilit visions that are as much inside the eye as in front of it” (Jones, 2015). Most of the time, and in most locations, one was completely enveloped in a coloured white fog, unable to see walls, ceiling, floor, or anyone else around (although conversations were quite audible). It was not a complete ganzfeld because the nearby parts of one’s body (nose, chest, arms and hands) remained visible. The overhead lights were also faintly visible when standing directly beneath and looking upwards (Fig. 2), but otherwise only the diffusely reflected glow of the light from the white smoke could be seen, at quite high photopic intensity (a similar level to a brightly lit office).

Nearest to the entrance was the magenta illumination. The initial visual affect, after coming from the subdued light with pools of white LED illumination in the waiting room (Fig. 1 left) was of a strong bright pink, which began to fade after about ten seconds and continued to fade until after several minutes it seemed to be a weak pink. Moving forward into the yellow illumination the initial impression was of a strong green, which faded to weak greenish yellow. Moving forward again into the cyan illumination, the initial impression was of a sky blue, which faded to a light greyish blue. Turning around and moving back into the yellow illumination (which had previously appeared green) gave the impression of an intense gold, which faded back to weak greenish yellow. Finally moving back to the magenta illumination gave the impression of a strong bluish magenta, which again faded to a weak pink. There was no way to move directly between the magenta and cyan illumination, as they were at opposite ends of the room with yellow in between. Judged on the Munsell chroma scale, the initial sensation in each case was a chroma of 10 to 12 units, fading after adaptation to about 2 units.

Figure 2. Magenta, yellow and cyan luminaires, photographed through the smoke.

2. INVESTIGATION

The visual effects we experienced could perhaps all be explained in terms of bleaching of the long, medium and short (L,M,S) wavelength retinal photoreceptors, analogous to the formation of after-images. For example, when adapted to magenta light, the sensitivity of the L and S photoreceptors would be reduced, whereas the sensitivity of the M photoreceptor would remain high, hence the apparent greenness of the yellow light. What was striking, however, was the intensity of the initial golden sensation when entering yellow from cyan, which had a slightly supernatural quality.

°To investigate the visual environment we took a camera, a colour chart and a spectroradiometer into the space to make recordings. Photographs were taken with a Nikon D3200, fitted with a Nikkor 18-70mm zoom lens, with the white balance set to 'Cloudy'. The auto-focus function was enabled, although the camera had great difficulty in focussing through the fog. The colour chart was a GretagMacbeth Digital ColorChecker SG, which includes the traditional 24-patch colour checker (upper centre), a selection of skin tones (lower centre) and other decorating colours, with white, grey and black patches in sequence around the perimeter. It was viewed and photographed at arm's length (approximately 65 cm) under each source of illumination (Fig. 3).

Figure 3. SG colour chart photographed under magenta, yellow and cyan illumination.

The images taken by the camera show the 'true' colour cast of the illumination; if the automatic white balance function had been enabled this would of course have been corrected back to near neutral in each case. The visual appearance of the chart, however, was rather different. Initially the whole chart seemed to have the colour cast of the 'after image' colour, depending on which source of illumination had previously produced the adaptation. After several minutes, when the after-effects had faded and the eye had become adapted to the present illumination, the chart appeared more or less normal, though suffused with the intervening layer of coloured mist. It was noticeable that under the cyan illumination, in the central 6-step grey scales, both forward and reverse, the three lighter patches appeared still slightly tinged with the colour of the illumination (bluish), but the three darker patches appeared slightly tinged with their complement (yellowish). The effect was also present, but much less obvious, under the magenta and yellow illumination.

3. DISCUSSION

What we observed was the Helson-Judd effect. In a long series of experiments, Helson (1938) placed a series of observers in an immersive viewing environment consisting of a wooden booth, lined with white or grey card. The illumination from above was produced by a powerful tungsten lamp passed through one of four filters (red, yellow, green, blue, with dominant wavelengths of 643, 596, 546 and 461 nm respectively) and a ground glass diffuser. Variable amounts of the filtered light and white light could be mixed together to control its colour saturation. Each observer was trained beforehand in the dimensions and scaling of the Munsell colour system, and asked to use these scales when in the booth to judge the perceived colour of neutral samples after adaptation to the illumination. Helson concluded that: "Other things being equal, the background reflectance is the most important factor determining the adaptation level and hence the colors of samples appearing on it." And consequently: "Samples above the adaptation reflectance take the hue of the illuminant color; samples below it, the hue complementary to the illuminant hue; while samples near the adaptation reflectance are either achromatic or greatly reduced in saturation." His results (Fig. 4) show observer judgements of colour saturation over the range ±8 Munsell units for red, yellow and green illumination

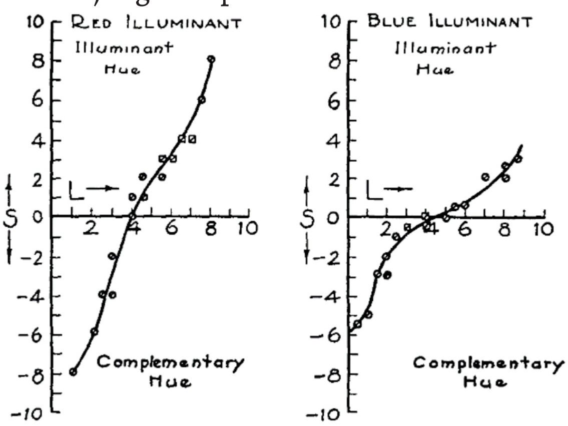

Figure 4. Perceived colour saturation of achromatic samples under chromatic illumination (from Helson, 1938).

and ±5 units for blue. He also found that, with only 1% of unfiltered lamp light mixed into the filtered illumination, samples began to lose their chromatic appearance, and when 7% lamp light was added to the chromatic illumination almost all the samples returned to their natural appearance, and were again called achromatic by observers.

The Helson-Judd effect was considered important enough by Hunt (1991) to include it in his complete model of colour appearance. Fairchild (2005), however, has been inclined to dismiss the effect as "probably unimportant in practical situations" because Helson's illumination was nearly monochromatic, and "it is not possible to observe the Helson-Judd effect under normal viewing conditions" with broadband illumination.

We used a hand-held GL Optic Spectis spectrometer to measure the radiant power in the installation over the wavelength range 330 to 770 nm at intervals of 2 nm. Fig. 5 (left) shows superimposed graphs for the magenta, yellow and cyan lights, indicating that the underlying fluorescent source was the same in all cases, with emission peaks at 405, 435, 489, 544, 589, 614 and 709 nm. The effect of the filters was to attenuate the power in the medium, short and long regions of the spectrum respectively. This was not broadband illumination, but neither was it monochromatic, because two out of the three LMS photoreceptors were stimulated in each case.

The chromaticities of the three lights were calculated, using the tristimulus functions for the CIE 1964 10° Supplementary Observer, interpolated to 0.5 nm intervals and plotted in the CIE 1976 u',v' chromaticity diagram (Fig. 5 right). Taking the mean of the three chromaticity coordinates as the neutral point, the dominant wavelength and excitation purity for each light were also calculated (Table 1). It can be seen that the dominant wavelength for magenta lies at the red end of the purple line, and that its purity is only 0.2, so nowhere near monochromatic. By convention, the complementary wavelength (green) is quoted. Yellow was most chromatic, and cyan intermediate.

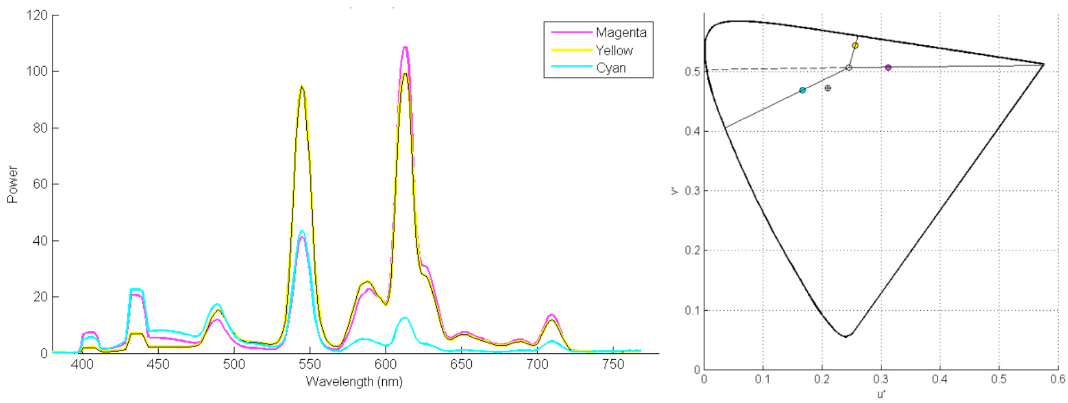

Figure 5. (left) Spectral power distributions of illumination sources; (right) Positions of lights in u'v' uniform chromaticity diagram. The position of equi-energy illuminant SE is shown by cross.

	x	*y*	*u'*	*v'*	*Dominant λ* (nm)	*Purity*
Magenta	0.4898	0.3538	0.3127	0.5082	493 (comp)	0.200
Yellow	0.4783	0.4506	0.2568	0.5443	576	0.691
Cyan	0.2745	0.3420	0.1675	0.4696	483	0.373

Table 1. Colorimetric coordinates of the three light sources.

The really interesting questions arising from this study are: why did the cyan illumination produce a stronger after-image than the other lights, and why did it evoke the Helson-Judd effect when it was not particularly saturated? We suggest that the changing chromatic environment when moving between the yellow and cyan lights approximated the trajectory of the Cerulean line that connects the predominant components of daylight: yellowish sunlight and bluish skylight (Mollon, 2006).

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Coloured Filter Lenses May Enhance Colour Vision Perception in Colour Vision Deficient People and Dyslectic Patients

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ABSTRACT

Aim: To show that colour vision deficient people may benefit from colored filters as glasses or contact lenses. Material and methods: The author has papers about using colour filters in colour vision deficient people. The papers about fitting colour vision filters and author's personal experience are reviewed. The colour perception is measured clinically with Ishihara pseudoisochromatic charts or Wang and Wand pseudoisochromatic charts. Ishihara charts have only red-green axis, but Wang and Wang charts have red-green and blue-yellow axis in measuring clinical colour vision. In the colour examination each eye's colour perception should be evaluated separately. The examination of the fitting of the colour filters is made also for each eye separately. Results: The disparity between the eyes in colour perception is in colour deficient people higher than in colour normal people. So mostly, almost always both eyes need colour filters in different colours. The results are mostly satisfactory for the patients. In 90 % of the cases the colour perception becomes better in (so called) Ishihara Index. It rises about 30-90 % in each individual patient. The perception achieves maximally about 1/3 of the different colours in normal colour vision. But the patients are mostly satisfied because they achieve colour ranges that are much higher than in their previous lives until that day. The pure dyslectic (reading difficulty) patients seem to have a subclinical interocular colour vision deficiency, so they benefit also in high rates from colour filters. Conclusion: The colored filters as glasses or contact lenses can be used successfully and efficiently in colour vision deficient people and dyslectic patients.

Colour Vision in Normal Aging, Congenital Deficiency and Retinal Disease

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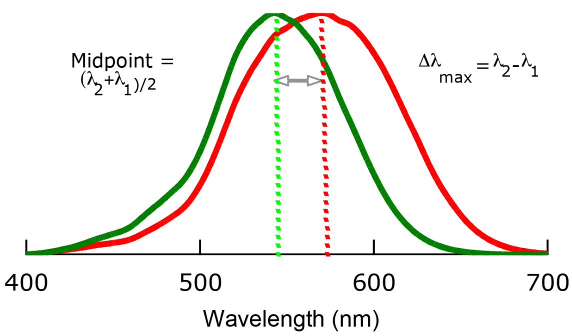
ABSTRACT

Significant advances in understanding the genetics of colour vision make it possible to account for much of the observed variability in both 'normal' trichromatic colour vision and in congenital colour deficiency (J. Neitz & Neitz, 2011; M. Neitz & Neitz, 2000). Recent developments in colour assessment techniques yield reduced within subject variability and hence more accurate assessment of both red / green (RG) and yellow / blue (YB) loss of chromatic sensitivity (J.L. Barbur & Connolly, 2011; J.L. Barbur & Rodriguez-Carmona, 2012) with reliable classification of the subject's class of colour vision (i.e., normal trichromatic colour vision, deutan-, protan- or tritan-like and acquired deficiency). The least and most sensitive young normal trichromats exhibit a ~ 2.2-fold variation in RG and YB chromatic sensitivity. The smallest thresholds correspond to ~ 20 years of age with ~ 10% increase per decade for RG and ~ 16% for YB colour vision. 'Normal' aging therefore only doubles one's threshold over the lifespan, an increase that is hardly noticeable (J.L. Barbur & Rodriguez-Carmona, 2015). Congenital deficiency, on the other hand, yields a continuum of thresholds from just above the normal limits of trichromatic colour vision to complete loss of sensitivity. Subjects that rely on a normal M- and a variant M-pigment for their residual RG colour vision (i.e., the protanomalous) are more affected and in general exhibit greater loss of sensitivity than deuteranomalous observers. Acquired loss of colour vision is more common than congenital above 55 years and its incidence increases gradually with age. It is particularly prevalent in subjects with diseases of the retina such as glaucoma and age-related macular degeneration or systemic diseases that affect vision, such as diabetes.

1. INTRODUCTION

Several studies that investigated colour vision changes, particularly in relation to acquired loss of chromatic sensitivity, failed to produce consistent results, largely because of poor understanding of the inherent variability in human colour vision, but also because of large differences in sensitivity and specificity associated with the variety of methods employed to assess colour vision (Rodgers, et al., 2009). The aim of this review is to examine the most important factors that cause increased variability in colour vision and to illustrate how RG and YB colour vision varies in normal trichromats, in congenital deficiency and in subjects with acquired loss.



Genetic factors determine the wavelength separation,($\delta\lambda_{max}$), between the peak spectral responsivities of M and L cones, the relative numbers of L and M cones per unit area of the retina (i.e., the L/M ratio) and the corresponding photo-pigment optical densities. Changes in each of these parameters can affect chromatic sensitivity.

Other factors include changes in the spectral absorption properties of the optics of the eye, effects of normal healthy aging, neural noise and diseases of the retina or systemic diseases that affect vision.

2. METHOD

We examined over 1000 subjects by assessing each participant's colour vision with the Colour Assessment and Diagnosis (CAD) test, Ishihara (38 plates edition) and the anomaloscope. Fig. 1 shows the stimulus conditions for the CAD test and the relationship between the measured RG and YB thresholds and the corresponding cone contrasts generated by the coloured stimulus. The measured thresholds relate linearly to the contrast signals generated by each coloured stimulus in S-cones (b) and in L- and M-cones (c). The age distribution of the 330 subjects that define the 'Standard Normal' (SN) CAD observer is shown in section (f). For convenience, all thresholds are expressed in Standard Normal (SN) CAD units (i.e., a subject with a RG threshold of 3 units requires 3 times greater colour signals to just see RG colour differences when compared to the mean threshold for young, healthy normal observers). The cone contrasts generated by the coloured stimulus are directly proportional to the subject's YB (section b) and RG (section c) colour thresholds. Although this relationship may not hold at every stage of chromatic processing along the visual pathways, it is reasonable to assume that the measured CAD thresholds are indicative of the subject's severity of colour vision loss.

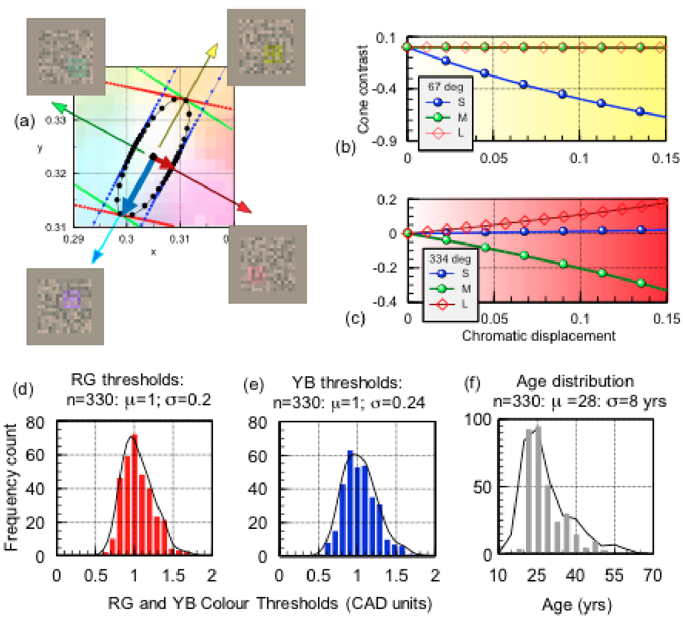


Fig. 1. Section (a) shows the colour displacement directions that isolate the YB and RG chromatic mechanisms in the CIE – (1931) chromaticity chart, together with screen dumps that show the YB and RG colour-isolating directions. The smallest colour signal strength needed to just see 'red', 'green', 'yellow' or 'blue' colours is measured along each of the four axes. The statistical distributions of these thresholds are shown for RG (d) and for YB (e) axes (for 330 young subjects with normal trichromatic colour vision). The mean YB and RG thresholds are shown as blue and red arrows in section (a). When normalized with respect to the corresponding means the results show ~ 2.2-fold variation in both RG (d) and YB (e) chromatic sensitivity (from Barbur and Rodriguez-Carmona, BMB (2016)).

3. RESULTS

3.1 Normal trichromats

Fig. 1 (d & e) shows the frequency distributions of RG and YB thresholds measured in 330 normal, young trichromats. The results reveal a ~ 2.2-fold variation between the most and least sensitive young subjects.

Fig. 2 shows the ranked distribution of RG thresholds in deutan (a) and protan subjects (b). Fig. 2 (c) shows the RG CAD thresholds plotted against the subject's ($\delta\lambda_{max}$) estimated from genetic analysis of cone pigment genes (J. L. Barbur, et al., 2008). The deutan and protan subjects included in the genetics study are indicated as black crosses in Fig. 2 (a, b), respectively.

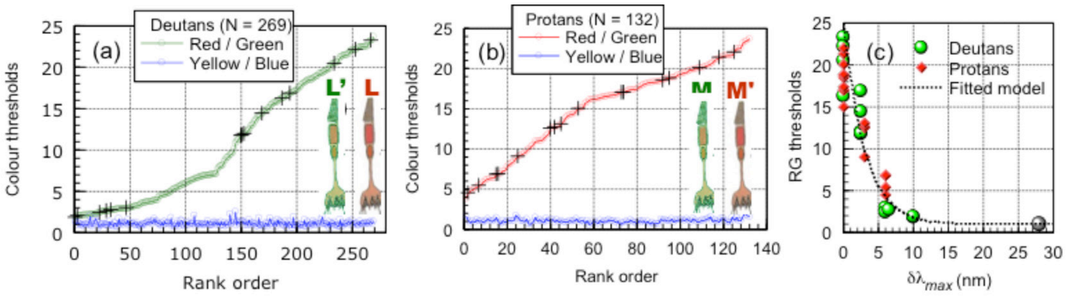


Fig. 2. Ranked distribution of RG thresholds in 269 deutan (a) and 132 protan subjects (b) together with the corresponding relationship between the subject's RG threshold and $\delta\lambda_{max}$ (c). The grey coloured disc in (c) plots the mean threshold for a normal trichromat and corresponds to a wavelength separation of ~ 28 nm.

The results (section c) show that the severity of colour vision loss is strongly determined by $(\delta\lambda_{max})$ and that a spectral separation greater than ~ 16 nm is sufficient to achieve 'normal' chromatic sensitivity. Significant inter-subject variability is observed, for the same $(\delta\lambda_{max})$, which suggests the involvement of other factors including neural noise and within subject variability.
The most interesting observation is the residual chromatic sensitivity subjects demonstrate even when, according to genetics, the same pigment class populates both L and M cones (i.e.,$(\delta\lambda_{max})$= 0 nm). This residual chromatic sensitivity has been attributed in the past to differences in pigment optical densities, which can affect both the quantum catch and the width of the cone's spectral sensitivity function (He & Shevell, 1995; M. Neitz, et al., 2004).

3.2 Effect of 'normal' healthy aging

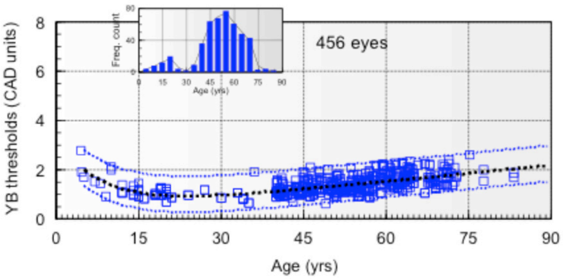


Fig. 3. Binocular YB thresholds as a function of age for subjects deemed to have normal colour vision. The mean binocular thresholds as a function of age are given by: RG_{bin} = 0.698 + 0.0121*age +3.373*exp (-0.19*age) and YB_{bin} = 0.24 + 0.0218*age +2.99*exp (-0.1136*age). (J.L. Barbur & Rodriguez-Carmona, 2015)

Subjects within the age range 4 to 90 years of age took part in this study (215 females and 197 males). Exclusion criteria were applied to 'filter' out subjects with congenital and acquired colour vision deficiencies. Data are available for both RG and YB thresholds for monocular and binocular viewing conditions (J.L. Barbur & Rodriguez-Carmona, 2015).

The results show that RG and YB colour thresholds decrease rapidly with increasing age during the first year of life with a more gradual decrease that continues into adolescence (Knoblauch, Vital-Durand, & Barbur, 2001). The smallest thresholds correspond to ~ 20 years of age with a steady, almost linear increase of ~ 1% per year for RG and ~ 1.6% for YB over the remaining lifespan. The loss of myelinated retinal ganglion cells axons and cell bodies with increasing age follows a similar trend and may account, at least in part, for the observed loss of chromatic sensitivity.

3.3 Acquired loss of chromatic sensitivity

Over 55 years of age, acquired loss of colour vision, and in particular YB loss is more common than congenital colour deficiency. In glaucoma, parafoveal loss often precedes foveal loss with almost no difference between RG and YB loss (Rauscher, Chisholm, Edgar, & Barbur, 2013). Patients with early stage, age-related macular degeneration (AMD) exhibit greater YB loss, but the differences become negligible in those diagnosed with retinopathy. Over 70% of patients with diabetes exhibit varying degrees of colour vision loss (in the absence of retinopathy) with thresholds ranging from just above age-matched normal limits to complete absence of colour vision (O'Neill-Biba, Sivaprasad, Rodriguez-Carmona, Wolf, & Barbur, 2010). The loss affects both central and peripheral areas of the retina and in AMD is also present in the functionally unaffected fellow eye. More work is needed to establish the extent to which loss of colour vision precedes clinical signs in both diabetes and AMD. Preliminary results suggest that early changes in colour vision may be an important risk factor in pre-screening for diabetes.

4. CONCLUSIONS

Colour assessment has become easier to carry out with 100% sensitivity and specificity in screening for normal trichromatic colour vision. The severity of colour deficiency can also be quantified accurately with reliable separation of RG and YB loss. The latter allows a clear distinction between congenital and acquired loss. The availability of more reliable, age-related threshold limits for RG and YB colour vision in normal trichromats makes the use of colour assessment more attractive and effective in detection of early signs or retinal or systemic diseases that affect vision.

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Superiority of Dichromats in a Visual Search Task Cued by S-cone Stimulus Value

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ABSTRACT

People with colour-vision deficiency typically perform poorly in colour perception tasks. Morgan et al. (1992), however, reported that dichromats exhibited superior performance in penetrating camouflage in a visual search task involving red-green mosaics. In their experiment, the red-green mosaic consisted of colours that served as distracting visual noise for trichromats, but did not affect dichromats. In the present study, we designed an experimental condition in which trichromats and dichromats could perceive the same number of colours. We investigated whether dichromats showed superior performance over trichromats in a visual search task where the stimuli were distinguished only by a difference in S-cone stimulus value. Participants observed 13 disks (1 target and 12 distractors) on a CRT monitor. Two colours were used as distractor colours, which had different S-cone stimulus values relative to the target colour, and were assigned to six disks each. The observer's task was to report which quadrant the target colour was located within. Our results showed that dichromats exhibited superior perceptual performance to trichromats. We propose that this effect may be caused by a difference in categorical colour perception between trichromats and dichromats.

1. INTRODUCTION

The human visual system provides important information about the outside world. Colour information serves a particularly important function for humans. People with congenital colour-vision deficiency typically show poor performance on colour discrimination tasks, because they are unable to discriminate particular colour combinations, referred to as "confusion colours". Some research, however, suggests that people with colour-vision deficiency might have advantages in mesopic and scotopic vision. Moreover, there is anecdotal evidence that during the Second World War, people with colour-vision deficiency could more easily penetrate camouflage than those with normal colour vision (Judd 1943). Morgan et al. (1992) investigated the ability of dichromats to penetrate camouflage using a visual search task. A uniform texture area was displayed, in which the orientation and/or the size of the texture elements in the target region differed from those in the rest of the pattern. In the camouflage condition, the elements were coloured to create a random red-green mosaic pattern. Observers were asked to identify the target area. The results showed that target identification accuracy was lower for trichromatic observers than for dichromatic observers in the camouflage condition. Whereas the red-green mosaic served as distracting visual noise for trichromatic observers, it did not affect dichromatic observers, because the red and the green functioned as indistinguishable confusion colours for dichromats. In the current study, we designed an experimental condition in which trichromatic and dichromatic observers could perceive the same number of colours. We investigated the performance of dichromats and trichromats in a visual search task where stimuli were distinguished solely by a difference in S-cone stimulus values among the stimulus colours.

2. METHOD

2.1 Apparatus and Stimulus

Colour stimuli were presented on a 17-inch CRT monitor (Sony HMD-H200) controlled by a computer (Apple Mac mini) in a dark room. The viewing distance was 53 cm. Figure 1 shows an example of colour stimulus used in the experiment. Thirteen coloured disks (1 target and 12 distractors) with a diameter of 1 degree were displayed on a grey background. The disks were arranged in equal intervals on the circumference of a circle with a radius of 4 degrees. The luminance of the background was 15 cd/m2 and the chromaticity was as same as the D65 chromaticity. The luminance of the disks was 10 cd/m2.

The disk colours were defined on the equal luminance plane in LMS colour space defined by the cone fundamentals proposed by Stockman and Sharpe (2000). Their luminance (Y) and chromaticity coordinates (l, s) were calculated using the following equations:

$$Y = 0.692L + 0.349M \quad (1), \qquad l = \frac{0.692L}{Y} \quad (2), \qquad s = \frac{S}{Y} \quad (3)$$

The chromaticity coordinates (l, s) of the D65 white point calculated by Eqs. (2) and (3) were (0.69, 0.5). The chromaticity of target (ltar, star) and distractor (ldis, sdis) colours was changed as follows: the ltar of the target colour was one of 0.66, 0.67, 0.68, 0.69, 0.70, 0.71, and 0.72, and the star was chosen from 0.3, 0.5, and 0.7. Two colours were used as distractor colours. The ldis coordinates of the two distractor colours were equal to the ltar of the target. The sdis coordinates were assigned to two values: star+0.2 and star-0.2. All disks were equal in L-cone stimulus value and M-cone stimulus value, but not in S-cone stimulus value. The target colour was assigned to only one disk, and each of the two distractor colours was assigned to six disks (see Figure 1). The assignment of the target colour and the distractor colours to the disks was randomized in each trial. Further, the position of the disks was rotated at random in every trial to avoid local chromatic adaptation.

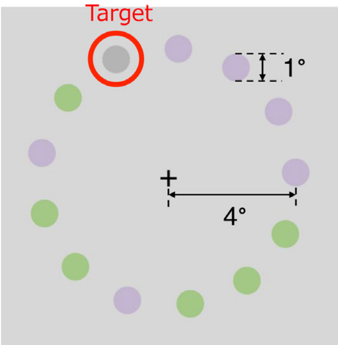

Figure 1. Experimental stimulus.

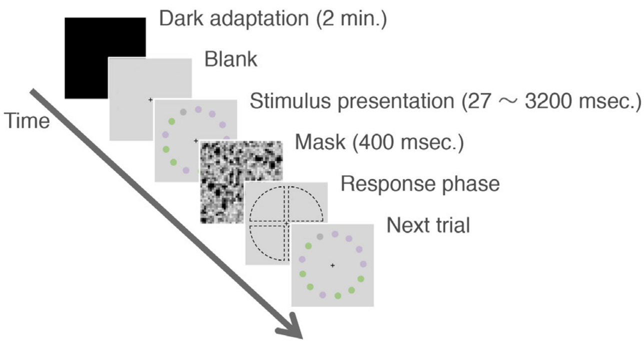

Figure 2. Experimental procedure.

2.2 Procedure

Figure 2 shows the experimental procedure. Each session began after 2 min of dark adaptation. The stimulus was presented at one of seven durations, selected at random: 27, 53, 107, 200, 400, 800, 1600, and 3200 msec. After stimulus presentation, a mask stimulus consisting of achromatic random dots was presented for 400 msec to prevent a colour afterimage. The observer's task was to locate the target disk, to which the target colour was assigned, and to report which quadrant contained the target colour. We measured the percentage of correct reports of the target position as a function of the stimulus duration for each target colour. Each session consisted of 168 trials for each combination of the target colour and the stimulus duration. Each observer performed 30 sessions.

Three protanopes, three deuteranopes, and five normal trichromats participated in the experiment.

3. RESULTS AND DISCUSSION

Figure 3 shows the results for each colour vision type when star was 0.5. The abscissa represents the stimulus duration. The ordinate represents the proportion of correct responses. The different symbols indicate the different l values of the target and the distractor colours. The different lines indicate Weibull fitted curves for the results of the different target colours. As the stimulus duration increased, the proportions of correct responses were higher for all colour-vision types. The increased rate of correct responses of normal trichromats depended on l values, but those of protanopes and deuteranopes did not.

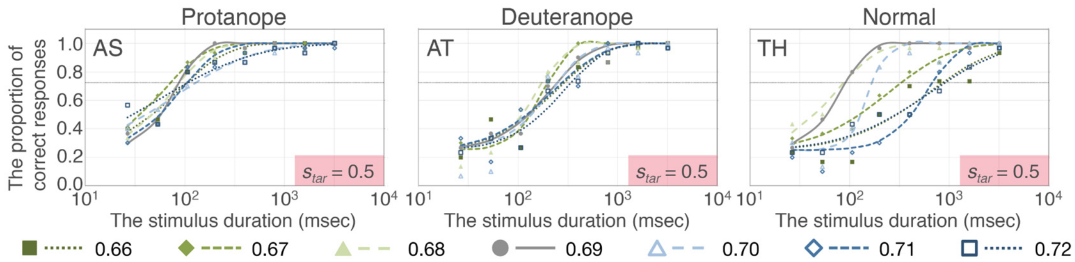

Figure 3. Relationships between the stimulus duration and the proportion of correct responses for each colour vision type (star = 0.5)

We calculated duration thresholds providing the proportion of correct responses of 0.724 to quantify the correct responses increasing with the duration. Figure 4 shows the geometric means of the duration thresholds for each colour-vision type. The abscissa represents the l values. The ordinate represents the duration threshold. The coloured symbols represent the different colour-vision types. The error bars represent standard errors.

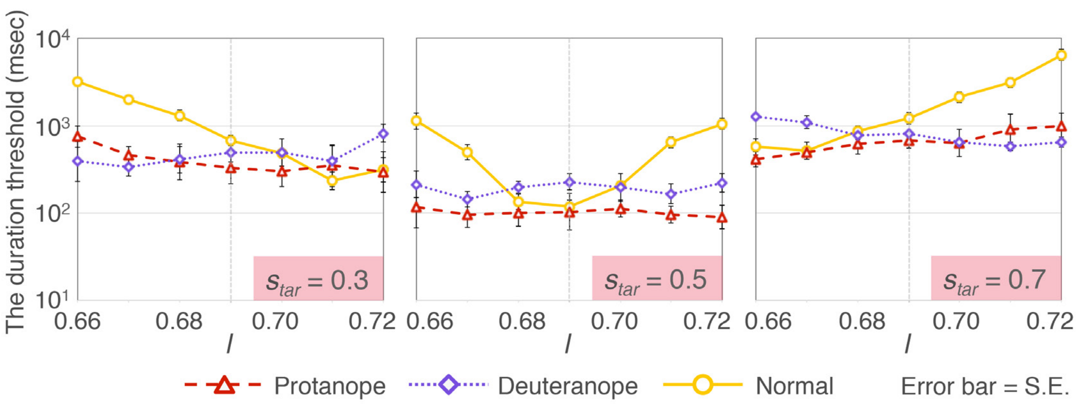

Figure 4. Comparisons of the duration thresholds among the colour-vision types

The duration threshold of trichromats was shortest when the target stimuli (ltar, star) = (0.69, 0.5), which was the D65 chromaticity. Moreover, the duration threshold was longer when the l value was further from 0.69 in the star condition of 0.5. In contrast, the duration thresholds of protanopes and deuteranopes were not substantia-

lly influenced by the l value in that condition and were shorter than those of trichromats in the l conditions of 0.66, 0.67, 0.71, and 0.72. This suggests that the difference in the influence of the l value may have been caused by a difference in categorical colour perception between trichromats and dichromats. When star = 0.5, dichromats perceived the target colours as achromatic, regardless of the l value, because the slope of confusion line through the achromatic point was almost horizontal in the tested range of l values. In contrast, trichromats perceived the target and the distractor colours as identical categorical colours in the l condition of 0.66 or 0.72, because the target and distractor colours were perceived as greenish when l = 0.66, and reddish when l = 0.72. Therefore, the tasks were easier for dichromats than for trichromats, because dichromats only had to find an achromatic colour from the 13 disks.
Even when star = 0.3 or 0.7, the results could be explained by the same phenomenon for star = 0.5. That is, it took relatively longer for trichromats to identify the target colours among the identical categorical colours that the target colour and the distractor colours belonged to.

4. CONCLUSIONS

The current results showed superior performance of dichromats in a visual search task. These findings demonstrate that dichromats were able to more easily identify a target colour than trichromats in a multi-coloured environment consisting of colours that could be discriminated by both groups. This effect may be caused by a difference in categorical colour perception between trichromats and dichromats.

ACKNOWLEDGEMENTS

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Color Selection for the Development of a Color Vision Test for children with ASD

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ABSTRACT

The visual perception in children with ASD (Austism Spectrum disorder) has been of particular interest among many researchers in the past years. These developmental disorders have shown atypical responses to visual stimuli, in particular color perception, suggesting a distinct processing of sensorial information. The Neitz, the Roth 28, The Chromatic Contrast Discrimination Threshold Test (CCDTT), the Farnsworth-Munsell 100-Hue Test, among many others, have been widely used by researchers as tools to study color perception and discrimination among patients with ASD. However, such tests involve the arrangement of color caps with just noticeable differences (JND) in color, or the discrimination of color figures and patterns. Such tasks are complex and can be difficult to isolate for those with atypical sensory processing. Therefore, it is important to develop psychophysical tools that simplify the assessment of color perception in patients with ASD. This study shows the selection of colors for the development of a color vision test especially designed for children with ASD. A total of 28 colors were selected out of 116 by a group of people with color vision problems. Later, the 28 colors were compared to those of the Ishihara test and FM Munsell and based on the confusion lines used for the construction of color vision test, a final selection of 11 colors is proposed.

Estimating Chromatic Adaptation in a Museum Environment Using a Tablet Computer

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ABSTRACT

Colour constancy has been explored extensively in the past in lab environments, using a multitude of experimental arrangements and stimuli. Rarely has the phenomenon been investigated in real environments, natural or unnatural, due to the large number of uncontrollable variables and the methodological logistics involved. A potential method for testing chromatic adaptation point, using achromatic setting on a hand-held tablet computer, is proposed and explored.

1. INTRODUCTION

It is generally assumed that a person can adapt fully to light of any chromaticity within a reasonable distance of the daylight locus, meaning that the light itself will appear achromatic and that the colours of objects under such illumination will maintain their chromatic inter-relationships. This process occurs with such effortlessness and efficiency that observers are generally completely unaware of the process, or the extent of the objective change that it masks.

Colour constancy is probably never 'complete' in the general understanding of the term, however, and degrees of colour constancy vary with the methodology used to measure them. Factors include the question asked to the observer (Arend and Reeves, 1986), individual observer 'ability' (Lee and Smithson, 2016), available object types (Kraft and Brainard, 1999), and direction of illuminant colour shift (Pearce et al., 2014). As a result of these and other factors, the point of perceptual achromacy is generally agreed to be somewhere along the line connecting the chromaticity of an object of uniform reflectance in the 'pre-adaptation' illumination and chromaticity of the same object under the 'post-adaptation' illumination. Understanding colour constancy in museum environments is of particular interest because the choice of lighting chromaticity can have implications for conservation (CIE, 2004).

Figure 1. The UCL Grant Museum of Zoology.

Measurement of the state of an observer's chromatic adaptation in real world environments is rarely undertaken (although see Kuriki (2006), due to the complexity involved in creating or sourcing the necessary portable measuring equipment, and the difficulty in accurately monitoring the environment whilst performing such experiments. One method extensively used in the investigation of chromatic adaptation in controlled environments is 'achromatic setting', whereby an observer is instructed through some mechanism to vary the appearance of a stimulus until it appears achromatic. Smithson (2005) notes that the level of colour constancy achieved by human observers is typically less for simulated scenes than for real scenes, and that the typical performance with scenes presented on computer monitors suggests only

50% compensation.
The method proposed here implements achromatic setting in a convenient form that can be used in a range of environments, with the aim of probing the perceptual mechanisms that underlie colour constancy. After a description of the apparatus and method, we report on two initial experiments to explore its applicability.

2. PROPOSED METHOD

The proposed method uses a portable tablet computer, running psychophysical stimulus presentation software (Peirce, 2007), to present two-dimensional colour gradients across isoluminant a*-b* chromaticity space. Observers indicate the point on the display that best represents their personal notion of achromacy (grey) by touching the position with the tip of a finger. After completion of multiple trials, where the stimulus is randomly rotated and translated by ±1/3 of the width and height of the display, a mean and standard deviation are computed to represent the set of given responses. An alternative would be to present successive single dimensional gradients.

Figure 2. An illustration of the presentation device displaying the stimulus.

The question of how many trials need to be completed requires careful consideration. It is assumed that there are unknown variables, which could cause an observer to select a different point depending on the specific stimulus displayed (which varies between trials through rotation and offset), and also that input precision is limited by the input method. It is therefore prudent to take an average over multiple trials, and thus over time, but this assumes that the observer's responses to stimuli are stable throughout the test. If we imagine a session with 30 trials, where each response is made within 2 seconds of the stimulus becoming visible, the session would take no longer than one minute. This should not pose a problem when considering short-term colour constancy (Rinner and Gegenfurtner, 2000), but prior adaptation over longer time periods (MacDonald and Roque, 2013) might influence results. Further, an observer might develop a specific 'technique' as the experiment progresses.
It is unclear whether observers will treat this task as a 'paper match' type of test, or as a 'hue/saturation/lightness' (h/s/l) matching type of test. See Foster (2011) for a discussion of this distinction. A tablet computer screen is an emissive device which is minimally influenced by its surroundings, and thus one might expect a h/s/l type match to be made, and yet it is designed to replicate the functionality of paper, with a well-known reflective surface for which one might expect the natural response to be of a 'paper match' type. Further considerations for this method include the effect of specular reflections from the screen surface, the tendency of an observer to use the periphery of the display device as a colour matching aid (assuming it is neutral), and a tendency for spatial bias towards the physical centre of the presented range.

3. EXPERIMENTS

Two experiments were performed, both utilising the above method on a Dell Latitude 10 ST2 tablet computer with 'BROTECT' Matte Screen Protector (223x126 mm active screen area, 1366x768 pixels, with a pixel pitch of 0.16 mm). The stimulus was specified in CIE L*a*b* values (L*: 60 uniformly across field, a*: ranging linearly from -50 to 50 from one side of the field to the other, and b*: as for a*, but along the perpendicular axis) so that the stimulus was of uniform lightness and smoothly changing hue and chroma. L*a*b* values were converted to XYZ tristimulus values, basing reference white on the XYZ tristimulus values of the display at maximum white (with screen protector). Linearisation of the measured device-dependent values was achieved through the use of a look-up table, computed by spline interpolation of the measured outputs at 15 pixel value increments from 0 to 255. The above was accomplished within Matlab. The stimulus was then saved as an 8-bit tiff image, which could be easily loaded and manipulated by the psychophysical stimulus presentation software PsychoPy. The stimulus was randomly translated and rotated at each trial. Throughout each experiment ambient lighting measurements were taken with a GL Optis 1.0 Touch spectroradiometer.

3.1 Experiment 1

In the first experiment 23 observers, who were members of the public at the UCL Grant Museum of Zoology, performed 10 trials, followed by 10 touch calibration trials (where the observer was asked to touch an unambiguous point on the screen, which varied spatially in the same manner as the previous colourful stimulus). The aim of this experiment was to examine inter-observer variability. Non-identifying demographic data was gathered for later analysis. The museum is lit with a mixture of artificial and natural lighting from large windows (see Figure 1).

3.2 Experiment 2

In the second experiment, two of the co-authors of this paper, referred to as DG and LM, undertook an extended version of the above, with 190 core trials followed by 10 touch calibration trials, in various locations, across several days with repeats in controllable environments. The aims of this experiment were to assess intra-observer variability, and also to ascertain an appropriate number of trials for future participants. 13 full data-sets were collected.

4. RESULTS AND DISCUSSION

For analysis, all achromatic selection data has been converted to CIE L*u*v* co-ordinates relative to the display white, in order that comparisons to the illumination chromaticities can be made.

4.1 How many trials?

Computations were performed upon the data from Experiment 2 to query what number of trials would be required for future studies. For each of the 13 full data-sets (consisting of all u*v* values of selected achromatic point, corrected by spatial calibration, for a single observer in a single location and session), subsets were created by randomly sampling n points from a full set, with n=10 to n=190 progressively. For each new subset the standard deviation, standard error of mean (SEM) and 'confidence interval - 95%' (CI95) values were calculated, and averaged across all 13 full data-sets, see Figure 2. The CI95 value defines a region either side of the calculated mean, within which there is 95% confidence that the real mean lies. A low value of CI95 is preferable.

It can be seen that for only 10 observations the CI95 is roughly 1.8 u* units or 2.5 v* units either side of the mean. This level of uncertainty would be impractical for analysis of data where the differences in selection point approach these values, but might be acceptable if the levels of difference are greatly in excess of this. After approximately 35 trials, the CI95 drops to 1.0 u*, and after 60 trials the same value is attained for v* units. So 35 trials is probably acceptable in most situations, but for greater precision it can be seen that the CI95 continues to drop as the number of trials is increased further. In practice the estimates for low numbers of trials are likely to be high; due to the resampling method (random, which would ignore slow drifting trends) and the use of the mean rather than the median, as is used in further analysis.

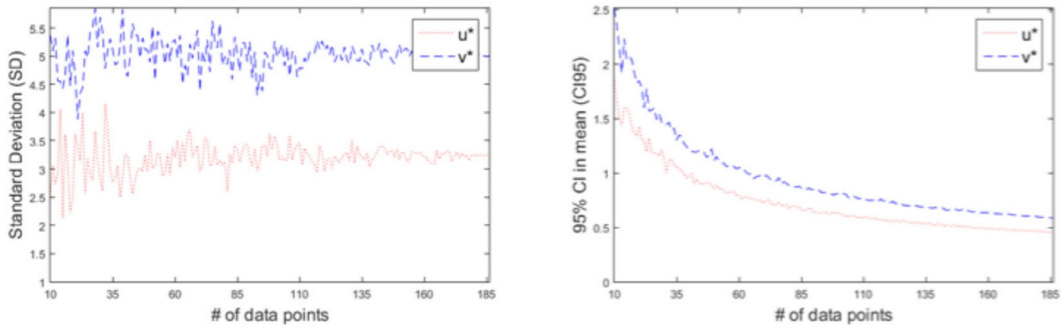

Figure 2. Standard Deviation and CI95 of progressively larger random samples of real data.

4.2 Inter-observer, intra-observer, and location-based variation

In Experiment 1 the standard deviations of the selected points (after data-cleaning where the single furthest data-point from the mean of the cloud was removed in order to filter out mis-selections) for each observer ranged from 1.5 to 14.5 for u* and 2.1 to 13.9 for v*. The standard deviation across observer sets (the apparent inter-observer variation) was 8.0 u* and 13.1 v*. The achromatic points cluster around the numerical neutral point of u*v* chromaticity space. It is not clear to what extent variations in selected neutral point in this dataset were due to inter-observer variation, system noise or variations in lighting conditions. For each observer trial 2 and trial 7 were undisclosed repeats of identical stimuli, and from this an indication of intra-observer variation was calculated: mean difference was 4.0 u*, 5.2 v*. The data gathered in Experiment 2 is presented in Figure 4, where ring centres represent median u* and v* values and the ring diameter equals standard deviation for each dataset. Lines project to the chromaticity of the ambient illumination in each environment, with u*v* values shown numerically. Standard deviations within this experiment range from 2.4 to 4.1 for u*, and 3.2 to 5.0 for v*. The environment with the most repeats was a basement room where there was no natural light ingress, and thus the lighting was constant (fluorescent tubes).

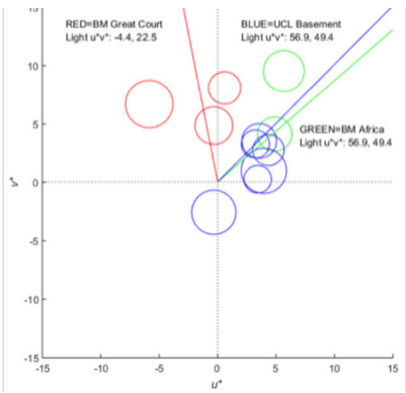

Figure 4. Chromatic adaptation results for two observers in three illumination environments.

ACKNOWLEDGEMENTS

Thanks to the Grant Museum of Zoology and the British Museum for the use of their spaces, and to the members of public who volunteered their time in taking part in Experiment 1. Experiment 1 was approved by the UCL Ethics committee: Project ID Number: 9357/001. Code used to create the stimuli and analyse data collected is available on github (github.com/da5nsy/SAPS). Collected data is hosted by UCL (http://discovery.ucl.ac.uk/1507912/), and further analysis is welcomed.

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Toward Colour Rendering of Selected Advanced Glazing Types

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ABSTRACT

For most people, the correct perception of colours of objects and room surfaces is an important part of the quality of life. The aim of this study was to increase understanding of glazing materials' effect on perceived colours. The study is based on the visual observation of colour appearance of nine test colour samples in a sequence of experimental situations by participants.
The following research question was studied: How is the perception of colour influenced by glazing types in combination with light of various colour temperatures (CT)?
The experiment was carried out at Daylight laboratory at NTNU, Light & Colour Group. It has been repeated with three different glazing types: electrochromic (EC), electrotopic (ET) and photochromic (PC) glass in combination with three different CTs of exterior light, 2700K, 6500K and 8000K. Since all the 21 subjects received all stimuli, this experiment had within-subject design.
The results from n-way ANOVA show that the effect of colour temperature of light is rather weak. However, a clear colour difference between the outside and the inside appearance of samples was observed for most of glazing types.

1. INTRODUCTION

How colours are perceived is determined by numerous factors, including individuals' vision and perception, surrounding background, light source, light direction, colour of light etc. The colour of light produced by a light source determines the apparent colour of objects, the atmosphere of the space, and the quality of the interior.
For most people, the correct perception of colours of objects and room surfaces is an important part of the quality of life. In this study the main focus is on the effect of coloured light created by the imitated daylight of various colour temperatures and passing through different glazing types. The window glass functions as an optical filter with a specific spectral transmittance and therefore it has impact on the spectral power distribution of the light passing through.
The interaction between light and colour might cause colour shift especially in interiors situated under different light sources i.e. having different colour temperatures. New glazing technologies and new materials are under development to meet the present trend to build large prestigious glass façades, which also enable utilization of daylight and ensure visual comfort and possibility to keep visual contact with outdoor environment. Very little is known about the impact of such modern glazing types on the perception of colours. Our question was: How is the perception of colour influenced by glazing types in combination with light of various colour temperatures?
Colour is not the property of objects, spaces or surfaces; it is the sensation caused by certain qualities of light that the eye recognizes and the brain interprets. The brain and eyes work together to enable us to see objects and colours. Just the participation of people is very much needed in studies of colour appearance.

2. METHOD

The research method was partly based on Matusiak et al. (2012) and Arbab, Matusiak (2015).

2.1 Experimental setting

Since it is easier and more economical to change the glazing in the small model rather than in a real room, the study was entirely done using a scale model. In order to answer the research question, a model with two rooms in the scale 1:5 was used; each room was 60 x 60 x 60 cm and represented an office room 3 x 3 x 3m.
The model on the right hand side (Figure 1) functioned as a test room with the tested glazing and the second one as a reference room without any glass (Figure 1).
The walls, ceiling and floor of the model were constructed using 5mm MDF. On the outside the models were painted in a black colour and on the inside they were painted in a grey colour. The model was also covered by a black curtain to reduce unwanted light penetration from surrounding.
During the experiment three different glazing types were used: electrochromic (EC), electrotopic (ET) and photochromic (PC). The EC glazing enabled three options: transparent, coloured and middle-point of these two states. The following CCT were used in the study: 2700, 6500 and 8000 K. The EC has a blue hue and its intensity depends on the voltage adjustment, ET is a milky glass and PC has a pale yellowish hue.
9 test colour samples were chosen for the study and were assembled in a Mondrian like picture (Figure 1 and Table 1). The 8 first test colour samples were selected from CIE 1995. The colour 9 (beige) was added by researchers since this colour is in the range of the typical outdoor façade colours in Trondheim; additionally, it is close to the colour of human skin.

Table 1. 9 test colour samples

Name	Appr. Munsell	NCS code	Appearance under daylight
TCS01	7,5 R 6/4	NCS S 3020-Y90R	Light greyish red
TCS02	5 Y 6/4	NCS S 4020-Y	Dark greyish yellow
TCS03	5 GY 6/8	NCS S 2060-G40Y	Strong yellow green
TCS04	2,5 G 6/6	NCS S 2050-G10Y	Moderate yellowish green
TCS05	10 BG 6/4	NCS S 3030-B50G	Light bluish green
TCS06	5 PB 6/8	NCS S 2040-R80B	Light blue
TCS07	2,5 P 6/8	NCS S 2040-R60B	Light violet
TCS08	10 P 6/8	NCS S 2040-R40B	Light reddish purple
TCS09*		NCS S 3020-Y50R	Light yellowish red (orange)

2.3 Experimental procedure

The experiment was performed at Daylight laboratory at NTNU, the Department of Architectural Design, Form and Colour; Light & Colour Group. More specifically under the artificial sky, which is the simulator of overcast sky, and which enables stable and even illumination (Matusiak and Arnesen, 2005).
Both models had the same colour tempe-

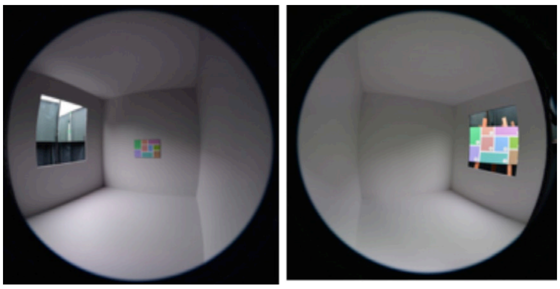

Figure 1. The experimental design used in the study.

rature of the exterior light. The previously prepared picture, see Figure 1, was placed outside the test room and was visible through the glazing (Figure 1); a much smaller version of it was placed in the reference room. The 21 participants could observe if, and in the case to which degree, the colour perception of a colour sample selected from the outdoor Mondrian picture looks similarly to the corresponding colour sample in the reference box. The evaluation was noticed by the participants in a questionnaire on the 5-steps scale where 1 refers to no difference (perfect match) and 5 to the largest difference experienced in the study.
To ensure that they did not have colour vision impairments all participants were asked to take two colour vision tests prior to the experiment or right after the experiment.

2. METHOD

The changes in colour perception observed by subjects and noticed in the questionnaire are shown in Figure 2 that presents average scores obtained for each glazing in the three CCT of light. It shows that the effect of different CCTs of light on colour perception had more or less the same distribution for all colours even though there are some small changes in scores.
As expected, EC-midpoint and especially EC-coloured had the highest scores of all studied glazing stimuli. EC glazing has bluish tint, both in fully coloured state and in middle-point state. It had lowest impact on the colours with bluish and green-bluish hues (numbers 6, 7 and 8) and the highest impact on the colour 3, 4 and 5 with reddish hues.

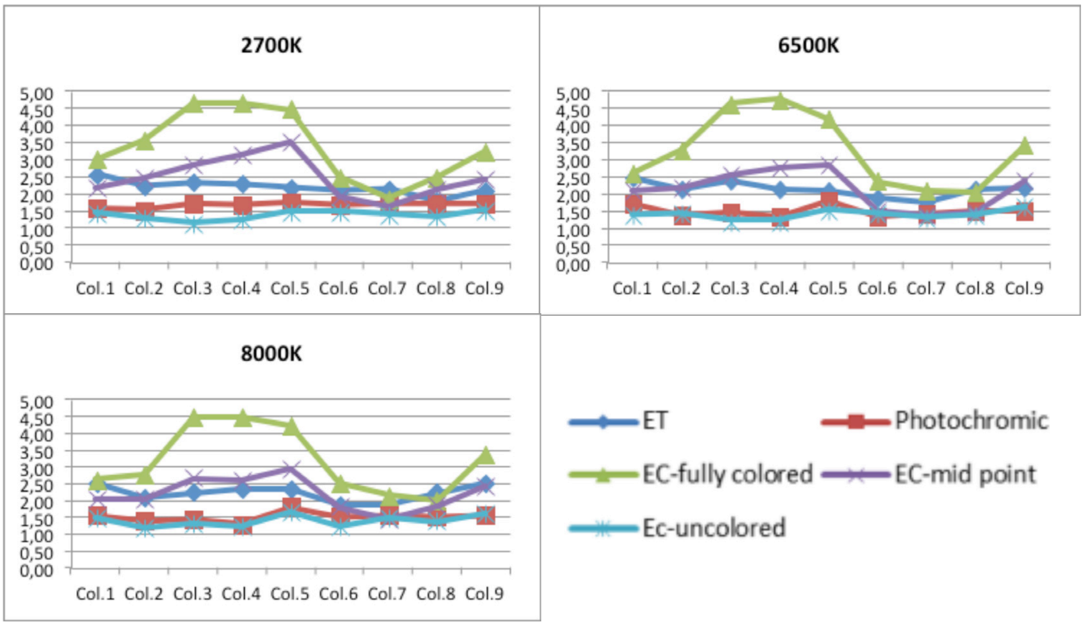

Figure 2: Comparison of glazing with different CT of light for all 9 colours (vertical axis is average score of all research subjects)

EC-uncoloured had lowest scores; PC glazing had almost the same behavior as EC-uncoloured. This result was not expected for PC since it has a yellowish tint in daylight. Both had the highest score, which means strongest impact, on the colour 5, the pinkish one. This colour was perceived differently from all other glazing samples, except for ET glazing.
ET glazing had scores oscillating around 2, it was surprisingly high score. In normal daylight conditions this glazing appears as whitish, something that gives an expectation for a minimal colour change. The green colour, no 1, had highest score, i.e. was

perceived most differently while seen through this glazing.
The effect of the CT of light and glazing types on the responses was tested further by N-way ANOVA. It was apparent from the low probability values that only glazing types have significant effects on the answers, not the CCT of light.
Another part of the experiment was to measure CIE coordinates and spectral power distribution of the light produced by different glazing combined with different CCT of light. They are available from authors upon request and will be published in a separate paper.

4. CONCLUSIONS

Based on statistical analysis we can confirm that glazing with different transmittance and colours had significant impact on the visual evaluation of all 9 colours and that the effect of colour temperature of exterior light was rather weak. The most probable reason is that observers were adapted to the exterior light that illuminated the small Mondrian picture in the reference room directly. It confirms that the human visual system has great ability to adapt to the colour of the illumination.
Even though a clear colour difference between the outside and the inside appearance of samples was observed for most of glazing types, the analysis of which colour is more responsive to which glazing was somewhat astonishing. For example the photochromic PC and EC-transparent (uncoloured) behaved almost equally for all samples and caused very weak colour differences, testifying rather good colour rendering of those two glazing types.
Oppositely EC-fully coloured tend to give severe colour distortions especially for colour samples with yellow and red hues. A strong colour shift was registered e.g. for the beige colour. This is an essential finding since this colour sample was chosen to be close to a skin colour; we may conclude that people seen through electrochromic glazing will not be adequately perceived. Results for EC in middle stage shows a similar pattern as fully coloured, although not as strong as that one. This means that the colour rendering of EC-glazing (except EC-transparent) is very low. The Milky glass, surprisingly, has lower colour rendering than the photochromic glass.
This experiment is a part of a bigger experiment heading to evaluate colour shift and colour rendering in spaces equipped with different glazing types and illuminated by light of different CT.

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Chilean Northern Colors in the Santiago Scene: A Contemporary Selection Based on pre-Colombian Textiles

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ABSTRACT

This article shows the development of three contemporary color concepts and their associated palettes based on the combination of colors that evocated the chromatic legacy from the northern pre Columbian Chilean textiles. The concepts were developed using as inspiration contemporary contexts in which the colors could be applied: interior paint, Furniture and Kitchen utensils. For each concept, three color palettes were proposed in paper using 15 colors out of 36 available from a previous research (Calvo, 2015). Each palette and each of the fifteen colors were visually assessed by 15 observers tested for normal color vision. The observers determined concepts, feelings and any geographical or climatic associations in their assessments. Additionally, a visual evaluation of the 15 colored samples, presented in two different surfaces, (watercolor paper and pine wood) was carried out by 10 observers with normal color vision. Results showed a validation of the selected colors as part of the identity of culture and geography of Chile. A strong relationship between color and its associated concept was not affected by variations in the brightness or texture of the materials. This study demonstrated that is possible to use these colors in new industries, contexts and applications, contributing to the preservation of cultural heritage and the aesthetics of current Chilean identity.

1. INTRODUCTION

A fair amount of research has been carried out with the aim to preserve the cultural heritage of the pre-columbian groups. Textiles can be thought as historical texts and communication systems that are key in the construction of identity. Textiles are the connector between past and present. Brugnoli et al. determined that Pre-Columbian textiles are unique structures that speak through variables such as: color, technique, material, among many others. "The textile traditions from the Andes are the result of cumulative years of work" (Brugnoli,Jélves y Hoces,2006). They also identified that color has been known to be an important symbol of their culture. Each color is perceived as a sign which directly influence the identity of people.

Chromatic signs have been used in different cultures where each color has its own connotation and also has a specific significance in conjunction with others. In that sense, each color can be considered as a sign with associations within a culture, both individually and as a whole. These perceived connotations can directly affect the identity of a community. "Each color incites a spontaneous reaction in each person, each color has a complete and concrete symbolic meaning" (Martinez, 1979). Therefore, color is an integral part of any cultural uniqueness in terms of associations.

This work proposes a series of contemporary color combinations that evoke the chromatic legacy from the northern chilean textiles. They are the result of a visual perceptual study that evaluated, compared and validated the representativity of such colors as part of a national identity.

The development of the northern color combinations was based in the chromatic circle (Calvo, 2015). Each palette was created using different contrasts and harmonies.

2. METHODS AND MATERIALS

This research was divided in three phases:

2.1 Phase I

During this phase, color design experts were interviewed to determine criteria and methodologies needed for the selection of 15 colors out 36 that were previously selectected from a study of the pre-columbian textiles (Calvo, 2014). Figure 1 shows the 36 original colors used for this study. The fiteeen colors were analyzed individually and gathered in three color concepts, each concept with three palettes. For the defintion of such colors and palettes, a methodology proposed by Ingrid Calvo was used (2016). Also, guidelines and trends exposed by Erika Woelfel (color specialist and trends of the company BEHR). In addition, data analysis was carried out from information obtained in web pages, social networks, portals trends, interior decoration. Thus, a chromatic proposal in relation to the current context was created, considering the application of color in different areas and uses. After the selection of colors, the individual colors were applied in two different surfaces: pine wood and watercolor paper. The palettes were proposed only in watercolor paper.

Figure 1. 36 Pre-Columbian Colors (Calvo, 2014)

2.2 Phase II

During this phase, a perceptual study was carried out with a group of 15 observers tested for normal color vision using the Neitz test (Neitz, 2001). Individual interviews were carried out with each of the participants. Each observer was asked to determined the meaning of each color individually, the associated incitement, and if the color was representative of the chilean culture. In addition, the same procedure was carried out using the palettes.

2.3 Phase III

For this part of the study, a focus group was carried out with a group of 10 participants tested for normal color vision using the Neitz test (Neitz, 2006). The fifteen individual colors were presented to the group in two different surfaces, (pine wood and watercolor paper). The observers had the opportunity to give similarities and differences regarding the colors. Also, the observers emitted a groupal opinion and possible applications were discussed.

3. RESULTS AND DISCUSSION

3.1 Phase I

Figure 2. shows the fifteen colors selected out of the 36.

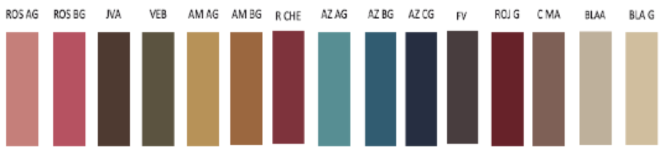

Figure 2. 15 Colors selected from the pre-columbian textiles

For the creation of the palettes, chilean identity was used as a trend. Three concepts were defined: Organic Eternity for interior use, Mystical Wisdom for furniture use, and Andean rainbow for kitchen cookware. Each concept was used to developed palettes which were composed of a dominant color, an accentual color and one or more mediators. Each concept used the selected colors in different proportions that were suggested by the group of researchers. A total of 9 palettes were proposed, three for each concept. Figure 3. Show the resulting palettes.

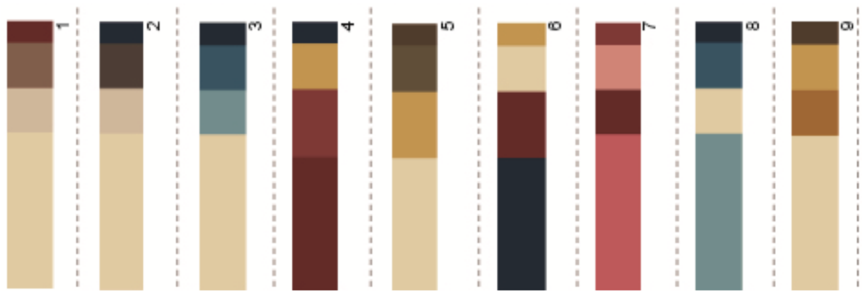

Figure 3. Proposed palettes for each concept.

3.2 Phase II

For the individual colors, the results showed that eight of the fifteen colors used in this study, were associated with chilean identity. Results showed that even thought the colors represent pre-columbian chilean textiles, the colors are asociated to the past and present of Chile. For example, the colors labeled BLAA, ROJG y VEB were associated to city, urban and contemporary. On the other hand, RCHE and AMBG were related to rural, tradition, and small towns. An interesting fact was that colors such as AMAG, AZAG and AZBG were not associated to a certain period of time, but to a geographic location inChile. Figure 4 shows the eight colors recognized as part of chilean identity. A complete analysis of the results will be publish later.

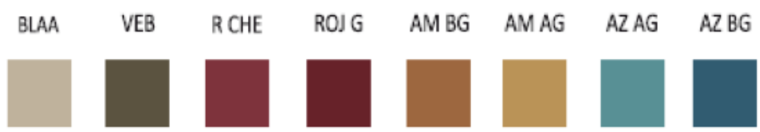

Figure 4. ColorsRecognized as part of the Chilean Identity

The qualitative analysis of color palettes proposed by the group researchers indicates that in all cases, there is a strong association with some Chile area and its climate. The proportion of colors in the palettes directly affects the perception of people, for example palettes 3 and 8 have the same colors, but different proportions. Palette 3 is associated with beach, coast, relaxation, etc. On the other hand palette 8 is associated with rain, extension, childhood.

3.3 Phase III

The comparison of the same color in two different surfaces showed minimal differences.. The comparison of the same hue in two different surfaces showed minimal changes in concepts associated to the color. However, the perceived brightness was different due to the physical properties of each material.

4. CONCLUSIONS

Results showed a validation of eight colors as part of the identity of culture and geography of Chile. A strong relationship between color and its associated concept was not affected by variations in the brightness or texture of the materials. This study demonstrated that is possible to use these colors in new industries, contexts and applications, contributing to the preservation of cultural heritage and the aesthetics of current Chilean identity.

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Study of the Effect of Culture and Emotions on the Construction of the Link between Smells and Colors

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ABSTRACT

The purpose of this study was to assess emotions impact on the relationship between odors and colors, not only inter-culturally (France - Lebanon) but intra-culturally as well : Lebanon (Zahle (rural area) - Kaslik (urban area)). In the last few years the study of emotions in sensory science field has gained a large importance (Gmuer et al., 2015). Since, nowadays understanding the motivations that drive consumer choices is one of the major challenges for marketing and consumer studies (Spinelli et al., 2014), especially since the measurement of the acceptability of the product alone is no longer a sufficient benchmark for product development and testing. Several studies have investigated the relationships between sensory characteristics and emotional responses (Cardello et al., 2012). The present study used the EsSence Profile, which is a method developed to measure emotions associated with food (King and Meiselman, 2010), to investigate the emotions effects on 18 odors stimuli (national and international odors stimuli), in Lebanon (201 subjects) and France (100 subjects). In Lebanon, participants from both rural and urban areas were tested (101 subjects from urban area Kaslik and 100 subjects from rural area Zahle). Participants had to link the 18 odors stimuli to emotions and colors. Differences were found between both populations and within the same population between urban and rural citizens, in terms of emotions used to describe the odors stimuli and in terms of colors linked to each odor stimuli. Which leads us to conclude first of all that emotions and colors associated to odors vary not only between two different countries but within the same country as well. Secondly, emotions play an important role in building the link between odors and colors, which can be a real challenge for the marketing departments in the food field especially in a small country like Lebanon.

1. INTRODUCTION

Nowadays, understanding the main motivational drivers of consumer food choice behavior, is one of the senior challenges for marketing and consumer studies (Spinelli et al., 2014). Throughout the years acceptance (liking score) has been the prime measure to understand consumer choices and preferences. In addition of sensory liking the product, from the associations assigned to a product by consumers based on experience and learning, these associations have emotional connotations (Cardello et al., 2012). So both consumers liking and emotional responses to food should be linked together to evaluate a product position in a competitive market.

In the last few years, researchers are becoming more aware of the connection between sensory perception and the emotional experiences elicited during product consumption (King & Meiselman, 2010). Emotions can be associated with a product by the brand or obtained by specific sensory properties that characterise it (e.g sweet makes on feel happy etc.), and especially by odours (Soudry et al., 2011). Indeed, smell has been connoted as a "sensory emotion" (Den Uijl et al., 2016). It could be due to the close anatomical location in the brain of the olfactory system and the systems for learning, memory, emotion, and language (Shepherd, 2006). On the other hand, colors have been found to influence and be systematically related to consumers emotional responses (Klimchuk and Krasovec, 2012). A growing number of studies started to investigate cross-cultural differences in the way in which people match gustatory information with non gustatory ones. For example studies conducted in Europe and Asia argue that bright green and red hues are considered to be the most preferred colors for food (Lee et al., 2013). Nehmé et al., (2016), conducted a study in Lebanon, France and Taiwan and showed that odor-color associations are culturally dependent. Several studies have been made to investigate the role of emotion in food product experience (Gutjar et al., 2015), or how odors influence emotions (Xiang et al., 2016) or the role of colors on emotions (Gilbert et al., 2016), additionally several studies have been conducted to debate the influence of culture on odor- color associations (Levitan et al., 2014). But rare studies have been conducted to inspect the effect of emotions and cultures on odor-color associations. The aim of the present study is to investigate the role of emotion and culture on the construction of the odor-color association intracuturally in rural and urban areas of Lebanon and interculturally between Lebanon and France.

2. METHOD

Sensory analysis have been conducted in both countries. Participants had to answer a questionnaire after sniffing each odor stimuli. The questionnaire was based on the EsSence Profile, which is a method published in 2010 by King and Meiselman to measure emotions associated with food.

2.1 Sample Preparation

Participants

100 naïve subjects were recruited in France (Université de Lorraine), 101 were recruited from the urban area of Lebanon, Kaslik (Université Saint Esprit de Kaslik, USEK) and 100 subjects from the rural area of Lebanon, Zahle (Université Saint Esprit de Kaslik, USEK Zahle). Participants had a mean age of 27 years old. All were naïve with regard to the stimulis and the purpose of the study. The participants were instructed not to wear any fragrance on the day of the sessions and not to have a meal, coffee, or to smoke in the 30 minutes preceding their session. Only participants who reported having normal sense of smell with no olfactory dysfunction were tested.

Olfactory Stimuli

18 food and floral natural aromas (Laboratoires Mathé, Maxéville, France) were selected as olfactory stimuli: rose, violet, orange blossom, lavender, cucumber, wild strawberry, lemon, lime, smoke, shallot, pineapple, caramel, mint, peppermint, pomegranate molasses (Lebanese odor), jellab (Lebanese odor based on date moloasses) and Mirabelle plum (a small yellow plum, specialty of the French region of Lorraine). Sixteen odors had the same aromatic intensity. The same odor of Mirabelle plum was presented twice with two different aromatic intensities (low and high intensity). Olfactory stimuli were thus prepared by injecting 1mL of each odorant into a small piece of carded cotton, previously placed into a small opaque glass bottle. No salient visual cues were therefore available to participants.

2.2 Psychophysical Experiment

Task location and procedure:

In both countries, sessions were conducted in sensory testing facilities with individual booths. Each testing booth had white walls and standardized white light source (D65). Each subject was presented with the 18 olfactory stimuli in a random order. For each olfactory stimulus, participants were asked to open the glass bottle and smell its content. After each olfactory stimulus it was recommended to rest for 1 min and to smell coffee beans presented in a glass bottle. After sniffing each odor stimuli, subjects had to name a color to each odor. They had to evaluate the difficulty of odor-color association (difficult/ not difficult), the intensity, the familiarity using unstructured scales, the edibility, they had to measure its acceptability on a scale of 9 and than to select one or more of the 39 emotions terms that describes the best the odor. Finally they had to say if they have recognized the odor or not. If yes, they were asked to name it.

Data Analysis

All data analysis were performed with SPSS (Version 21). Chi Square tests were used to assess whether there were any differences between the choices of colors made by the French and the Lebanese participants for each odorant. An alpha value of 0.05 was taken as the level of significance throughout the analysis.

3. RESULTS AND DISCUSSION

Culture effect on the relation between odor and color:

Unsurprisingly our results confirm the existence of consistent crossmodal associations between specific odors and colors in each tested population, as several studies have demonstrated it before (Maric & Jacquot 2013; Nehmé et al., 2016). Among the 18 odors tested for the study, 14 indicated a significant difference in the choice of a color for a specific odor, between Kaslik Lebanon, Zahle Lebanon and France. The results show that participants did not choose colors uniformly but rather tended to choose some specific colors when making odor-color associations. In this study, color-odor associations are mainly based on a semantic way where the function of the odor's object in each country is the main adjustment variable. For example, mint, peppermint, violet and lemon have not showed any differences due to the fact that in both countries and in the 3 areas, these 4 odors are used in the same way. On the other hand, a local known product mainly produced in the Lebanese mountains, Jellab, have shown differences in color-odor associations. Even in a small country of 10452 km2 as Lebanon the current study proved the effect of culture, not only internationally but also within the same country, in terms of environment, intra-cultural and culinary habits and ease of access to more local productions, on the relation between odor and color, and its effect on odor parameters. Emotion effect on the relation between odor and color: Between the 14 odors that realized significant differences in the odor-color associations. Pomegranate molasses realized the highest number of significance differences in emotions terms used to describes it in the 3 areas, where 18 emotions terms out of 39 where considered significantly different. This could be due to the fact that in France this odor is unknown, it is a Lebanese odor, and this odor is used in many dishes in Lebanon but mainly in Zahle the rural area of Lebanon. So emotions created by this odor were heterogeneous. In France they mainly associated the odor of pomegranate molasses to mild, calm and pleasant. In Kaslik, it was associated to calm, good and eager. While in Zahle, it was associated to calm disgusted and good. Pomegranate molasses is usually produced in mountains and rural

areas, it is surprising that subjects in Zahle associated it to a negative term as disgusted. It could be due to the fact that pomegranate molasses used in the tests were produced industrially while subjects in Zahle usually produce the molasses at home and in an artisanal way, so the syrup obtained will have a stronger smell. In opposite shallot odor, realized the lowest significance differences in emotion terms where only 5 emotions showed significant differences. So we can say that citizens in both countries (and in the 3 areas) had homogeneous opinions and emotions regarding the shallot odors, which is an onion, used in both countries. And citizens mainly used the same 3 emotions but in different order: aggressive, disgusted and wild. All odors taken together, 9 emotions are in common between the 3 areas, 4 emotions are in common between only Kaslik and Zahle the two areas of Lebanon and 2 emotions between only France and Kaslik. While there is no emotion in common between France and Zahle. In total, 13 main emotions were used in France, while 18 main emotions were used in Kaslik and also 18 emotions were used in Zahle. The main emotions used only in France are peaceful and nostalgic, which represent a sentimental or wistful yearning for the happiness felt in a former place, time or situation. French citizens in their majority tend to have nostalgic feelings to their past, according to an article published in le Figaro on the 24th of January 2011 by Anthony Palou. The culture in France is nourished on the celebration of the past, sometimes to excess. This nostalgic feeling influenced as well the association of French participants of emotions to odors, due to the fact that nostalgic emotion was a main emotion used only in France. In Kaslik, the 3 main emotions used were: satisfied, warm and stable. Kaslik is the urban area of Lebanon, where citizens have an easier and quite stable lifestyle. People living in the city usually earn more money to be able to afford a house and other material goods conducting to a more materialistic evaluation of what is a pleasant life. So clearly the urban lifestyle affected as well the choice of emotions associated to odors. The specific emotions of Zahle area were: loving, bored, affectionate, polite, interested. Zahle is the rural area of Lebanon, where life is usually calmer and where people are closer to each other and they live a life full of routine, which can explain the use of these emotions.
In fact many studies explained that eating environment have a deep impact on our food choices and enjoyableness of food (Garcia-Segovia et al., 2015). On the other hand, odors have the powerful ability to trigger off vivid emotional autobiographical memories (Chu & Downes, 2000). Odors can also influence moods such that pleasant odors can induce positive moods, whereas unpleasant odors can induce negative moods (Rétiveau et al., 2004). Our results demonstrated that unpleasant odors have reached to a good consensus whereas pleasant odors have led to a more cultural interpretation of what is positive moods

4. CONCLUSIONS

The aim of the present study was to demonstrate the impact of emotions and culture on the relationship between odor and color inter-culturally (France - Lebanon) and intra-culturally, Zahle the rural area of Lebanon and Kaslik its urban area. The differences found in the associations of color to the 18 odors stimuli and of emotions to these odors between the 3 areas, showed that emotions and odor-color association do vary across countries and even between 2 areas of a very small country as Lebanon.

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Aymara Weavers and their Colors through Time

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ABSTRACT

In the Andean cultures textiles had and have a relevant role as a cultural medium. Weaves identify, dress, shelter, embellish and are an important defining element in ritual and celebration occasions. Like all cultural artifacts, they are in continuous transformation and materialize their creators' cultural changes, who, mantaining a continuity in fundamental axes, selectively adopt what allows them to recreate over and over again their works and messages, reinvigorating and updating their contents. Color is an essential component of this language, and at the same time a reflex of the dynamism of these cultural processes.
Aymara people, heirs of the millenary Andean culture, are native people without borders that live preferably in high spaces (above 4.000 MASL) in Peru, Bolivia, Argentina and Chile. This work presents the observed changes in the use of color in traditional weaves of aymara crafstwomen from the chilean Andean high plateau for over a century. Associated to technological changes, in this time lapse, weavers have incorporated new techniques and materials, and at the same time are challenged by different chromatic possibilities which they have interpreted in their weaves, managing to sustain their cultural heritage over the permanent intromission.

1. INTRODUCTION

Textile language, like other art forms, transcends language and geographic barriers. A determining factor in it is color communicational potential as a fundamental element in the configuration of the tactile visual images originated by weaves.
Obsession and search for the obtention of color was an early drive for Pre-Columbian painters and dyers to explore and recognize the different sources that the environment provided naturally, developing a dying tradition that has precedents in textiles dating from at least 5.000 years to the present. At the time of Paracas culture (700 BC- 100 BC) there was already a wide control of the chromatic spectrum, achievement that has been recorded in their extraordinary embroided mantles. This long road forged specialists in each of the involved tasks and at the same time diversified the chromatic expressions that have particular characteristics in each culture, also linked to the different geographic spaces they inhabited. The persistent effort to obtain color precission and persistence in pattern repetition communicate a repertoire ellection that contributed to differentiate and strenghten these identities.
Contemporary Aymara weavers are direct inheritors of this textile and dyeing tradition, which can be corroborated in the accuracy of some of their more traditional weaves with long-standing models retaining the same compositional base.
These changes have led sometime generational tensions among weavers and have been seen often with a contemptous bias by people outside their culture, in a nostalgic position to the loss of certain color languages. These changes respond to the appeal these new colors have for craftswomen and they are free to add them to their message. The phenomenon exposes a situation that is interesting to analyze because beyond the different chromatic interpretations, the essence of the Aymara textile tradition remains.
Scattered in the vast territory of Andean highlands, the Aymara recognize their common roots even though at the same time they provide recognition of differences within the ethnic group. For this, weaves have been the preferred medium, in which

we can recognize the origin of each person according to his/her attire, distinctions that sometimes are very difficult to detect for someone outside their culture. This shapes and colors language has been in the last century constantly intervened by the addition of new colors that come from foreign materials that have been incorporated into the local tradition.

2. METHOD

The focus of this work is on weaves of Aymara craftswomen in Chilean territory that inhabit the regions of the far north, specifically the highlands of the second region, Colchane town, who have maintained their textile task with greater fidelity to tradition .

Intheir permanent displacement in territories from mountains to the sea, they have developed a system of social and economic organization that allowed access to different ecological niches achieving an efficient management of the resources needed for the textile activity based on camelids raising. In the highlands of the Andes, a kind of grass grows and allows grazing llamas and alpacas and wildlife as vicunas and guanacos. The generous livestock provides different qualities of fiber. The most prized for its fineness is the vicuna, the most abundant is the one of alpacas. The strong connection with nature is the basis of the Andean worldview and deep knowledge of the Aymara of its flora, fauna and ecosystems has allowed them to get in turn the best use of its resources.

In the last 40 years, many researchers have an interest in textiles from this area (Medvinsky 1977, Gundermann & González 1989, Cereceda, 1990, 2010, Martinez 1992) contributing to record and understand a heritage at risk before the advent of modernity and market impositions that have altered the lives of the Aymara.

For purposes of this research, work has been done by observing and recording color relationships in traditional textiles, from different fields; clothing (everyday and festive), and of agricultural use as different container formats. This observation considers weaves of different times, in a span of about 100 years, in which fibers and dyes of various origins can be identified, recognizing in them the particular use of color and that at the same time, far beyond the changes, the interpretation modalities undergo transformations but respect tradition.

These relate to the messages that weavers build from the relationships of colors and readings they have of them. There are certain concepts such as differentiation between the extended space of a single color named "pampa" in contrast to the space intervened with lists or figures corresponding to intervene or "cultivated" space, here it is synthesized the natural versus the cultural.

Another resource and interpretation are systems listings characterized by their availability in allqa, Aymara concept that expresses the opposition of contrasting colors or the same shade in chiaroscuro. By providing two wide lists of different color called churu, the contrast relation is smoothed through the inclusion of a small mediator line called qallu.

Perhaps the most characteristic color system of Aymara weave is constituted by the k'isa that balance light and shadow in a color system of five to seven tones, fulfilling the role of joining a space with another in the woven surface. (Cereceda 2010).

The three described resources are observed transversely in the different used palletes.

3. RESULTS AND DISCUSSION

Until the nineteenth century, the Aymara textiles were interpreted from two chromatic records, one from the natural colors of camelid fibers and the other of the colors obtained by processes of natural dyeing.
The first of these, the chromatic universe of natural fibers of camelids are classified under the category of k'ura colors. The variety is so wide that can exceed sixty nuances. In the textile language, weavers accurately distinguish a variety of tones: Janq'u (white), ch'umpi (brown), p'aqu (vicuna brown), q'usi (cream brown), roan, qullqi (Silver), uqi (gray), ch'ära (black), among others.

Inkuña *altar cloth,in natural k'ura colors*

Chuspa bag, *in natural dyes, 2267 MChAP*

The colors from natural dyes had their origin in plants from high lands like lampaya, tola sipu, uma tola, queñoa and Molle, in lowlands. It is known that in the past, the natural dyeing was highly developed and that the exchange of color sources with distant places was permanent, cochineal and indigo were among the dyes that were brought from other lands.
Both records allowed to establish distinctions and define areas of use, this is how the natural colors of the fibers are defined with daily use, which is in harmony with nature and is applied in garments for grazing and seeds keeping and agricultural products. Dyed colors are instead preferably used for festive and/or ceremonial weaves. This differentiation is maintained today.
At the end of the nineteenth century, chemical dyes begin to arrive and to be incorporated progressively into weaves by generating a new chromatic register which coexists with the two previously described.
Later in the 60s with the opening of the market to acrylic fibers, a color that, because of its intensity, was in line with the search for the weavers, particularly the younger ones, which revolutionized the dyeing process and the cultural language of the colors. These new colors were wisely incorporated and reappropriated by women in the textile language, especially in traditional weaves of festive and ritual use, particularly in the described: k'isa, which, inspired in the rainbow mediate between the light and the shadow. Each k'isa is named according to their dominant color: lidiok'isa (pink), jarumak'isa (orange), ch'uqñak'isa (green), laramak'isa (blue).
In recent decades, associated with movements of ecological awareness and the evocation of all that comes from the natural environment, the weavers have been driven to recover lost knowledge, however, this doesn't prove to be a way that fully meets their needs, as not all plants manage to renew with the time required. Replication of

natural hues with chemical dyes emerges as an alternative.
As part of research conducted in the Museo Chileno de arte Precolombino , research teams at the Universidad Católica created color charts for the pre-Columbian textiles from the Nasca (366 shades) and Northern Chile (250 shades) cultures. For this purpose a colorimetric measurement with a spectrophotometer was made and yielded specific reflectance curves for each color, expressed in numerical data from CIELab color system. This numerical information was processed to reproduce each color with artificial dyes for alpaca and cotton. These charts have been made available to the Aymara weavers, who, by choosing some colors have seen the possibility of recovering certain colors that can no longer be obtained naturally.

Churuchilenitowak'a, belt using k'isas.

Belt, using some precolumbian replicate colors.

4. CONCLUSIONS

In conclusion we can identify at least five chromatic records in the current Aymara weaves:

- Natural colors of camelid fibers. K'ura colors
- Colors from Natural Dyeing
- Colors of chemical dyes on natural fibers
- Colours of acrylic fibers
- Colors with chemical dyes that replicate shades of natural dyes

These colors, of different origin, are freely worked by the weavers who make them interact in different pieces, recreating, reinterpreting and transforming their contents, contributing from there to keep their culture alive.

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Colors & Their Values: Analytical Study of Historical Persian Marriage Contracts

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ABSTRACT

Persian marriage contracts are among rare documents in which passion and practicality, which are contrast components of married life, come together. They form a distinct branch in the Islamic Art of the Book in general and in the Persian traditional arts in particular. This is due to their unique and outstanding characteristics, both in the area of literature and in the domain of visual arts. This paper is the outcome of the study of 73 original Persian marriage contracts from Iranian public and private collections that were studied over a period of some 17 years. In addition to these, 27 additional marriage contracts from the collection of manuscripts of the Harvard University, dedicated to the study of the life of women in the Qajar period, and 5 contracts from the Islamic Arts Museum Malaysia were included. The primary focus was to extract the core colors used in the contracts, and, accordingly, developed a color palette. As colors carry with them certain cultural and religious values, literary sources contain passages on Persian color theories from philosophical and mystical literature, have also been studied.

1. INTRODUCTION

Historical marriage contracts of Iran, before the introduction of printing industry, came in different sizes and of a range of decorations, following the desire of those who commissioned them. The classically decorated contracts that became popular during the early Qajar period (1794-1925) follow, more or less, the general designs and decorative features of Iranian illuminated manuscripts, especially those of the Holy Qur'an. This reverence is partly because marriage is regarded as a sacred institution. Moreover, all marriage contracts under study, without a single exception, have prominent presence of Qur'anic verses and Prophetic tradition (hadith) that address the importance of marriage. These attractive documents combine dry recorded data of a social/historical event with religious devotion, and present individual commitments with artistic expression. Most of the surviving marriage contracts belong to a span of some two hundred years – from the early 18th to the early 20th centuries. Due to the bulk of specific data – that cannot be attained from other sources – they are revered as historical 'documents' and as such they are mostly preserved in places such as the Iran National Archives Organization. Their astonishing colorful illustrations and illuminations, however, have secured a high place for them in the arena of art. In the past few decades more and more marriage contracts have been displayed in museums, and art collectors are showing an increasing interest in possessing them.
The first book that presented a collection of Iranian marriage contract in a systematic manner and with 66 color plates was published by Negarestan Museum *(Iranian Wedding Contracts of the Nineteenth and Twentieth Centuries, 1976)*. Almost quarter of a century later, The Sacred *Art of Marriage: Persian Marriage Certificates of the Qajar Dynasty*, was published by the Islamic Arts Museum Malaysia (Zekrgoo 2000). With 96 color plates of some 73 contracts, it provides a detailed study of the textual structure, layout and artistic aspect of the works. The book, however, does not include an account of the colors. During the last few years, a more detailed study was conducted

on the aesthetic dimension of the works that includes extraction of the color pallets as well as the symbolic significance of the colors (Alhagh 2013). Aside from the above, some of articles were also published (mainly in Persian). None of the available sources seem to have addressed the issue of color as an independent study; the present paper is perhaps the first attempt of its kind.

2. METODOLOGY

In order to develop a color palette, the focus had mainly been the areas decorated with colorful pigments and inks. These include the large and most attractive visual element of each piece *(sarlowh)* in particular, as well as the floral and geometric patterns that adorn the documents as a whole. The hues were extracted and reproduced manually using gouache and poster color, and hand produced colored papers (silk screen technique). A general color palette with 28 colors, inclusive of gold and silver was produced. Colors were first arranged based on their hues, as well as warmth, coolness, and neutrality, for a natural flow and easy reference. Individual colors were then studied against two main factors: 1) the cultural context and socio-economic conditions in whom the marriage contracts were produced, and 2) the Persian theories of color available in the literary sources.

3. COLOR THEORIES IN PERSIAN LITERATURE

Muslim philosophers, Sufi scholars and poets have often discussed the symbolic significance of colors in terms of their correspondence with heavenly spheres and spiritual domains. The founder of the Iranian school of Illuminationasm (Hikmat al-Ishraq), Shahab al-Din Suhrawardi (1154-1191) associated the stations of a soul in its travel with certain colors, from black that is considered the lowest, to red and at last to white which he considered the ultimate color. Najm al-din Kubrā (1145-1221), a Sufi master, and the founder of Kubrawiyah order gave the universe seven levels each signified with a particular color. According to him, intelligence is white, Spirit is yellow, Soul is green, Nature is red, Matter is ashy (gray), Image is dark green, and Material body is dark black. He further associated white with Islam, yellow for faith, dark blue for beneficence, green for tranquility, light blue for certitude, red for gnosis, and black for passionate love and bewilderment (Irwin 1997: 196).

Persian artists created a traditional name of the "Seven Colors" or Haft Rang. A renowned Iranian poet, Nizami (1141-1209), stated that seven colors that match to the Seven Heavenly Spheres are black, yellow (or gold), green, red, blue, sandalwood (or brown) and white (or silver) (Barry 1996: 33). These seven colors were divided into two groups: white, black and sandalwood are the first group of three colors while red, green, blue and yellow are the complementary group of four colors. Through time various Color Systems were introduced. This did not, however, end up in the formation of a single and concrete theory of color. The attitude of individual shades and hues were driven from a variety of sources; these include climate, nature, religious, mystical, astrological and political symbolism, folklore, etc.

4. COLOR IN PERSIAN MARRIAGE CONTRACTS

The colorful sarlowhs of the contracts are usually identical to those of the Qur'an manuscripts. The illuminations that decorate the page margins also follow the overall format of the Persian illuminated manuscripts. The colors, on the one hand, are inspired by the traditional color palette, predominated gold, accompanied by dark blue (mostly lapis lazuli) as a common contrast, red (in most cases cinnabar), various hues of green (in many instances verdigris), plus black and white, and occasionally silver (Figure 1). On the other hand, in a number of contracts, especially those belonging to the middle-class families, a more relaxed treatment of colors is observed. The degree of spontaneity, which in certain cases crosses the boarders of skills and touches the domain of carelessness, involves use of freehand transparent washes of raw and vivid colors. The spectators sometimes tend to show appreciation of such unorthodox treatments, as they find the free application of bright colors harmonious with the jolliness of the happy event. In the latter examples, one can feel the presences of regional tastes (Figure 2).

Figure 1 (Left). The opening pages of a booklet Marriage Contract with two identical sarlowhs. Collection of Middle Eastern Manuscripts, University of Melbourne. The predominant use of gold, lapis lazuli and cinnabar is observed on the sarlowh and margins surrounding the text. The overall design is reminiscent of the manuscripts of Qur'an

Figure 2 (right). Two pages from a booklet type Marriage Contract. Collection of Hessamoddin Khoromi. The lavish use of gold is indicative of the well economic status of the family. However, the free hand treatment of the floral motives on the margin, as well as the unorthodox use of bright pink and blue brings freshness to the work. (Zekrgoo 2000: 98)

Figure 3. Detail of the sarlowh from a scroll type Marriage Contract. Collection of Hessamoddin Khoromi. Realistic treatment of motifs, such as roses and birds symbolize the holy matrimony and the joyous love that holds together the newlyweds. The dominant use of red and pink is a fresh approach and of symbolic significance. (Zekrgoo 2000: 35)

The attempts to analyze and classify the colors used in the Iranian marriage contracts were made in two phases. The first phase was aimed at extracting and arranging the colors. The colors were produced by hand using gouache and poster color. The color samples were then arranged based on their warmth, coolness and neutrality, for a natural flow and easy reference (Table 1). The second phase had a more specific agenda. In it we tried to select colors that were predominantly used in the contracts. Efforts were also made to divide the customary/classical colors used in the classical illustrated manuscripts, and the hues that were more personal, in terms of artistic expression and reflecting local/provincial aesthetic tastes (Table 2).

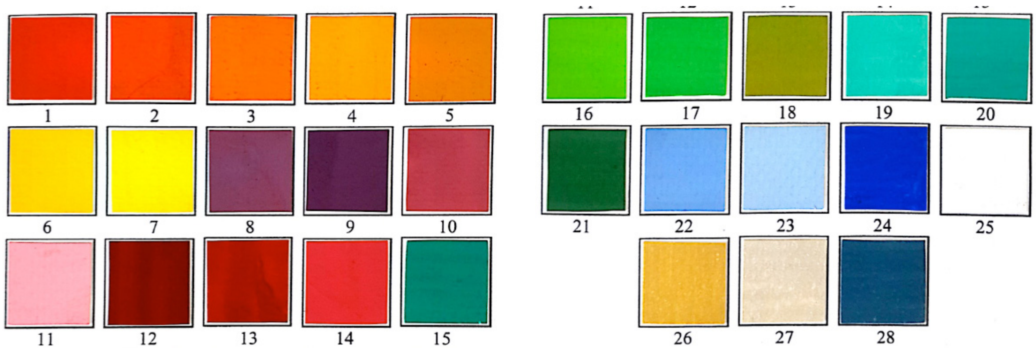

Table 1. An overall Color palette of Iranian Marriage Contracts (Alhagh 2013: 151)

Color	Hue	Usage	Meanings associated
Gold/ Yellow		Classical	Spirit (N.K.); Faith (N.K.); One of the seven heavenly spheres (Nizami); Light (Popular)
Blue		Classical	Beneficence (N. K.); One of the seven heavenly spheres (Nizami); Royalty (Popular)
Red		Classical	Medium height of the soul (Suh); Nature (N. K.); Gnosis (N.K.); Royalty (Popular)
Green		Classical	Soul (N. K.); Tranquility (N. K.); One of the seven heavenly spheres (Nizami)
Light blue		Classical	Certitude (N.K.); Sky; Tranquility; Peace (Popular)
Orange		Classical	Fire; Energy (Popular)
Black (just outlines)			Lowest stage of soul (Suh.); Material body (N. K.); Passionate love and bewilderment (N.K.); One of the seven heavenly spheres (Nizami)
White (rare)			Highest stage of soul (Suh); Intelligence (N. K.); Islam (N. K.); (Identical to silver) One of the seven heavenly spheres (Nizami)
Silver (rare)			(Identical to white) One of the seven heavenly spheres (Nizami)
Pink		Provincial	Joy; Youth; Excitement (popular)
Pastel green		Provincial	Spring; Rejuvenation (popular)

Table 2. Predominant colors and their suggestive meanings. The abbreviations that appear in brackets next to the meanings in the right column are references to the scholars from whom they are drawn as follows: N.K. = Najm al-din Kubra; Suh. = Suhrawardi.

5. CONCLUSIONS

Marriage documentation has been an ancient tradition in the history of Iran. The bulk of the historical marriage contracts belongs to the Qajar period. They belong to a wide range of people of social classes and of various economic status. Their decorations follow, on the one hand, the traditional style of classical Persian illuminated manuscripts and, on the other hand, local aesthetic tastes and values. The most attractive and colorful areas of these documents are their sarlowhs, followed by their decorated margins. This research has extracted the color spectrum of such documents. The findings of the study have been presented in the form of color palettes, presented in two tables: 1) an overall palette exhibiting the range of colors, and 2) a specific color palette identifying dominant colors and their cultural significance.

5. CONCLUSIONS

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Architectural Colour; a Discourse in the Popular Norwegian Press and Social Media 2014 to 2016. The Greying of Norway

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ABSTRACT

This paper will examine the visual and verbal rhetoric that project the power relationships in the drift towards achromatic colour schemes in new architectural projects and the repainting of surface colour of existing buildings that fall outside heritage regulation in Norway. This is examined through media debate to expose the power relations of cultural capital in the rhetoric used by the stakeholders in the ranging, from householders, to architects, heritage experts, local authorities, colour designers and developers and as mediated through journalism. It considers the relationships between agents in the exercise of cultural capital. It asks how the drift towards the achromatic is mediated and if this is the influence of the cultural capital of decision makers, an accumulative tipping point that leads to a change or the absence of disciplinary knowledge in the complexities of colour in the professions that are responsible the colour of public space. Standpoints taken by key participants as articulated in the media are analyzed to examine hierarchical roles and establish a clearer understanding of the mechanisms though which this change takes place. The authors will argue that the achromatic pallet is now the standard norm.

1. INTRODUCTION

The debate on colour in architecture has surfaced in the Norwegian press over the last five years. This is exemplified in two polarized standpoints, on the one hand, complaints about inappropriate colour use that spark social media and printed media reactions for and against, on the other, arguments for and against the white, grey, black, beige pallet that dominates new building and is impacting previously chromatic zones. This enquiry takes up the question of grey, and will define a model of the key drivers of this process based on the concept of power emanating from cultural capital and its influence. The most profiled critical examples in this drift towards grey are in articles in media channels (Norway in black, white and grey) in D2 , (this is how Bergen is turning grey) in Bergens Tidene (Modern city architecture on the edge of inhumanity) and (all of Norway is being painted grey) both NRK.

2. METHOD

The authors have examined three main sources of influence on colour. Media and net-based discourse and visual weighting in promotional material from paint producers. The authors have surveyed some 115 media and net-based articles and attached commentaries in two main categories, first, advice on selecting exterior house colour, second, debates on house colour. This has been used to diagram the dynamics of the current development and chart the inputs in terms of their position from the perspective of cultural capital and its production of professional certainties and public uncertainties. We argue that this is a process with its origin in the continuation of an identifiable historical tendency.

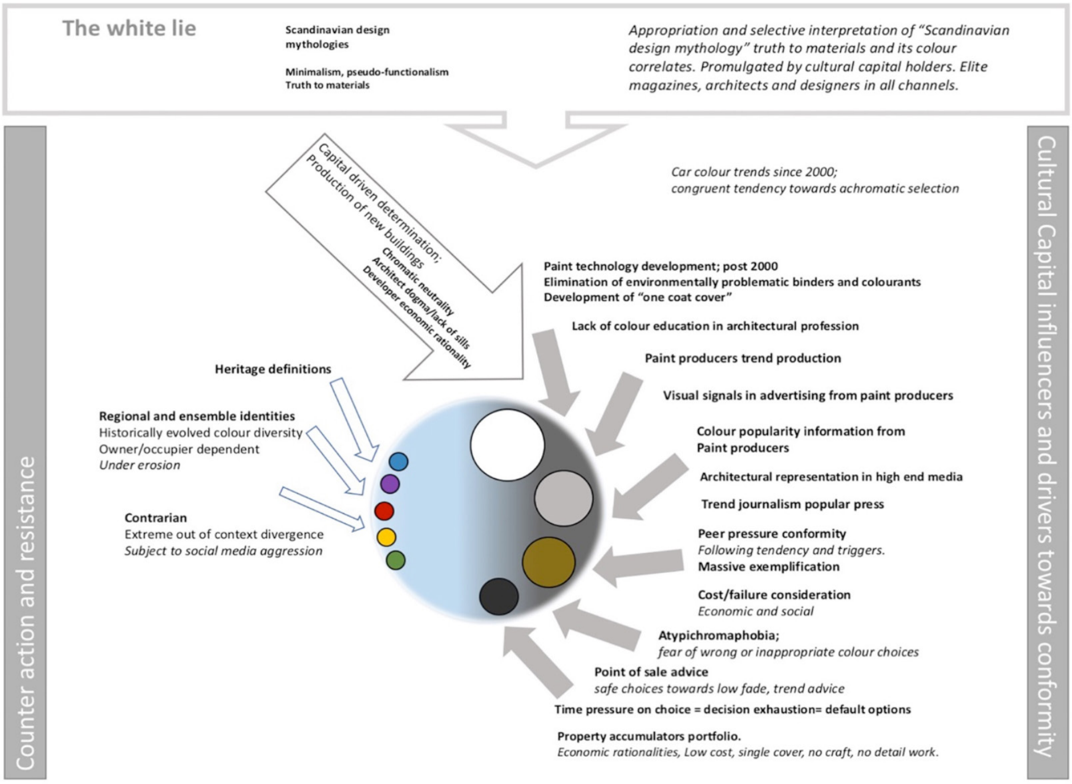

Figure 1. The cultural capital drivers.

2.1 The protagonists' positions in the process

These agents are defined as follows, developers (a), the architects (b), the paint producers (c) the experts (d) and the public (e). It may be usefully split into two overlapping sets; first, the developers and architects that define new building and exercise power over colour definitions, in new block production of housing (flats) the public have no input in colour choice. In prefabricated housing, the consumer has some option of colour choice. In the overlap are the paint producers, who exercise an influence in amplifying trends in both directions towards the construction market (prefabricated in particular) and mediated by the experts towards the existing housing stock and the public.

(a) Developers are driven by large scale economic rationalities of speed, profit concerns and hold to a dogma that colour neutrality are what the consumer want, they also promote the view that this is a means to hold the production cost down. The volume of building of blocks of flats and high density multiple unit estates has a substantial visual impact on the chromatic urban structure in comparison to the traditionally more spread and small scale building types.

(b) Architects are often locked into a persistent dogma originating in an elitist and selective mythology on the nature of modernist Scandinavian design, coupled with a more recent appropriation of environmentalism. "Wood should be allowed to be wood, steel to be steel, metal to be metal, maintenance free, environmentally neutral and untreated" and "colour is the clouds the sea and the sun, one dos not want to compete with nature" to quote from architects interviewed in DN2. Unfortunately, this truth to materials ideology is rarely implemented with consistency, but tends to give rise to a mimetic correlate in an achromatic colour palette. Furthermore, architects lack the power to resist the developer's rationalities and even when they try they lack the colour skills necessary, or the design time required, to make a convincing argument or produce a satisfactory result.

(c) The paint producer's pivotal role takes two linked forms: the production of the material and the production of change via trend development to maintain turnover and feeding the consumers desire to be "up to date". The publication of consumption data, commentary and linked visual rhetoric, is designed and directed at the consumer in a way that emphasizes producer determined trend choices.
With reference to black and other dark colours, a colour manager at Jotun states, "it´s unbeatable on cabins and modern architecture, but there is no limit to which type of house it suits." And, "people are choosing grey for the house and details... black is also popular...the trend is the same all over the country" - colour consultant for Nördsjö. "Grey is the most popular colour now" - spokesperson for Systemhus, a provider in the prefabricated market. The major paint producers are active in the discourse at both point of sale, through their own and point of sale web portals and in social media. To a large extent, this material is consistent in promoting the achromatic pallet as stylish, modern and above all safe, while treating chromatics as a traditional historical necessity and labeling some colours (blue and green) as problematic. An analysis of the visual rhetoric correlates with studies of the visual examples of colour charts available from the major producers of exterior paint on the Norwegian market, Jotun, Nördsjö and Flügger (Table 1). Exterior house colour exemplified in a wide sample of advice websites shows a similar result (Table 1). This correlates with the volume of sales in whites, greys and black/brown.

Exterior Colours Presented in Colour Charts *	
Grey	45 %
White	22 %
Black	11 %
Red	10 %
Green	8 %
Yellow	4 %
Blue	0 %
Beige	0 %

Exterior Colours Presented on Norwegian Websites	
White	55 %
Black	18 %
Red	11 %
Yellow	7 %
Grey	3 %
Beige	3 %
Blue	1.5 %
Green	1.5 %

* *Jotun's additional colour chart for only bright white exterior colours was not included in this study.*

Table 1: Accumulative results for exterior colours presented by the three major paint producers on the market in Norway. Exterior house colour in a wide sample of advice websites

(d) The experts may be divided in three categories with promotional, reactive or reflective agency dependent on context. The experts connected to the paint industry tend to drive and enhance trends with a high degree of visibility due to their privileged access to point of sale and embedding within the industry's promotional structure and a consequent rhetoric of certainties. The independent academic experts are reflective, working from a contextual, historical and design perspective. The cultural heritage experts are reactive, mostly working to preserve historical cultural value. There is some overlap between the field of action in relation to the independent and heritage expertise. In the promotional media surveyed by the authors the industry trend certainties are prioritized and recommendations for contextual reflection and suitability to neighborhood, while mostly present, come at the end of the discussion as an afterthought.

(e) For the public, the level of agency is dependent on the forms of ownership, a residential management committee generally regulates blocks of flats, and this management ownership is common in single house and multiple unit estates that can range from a small number of buildings to over 50. New blocks of flats afford no agency and are determined by the developer/architect coalition. Older blocks provide some agency if repainting is required and the materiality is suitable. New housing estates at all scales are dominated by the current trend towards achromatic, in multiple cases for ease and safety from controversy the choice from a limited achromatic pallet is offered. This tendency is also affecting older ensembles from the 40s 50s and 60s that were previously chromatically diverse. From a managerial point of view, it is understandable that conflict avoidance in the emotive question of house colour is attractive. True public individual agency in colour choice exists in the villa type housing, and in older collections of smaller owner/occupier town units. In the first case, new build conforms to the current tendency and some older structures follow this trend on repainting. Even in zones of strong chromatic quality that are regarded as representing cultural value identity, we have observed the ingress of trend grey. It is in the older villa and town typology that are outside current heritage regulation but of high cultural and historical value that the most heated and reactive argument takes place over the right of self-determination contra contextual appropriateness. A significant component in this is the property speculators indifference to the role of colour in architectural quality.

3. CHROMA-ATYCHOPHOBIA

Critical factors accumulate to generate what we call chroma-tychiphobia; time pressure, decision exhaustion and peer pressure. Ridicule over inappropriate choices in social media, the complexity of colour design and the wealth of contradictory advice. The volume of choice seen in the context of trend exemplification are all powerful motivations for a fear of making wrong choices that drive towards the solutions exemplified in safe trend colours.

4. CONCLUSIONS

The developer, architect, paint produces and profiled early adopters constitute both the actual capital and cultural capital drivers of this process to and beyond the tipping point. The current white grey black is now a default no risk standard. Critics, despite their knowledge fail to gain traction in counter argumentations due to relational complexity, the absence of adequate media profiled exemplification and the misapprehension in the public that their comments constitute, at best, a reactionary attitude, at worst, a desire to take over control and decide on their behalf.

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Colour as sign of identity in urban textiles

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ABSTRACT

Textile Design as a Sign of Identity is the title of one of the projects developed over the past five years in the Textile Design Level 2 teaching course, as part of the Textile Design Degree. One objective is to identify and incorporate significant elements to communicate a regional or cultural identity in a series of textiles for home, hotel and office.
In this paper we will focus particularly on the color registers involving a total of 160 projects. As in other studies, we want to recover a space for reflection on the symbolic aspects of color, typical of the students' personal and national culture, partly lost owing to the commercial importance attributed to international trends and homogeneity that this produces in the color experience.

1. INTRODUCTION

Textile Design as a Sign of Identity is the title of one of the projects developed over the past five years in the Textile Design Level 2 teaching course, as part of the Textile Design Degree. One objective is to identify and incorporate significant elements to communicate a regional or cultural identity in a series of textiles for home, hotel and office.
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As Canclini (1996: 265) discusses, the process of urbanization in Latin America involves a heterogeneous symbolic offering, renewed by a constant interaction between the local and national and transnational networks. We are interested in promoting a textile design that is carrying a sense of identity that is meaningful to designers and users.
According Lacarrieu (2004) the discourse on identity is often carried through heritage objects, museums, archives, libraries; it tends to occlude other memories, identities and assets.
To develop a meaningful construct in order to incorporate elements that reflect the diversity of contexts, students are encouraged to look at the usual in a new way, to identify those signs that are so embedded in culture that are not perceived as such. We find particularly useful here the concept of vernacular design (Bernatene and Ferrarese, 2008):

> *(...) "en el lenguaje vernacular, el objeto es más contextualidad que individualidad, no se asocia a una persona, sino que prima lo colectivo sobre lo individual. Pertenece al entorno y en parte lo refleja" (in the vernacular language, the object is more contextuality than individuality: it is not associated with a person, collective takes precedence over the individual. It belongs to the environment and partly reflected it).*

With this criterion, the students have worked from objects traditionally considered typical of a place (the murals of Lanín alley, for example) but have also discovered unexpected and not so obvious instances such as building cracks, neighborhood markets, hidden doors, neon signs, machinery, an abandoned prison, people's hair, casino lights; also mythical landscapes such as the subterranean city of Erks or such as the created from historical or literary stories.
As Caivano (2014) explains, color and cesia *(...)"may have, of course, symbolic and iconic values. They can represent feelings and moods, produce associations with concepts; in other words, they can have different meanings, also by means of established, acquired or learned codes (when they behave as symbols), and by means of relations of similarity or resemblance with the represented objects (when they work as icons".*

2. METHOD

The work methodology involves determining an identity code of a geographical area (region, city, area of the city): iconographic elements, natural elements, architectural details, characters of the site, products or typical materials, sounds and of course colours. The information cannot be obtained through a virtual search: one requirement is that students must visit the place to produce a corpus that reflects a personal and meaningful perspective.
The visual record is done mainly through photographs, drawings and colour scanner apps; each of the selected objects corresponds to a series of three images with different levels of detail.

The graphic record must include:
- Three keywords defining what identity concept is intended to communicate; each word requiring two attached images.
- A palette with no more than 20 colors (day or night colors), named according sensations associated with the main concept. They should emerge from the day or night observation conducted: colors of architectural materials, plants, signage, artist palette, or other relevant option. Samples of materials of inspiration can be attached.
- Up to five materials the student founded representative of the area, in a real or metaphorical way.
- Up to five of patterns the student founded representative of the area, in a real or metaphorical way. They should constitute a series of different degrees of complexity; the representation system is free: drawing, collage, and digital.

This material becomes in a series of textiles, including Jacquard and dobby weaves, sheet sets and modular carpets.

3. THE COLOR REGISTER

The selection of areas and associated palettes has been extremely varied. A classification was made according to the chosen areas.

3.1 Argentina Regions

Name	%	Subjects	Palette
Patagonia	19	Flora, Mapuche culture, glaciers, Welsh culture, legends, port.	
NOA	11	Geology, landscape, weaving, pottery, folk festivals	
Littoral	7	Flora, fauna, yerba mate,cestería, fishing.	
Cuyo	5	Vineyard, mountains, Huarpe culture	
Center (Córdoba)	4	Legends and myths, Hênia-kamiare culture (Comechingones), golf	
Pampa	4	Geology, beach	

Table 1. Argentine regions

3.2 Argentina cities

Name	%	Subjects	Palette
Suburbs of Bs As City	10	Delta, Ports, Casino, mall, train stations, markets, old construction	
Little towns	3	Architecture, traditional grocery store	

Table 2. Argentine cities

3.2. 1 Argentinian cities. City of Buenos Aires: neighborhoods

Name	%	Subjects	Palette
Rosario	1,6	Artist, urban layout	
La Plata	1	Artist, urban layout	
La Boca	1	Architecture	
San Nicolás, Monserrat,	2, 5	Architecture, Theater	
Pto Madero	1, 6	Architecture, Casino	
Caballito	1, 6	Science Museum, Park	
Recoleta	1	Cemetery architecture	
Others	2, 5	Public transportation, abandoned cars	

Table 3. City of Buenos Aires: neighborhoods

3.3. Buenos Aires Province

Name	%	Subjects	Palette
Belgrano-Colegiales	5	Chinatown, Gardens, Church	
Palermo	4	Parks, Artist, University	
San Telmo	4	Architecture, textures, tunnels, tango	
Barracas	2,5	Murals, architecture	

Table 4. Buenos Aires Province

4. CONCLUSIONS

The instructions for the activity have been adjusted over five years. We found that the closer and more familiar the students are to the environment where they perform the survey, they focus on more significant and less obvious details. When they explore the place by walking around, taking pictures, drawing and talking with people, instead of finding information on the web, color palettes are more diverse and also more personal and meaningful configurations appear in the graphic vocabulary.
Even if the reference images have saturated colors, in some cases the color palette appear duller in the final product. Commercial forces in certain markets cause the student to carry out this modification. Product design with a chromatic identity that can be at the same time inserted in the market is the challenge to achieve.

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Second Colour Life

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ABSTRACT

It is a well known fact that practical training of a university student is very important not only for the performance of the profession but also for their personal and academic development. In that sense, the academic training of future professionals in Product Design Engineering covers a wide range of educational possibilities, which are based not only on the industrial aspects, but on ways of relationships with the Design Culture. Nonetheless, Colour Culture teaching needs a deeper study model in order to became Colour in a essential factor on the design project.
Therefore, the title and content of this paper respond to the reinforcement of two parts. Firstly, to teach student the creative aspects of colour applied to plastic arts and, secondly, to learn the different kinds of representation, from two-dimensionality to three-dimensionality. Thus, we understand that giving a Second Life to Color could include two conditions: the study of the arts and the opportunity of materializing a design. Using materials in order to achieve new ways of seeing the world through art.

1. INTRODUCTION

The study of colour and its application in Design has always been a necessary task. It is in Industrial Design History, in the late 19th century, when the language of industrial paints, the laws of physics, the creation of new products through innovative ways, applying colours based on new management methods begin to take importance (Gage 2001: 159).
Clearly, within the Industrial Design panorama, both the shape and colour have been materials factors, as well as generators of creative proposals in the new panorama of plastic arts: a new conception of arts and life (VV.AA 2105: 15-40). One of the most characteristic examples of the industrial product development is found in the creations of De Stijl Group and the renewal manifestations of the School of the Bauhaus. Its representatives did not leave indifferent to a society in process of cultural change, through a large range of artistic creations.
It follows that, any training in the field of Design, must be based on a cultural knowledge that express the colour from different perspectives. The city and urban spaces designed for developing social activities, allow multiple proposals that enrich these places. Artistic creations nowadays, commit to pushing up the value of urban culture by displaying designs. From urban elements to graphic communication.
The teaching staff of the subject entitled "Product and Environment Colour Design" of the Master's Degree in Design Engineering seeks to sensitize the different ways to carry out a plastic intervention, and to achieve new artistic strategies in the design field and to enrich designer's knowledge. It focuses on the study of Colour in the product design development through two different ways. Firstly, by experimenting with society and, secondly, with the place as a clue element of any product design project (Fig.1). An educational work is developed. It helps to understand that colour and design, as a part of a community, are having greater impact.
The teaching staff of the Department of Architectural Graphic Expression has been present at this faculty since its creation in the academic year 2007-2008. Developing

a multidisciplinary experience, which allowed them to carry out university teaching methodology related to the product design applied to several environments. It seeks to encourage a broader and global Design and Colour Culture adapted to the cultural activities of the city. Therefore, it helps to enrich the artistic nature by designing new proposals based on chromatic interventions for citizen's attention, emphasizing, on the one hand, the visual importance of colour and, on the other hand, the reuse of materials.

Figure 1. Design Projects of students in urban space of Valencia "Mercado en Verde" ***("Green Market").*** *Exhibition. ETSID. UPV. 2014-2015. Students: Marta Veintemilla, Teresa Argente, Frida Erikkson, Ana Tomás, Ana Gallego, Antonio Cobaleda, Ariadna Santana, Cosima Grundl, Tania Acevedo, Iliana Campa, Rafa Megías, Javi García, Elisa Sanz, Mathieu Espiot, Sam Bakhshi, Bast Bente, Paula Corredera, José Antonio Callero, María Juan.*

Link video in YouTube: https://youtu.be/egZZy6kKA1w

The contents, methods and learning resources in this subject are linked to activities of social participation, project development based on direct experience, solidarity initiatives and social needs. It seeks to enrich the theoretical knowledge of students from experimentation and action.

2. METHOD

In order to obtain a right level of university knowledge about Colour and Design, we start by teaching a theoretical background on product, colour and contemporary culture. Knowledge of colour and shape perception and the theory of design basis of Albers, Goldstein, Arnheim or Wong, as well as theoretical aspects of design philosophy of Flusser, among others, is reviewed by students. The aim is to learn how to use this learned knowledge in order to express the colour nature and the colour quality in product design in a particular environment with specific features. Colour, like any other variable, is subject to laws. These laws must be known in order to stimulate the product design nature. Therefore, a knowledge basis is set up in order to understand the visual, perceptual and communication design structures.
As a result, some proposed activities have constituted an approach to small and medium-sized business based on artisanal manufacturing and the need for delivering solutions that provide a creative vision to the spaces. The aim is to please and bring the public to the purchase of a product. Innovation is gone in deeply, pleasant spaces are enabled and branding methods are proliferated (Julier 2010).
It is implied that such activity is based on a specific project learning, which aims to work from the idea design stage to its construction. The proposals are based on an

initial illustrative scheme. Each student has this scheme in order to understand the process. The creation of each design should be created for collective use.
This scheme is created to stimulate student interest. It tries to bring the student to: the real world, the enterprise, the manufacturers of products and services, professionals in the design sector, the marketing, the stages of production, the latest trends and, obviously, to apply colour as a priority through a new design concept.
Following the explanation of the theoretical contents, this learning materialized by experience. It is developed in progressive stages: firstly, the initial practice, based on the search for information. Secondly, fieldwork knowledge is developed and finally, creative and innovative solutions are carried out. This allows improve the design project, each time better supported and adapted to the context in which it takes place.
The several stages of the study and research carried out around colour, new trends, manufacturing, new technologies and industrial development generated in recent times, allows extending knowledge about design involved in designer's creative processes (Aicher 2002).

3. PRACTICAL EXPERIENCE: "Colour recycling"

To carry out the project design, it is necessary to turn to "participatory design", that is, joint work by cooperation in teams. Therefore, a highly creative and problem-solving environment is created. Design premises are resolved by applying knowledge in a practical way, materializing each team design project (Fig.2). There are four main factors to consider for the project:
-The place, where the project is located. Analysis of the space as a place where the object is inserted.
- The object, as an element to modify, giving it a new use, considering the materiality of it,
- The material, proposing a new application on it, a second life, to be treated by colour.
- The colour, as a differentiating factor, to achieve a more creative and chromatic interpretation in product design studies.

Figure 2. Setting up of the Design Projects of students in UPV. "Mercado Solidario". Ágora UPV. 2015-2016. Students: Carlos Andrés Ossa, Gonzalo Acosta, Milena Valkova, Pablo Lardón Amat, Alicia Parra, Noelia Cirac Cortés, Jenifer Viar Lope , David Minton Albero, Carlos A. Ospina, Marcelo A. Reyes, Javier Castellano Cañones, Javier Gómez Rodríguez, Alejandro Núñez Plaza

Link video in YouTube: https://youtu.be/08mrFYE7MNQ

4. RESULTS AND DISCUSSION

Many of the proposals carried out by the students of the Master's Degree in Design Engineering have been worked and emplaced in spaced selected by shopkeeper, offering a sample of sensitivity and collaboration. Thus, social groups and partner companies assist students and teaching staff by generating enthusiasm in the student. This Master is getting closer to achieving their incorporation into the world of work. For this reason it is committed to a learning method based on a educational real project. In this regard, the student's received training is becoming more and more diverse and multidisciplinary.

Finally, it should be noted that many of the works carried out by students have been disseminated on social networks and exhibitions. It allows the interaction between the student and the entrepreneurs and craft industries. It provides the opportunity to continue developing new and different designs for innovative commercial spaces. Therefore, we think that a cultural and creative wider vision should be provided, exploring new design proposals, which are conceived, from art. Focusing on the object, the space and esthetics. From these premises, students design and materialize a design project, in a certain space and with a specific use. Offering a second life to an object, which is devoid of character. It is reinterpreted by using colour.

5. CONCLUSIONS

To promote a project from experience and from interdisciplinary is necessary. It have been focused on bringing into the classroom a real problem requested by a company or social services and using the most suitable means, techniques and processes of manufacturing.

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ColorTranslation Tool. How Graphic Designers Care About Color Management

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ABSTRACT

The research presented here aims to explore the topic of color reproduction, mainly with regard to how graphic designers currently communicate technical data concerning color. We want to see in what way the working methodologies of these professionals contribute to the predictability, consistency and uniformity of color reproduction at a time when printing technologies, media, and available resources are increasingly diverse. From this study it was possible to confirm that color reproduction has experienced very significant developments in the printing industry and, therefore, it is necessary to understand how these changes affect the work of graphic designers with regard to the use of color management tools. To improve color communication, we developed a platform – ColorTranslation Tool – where graphic designers can gather the scattered information, particularly with regard to PDF and Preflight default settings and also download Color Settings for certain production conditions. With this tool, the user can select a number of settings depending on the type of work they are producing and, them get access to a set of files that can be loaded into their software to update the Color Settings. We based these settings on industry recommendations and norms, and the tool was evaluated and validated for a broad range by experts in the fields of graphic design, color management, digital workflows and print production.

1. INTRODUCTION

Color management applied to the graphic arts industry can provide tools that ensure color can be reproduced consistently and predictably throughout the workflow, from creation to final production. Technological tools do exist and are available; however developing the know how to implement and use these tools has been the biggest challenge of the past few years (Grey 2006). The complexity of color management systems is, in part, due to the wide variety of capture devices such as digital cameras and scanners, display devices such as monitors and projectors, or output devices such as printers. In addition to the equipment, software settings used by graphic designers has become the key to establishing and communicating colors correctly. Thus it becomes difficult to design parameters and working methods.

Color reproduction has gone, in the few past years, from an absolute dependence on professionals with great expertise and experience to a range of automated processes that attempt to drastically reduce the variation in color reproduction (Sharma 2004). With regard to color management systems, the trend points to a simplification of procedures and, above all, standardized production. During the period in which color reproduction was essentially a photomechanical activity, processes were solid in its assorted well-defined phases. Reproduction color systems have broken some of these barriers and they now allow information to flow between those concerned in the process. Color control does not begin only in the prepress stage but at the moment of capture or production of image files. There are now tools that simplify control of color still at the client and at the designer, allowing the correct definition of color parameters and the communication of these issues among all parties.

2. COLOR PROFILES

One of the most significant steps for the creation of the color management systems as we know and use today was taken in 1993 with the foundation of the ICC – International Color Consortium – in order to create and promote a system to enhance a reproduction of predictable and consistent color workflow. Originally founded by nine companies (Adobe, Agfa-Gavaert, Apple, Kodak, Fogra, Microsoft, Silicon Graphics, Sun Microsystems and Taligent), this group currently has over seventy members that contribute to the development of the concept of color management. This consortium attempts to join together different aspects of color reproduction in order to produce generic standards that can then be adapted for each of the represented industries. A major problem in color reproduction has to do with the difficulty of reaching a precise, or at least good, color matching across devices such as a display and a printer. This problem was easily solved when designers and producers worked in a closed system where all devices, scanners, monitors and printers were calibrated to work consistently with each other. The customer featured the original to reproduce, monitored the scanning and color treatment performed by expert operators, and after that the system was prepared to reproduce the original colors accurately.
The current problem lies in the variety of devices and print media we now have at our disposal, translated into an impractical amount of color conversions between all devices, making it impossible to attempt to standardize the color reproduction process. The solution proposed by color management systems eliminates color translation directly between different devices and enables communication between devices and a connection color space. Thus, each device needs only to relate to this independent color space, and not with each device in the workflow.

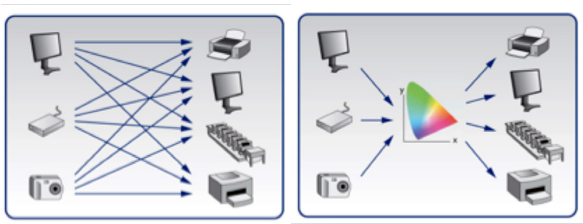

Figure 1. Illustration of color communication between devices, and between devices and a connection color space (Lacie 2013).

This independent space does not change the RGB or CMYK values but rather decodes them and turns the color value into a universal language that can be understood by any color management system. Likewise, ICC profiles do not change the behavior of the devices, only defines how they should represent a certain color value (Fraser 2004).

3. CASE STUDIES

There are currently tools to which graphic designers have accesses that, at least technically, allow for the reduction of color differences between displays and printed materials. We can say that color is a sensation that depends directly on the device, and it was in order to overcome this situation that the first color management systems appeared. Homann (2009) states that color management exists "...to ensure the correct color reproduction throughout the workflow, from the first draft to the final product." We analyzed several case studies during our research to deepen the current state of the use of color management systems and have an in-depth understanding of the production processes of designers and printers with regard to color management-related task. These studies were selected bearing in mind its geographic origin, the different promoters and the analysis of different aspects of the same problem.

In this process Riordan (2006) initially highlights the lack of standards and specifications for the phase between creativity and performing a color proof, but he then introduces designers as professionals with little concern for color settings in their software, always giving preference to preset standard parameters. He also recognizes that this attitude is due to the fact that they turn the responsibility for final color adjustments over to the prepress and print professionals who produce designers' work. But in his studies, O'Neill (2007) arrives at the conclusion that designers and print providers rarely use color management systems, and workflows are often incompatible, meaning tasks have to be carried out in duplicate, increasing the probability of error. Unlike Riordan, O'Neill suggests that efforts to improve the processes involved in color management should center on promoting collaborative work between the different parties concerned. Later, Martin (2010) confirms some of this data and adds that only a small percentage of final files comes to printers with embedded color profiles, and even when this is the case, the print provider ultimately removes them, due to lack of trust in the way they were created. The author puts forward that current color management systems, although scientifically correct, are so complex that it is hardly possible to implement them properly. To address this situation Martin proposes the development of an application or software to help in the task of communicating data between different workflows. Wilamowski (2010) finds exactly the same difficulties in education and communication of color and proposes solving this situation by creating a platform, which she calls a Print Mediator, which would be responsible for communication between designers and printers. Although the idea has not been put into practice, it is theoretically a solution, one that may be valuable depending on the complexity of this mediator. The researcher declares that this solution requires verification, because it is acknowledged that this kind of platform may have the opposite effect and, due to its complexity or imperfect design, may deter users. In order to standardize and make the workflows of designers and printers compatible, Enoksson (2010), in addition to proposing a didactic tool, suggests standardization to achieve better communication and translation of information on color among all users. He states that this standardization should take place during both the creative and production processes.

4. COLORTRANSLATION TOOL

After analyzing the different case studies presented above, we questioned how our research could help overcome the problems detected. Already in the first phase of the literature review, we noticed that many authors indicated a lack of communication between the different players in the printing process as the major problem for the non-fulfillment of expectations in color reproduction. At the same time, the lack of technical knowledge, the constant transformations undergone by the sector and the complexity of color management systems were also identified as barriers to enabling a predictable and consistent color reproduction.

Although several approaches were available to us, we chose to try to build a platform that allows customers or designers to select several color parameters into their computer applications. Thus we can begin to manage color right from the start and ensure that the communication of technical data is done in the best way. During our theoretical research we realized that there are already several international organizations concerned with standardization processes to ensure consistency in the treatment of color. One of these organizations is GWG – Ghent Workgroup – based in Belgium, which has developed a set of recommendations and specifications for the areas of publishing and packaging, based on the experience of the professionals involved. Founded in 2002, this organization has grown in terms of membership and international recognition, and is recognized mostly for the 2012 specifications recommending a set of indicators, which a PDF file should contain, depending on the type of product under consideration. These specifications can be obtained free of charge from the organization's website, and then loaded into the computer application used to create the PDF files. In addition to these specifications, the GWG regularly publishes supporting documents showing how the PDF specifications should be used.

Another tool that designers can use before they send the file to production is the Preflight option. Although some computer applications already have this feature, which check if the PDF file was created with the necessary conditions for production, VICG has developed a set of profiles themselves for the printing area, which allow the verification of specific errors. This Belgian entity gives free access to these tools that can be imported into Adobe applications, including InDesign. Although it is possible to obtain specifications for creation and preflight PDF files, we noticed that there is no entity to recommend the configuration of color parameters for image editing, vector drawing or layout software.

The correct configuration of the color settings allows making the appearance of color stable throughout the creative processes and can then attend to properly communicating the color data to the following production processes. In the case study presented above, Riordam stated that designers did not pay attention to these parameters and so it seemed to us important to create a platform where we could download this type of information. Therefore we decided to create a tool where, in addition to PDF presets from GWG and preflight verification profiles from VICG, it could be possible to download the color settings created by us based on ISO standards for this sector.

As we intended from the beginning that the greatest number of people could use the tool, we aim to have the platform available in Portuguese and English at least. Therefore the tool name would have to be simple and understandable to the target audience. During the early stages of the research, we repeatedly came across descriptions by several authors explaining how a color management system or a color profile worked. The most well known examples compared the color profile to a dictionary or a currency converter (Johansson, Lundberg, Ryberg 2008) and hence the idea of the term ColorTranslation arose. During the process of creating this tool, it became necessary to create the color settings, compile the PDF and preflight presets from scratch, and define how the user could select this information and download the necessary files. After about two months of tool development, the first version was tested by a small group of people whose suggestions helped improve tool' aesthetic, functional and technical aspects.

This platform is already built and will be available free of charge to all, and it is intended to be a continually developing and mutable tool. Thus, all actors involved can use this platform to access the latest data related to color settings, PDF and preflight presets. In the near future we also believe that it will be possible to customize this tool so that print companies can provide their customers with their own settings for printing.

5. CONCLUSIONS

After the two methodological steps taken in our research, it was necessary to act to present a solution to the problems identified. On one hand, it was necessary to make it simple and accessible to technical information that is already available in a dispersed form, and on the other we also wanted to contribute to a more integrated solution that could help designers make decisions on how best to communicate color data. To make this possible, we isolated three factors that seem unavoidable to us

when we need to digitally communicate a certain color: the color settings, the default settings for PDF, and Preflight profiles, present in the software applications used by any graphic designer. But while for the latter two there are already international organizations developing and providing such data, in the case of color settings there are not. Apart from this fact, an analysis of case studies also demonstrated that the vast majority of designers don't consider these definitions very important despite the fact they play a central role in how the information is transmitted to the output.
To improve this situation, we developed a platform where we can gather the scattered information, particularly with regard to the default settings for PDF and Preflight files, and provide the preferred color settings for certain production conditions. Through this tool the user can select a set of requirements depending on the type of work they will produce, and then get a set of files that can be loaded into the software to update all color settings. These files were created based on industry recommendations and standards and evaluated by a panel of experts in various fields.
We can therefore conclude that it is possible to develop tools to support the decision making of designers, particularly regarding communication of technical color data, thus contributing significantly to the promotion of predictability in color reproduction, and thus confirming the hypothesis we established. By doing so we have contributed to the body of knowledge of the subject studied during this research.

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Empirical Approach to Define a Digital Colour Space for Light Emitting Textiles

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ABSTRACT

The paper describes an approach to define a colour space for LED light emitting textiles. The combination of lights and textiles is settled in an innovative textile material category called smart textiles. Within the context of material research and culture light emitting textiles are considered as smart surfaces using a so-called transfer-technology, which integrates functionality into fibers and yarns based on its conductive properties. These materials are "giving" body to the thought that new is not only what a material "is" but what it "does" (Küchler 2008) and these surfaces after all will change our perception of materiality as they can change their appearance (Müggler and Tomovic 2014).
This paper describes the empirically developed digital colour space for light emitting textiles, which prepares new technology for future use in textile and product design. The experimental setting is methodologically based on the Natural Colour System (NCS), which permits to assess chromatic values visually. The examinations followed three steps: defining white values as baseline; calculating chromatic values; evaluating and refining all values in an expert panel. The outcomes indicate, that a solely mathematical defined colour space should be revised visually. The findings can be applied in design work with light and textiles.

1. INTRODUCTION

This paper deals with the process of selecting colour characteristics of LED light sources for light emitting textiles. Most textile designers consider chromatic light as a rather abstract topic, mainly because it is not part of their traditional textile design expertise. The challenge for textile designers working in the field of smart materials is to handle the immaterial properties of light in combination with material and colour properties of textiles. Although textile designers deal with a wide range of colours, the almost infinite number of chromatic lighting nuances poses a challenge for them. Reproducing and modifying a specific chromatic hue requires knowledge and experience. Hence it would be logical to start with a limited selection of chromatic lights. However, textile designers should not feel restricted by this selection. Therefore the goal was to reduce the almost endless options within the digital colour range to a palette of colours, which are easy to handle and fully support the introduction of light design principles in textile design.
Light emitting textiles result from a multi-disciplinary project that enables design-driven material innovation (Klooster 2010). The project e-Broidery 2.0 involved textile design researchers, embroidery manufacturers and electronic engineers. The developed technology enables the integration of multicolour lights into textiles by machine embroidery. By using a control unit additive colour mixing of LEDs that can be dynamically changed is realized. The project team studied the light effects when LED lights interacted with textile materials in an interior setting. The aim was to define a digital colour space for LED lights that are used in combination with textiles. The project is driven from a textile design perspective and the results are intended to create a textile material and surface with novel aesthetic qualities.
Following research question was addressed: What is an adequate amount of chroma-

tic steps and hue-values to meet the needs of the designer to create appealing light designs for light emitting textiles?

2. METHOD

The process to define a colour space for the e-Broidery 2.0 technology included three steps: first a visual examination to determine achromatic white light values for two types of luminous surroundings; second a theoretical part to define preliminary values according mathematical calculations; third an empirical part during which an expert panel reviewed and refined all chromatic values. To navigate within the colour gamut defined by red, green and blue LED light sources axes according to those in the Natural Colour System (Tonnquist, 1986) were consulted. Hues were defined by using the unique hues yellow, red, blue and green as reference.

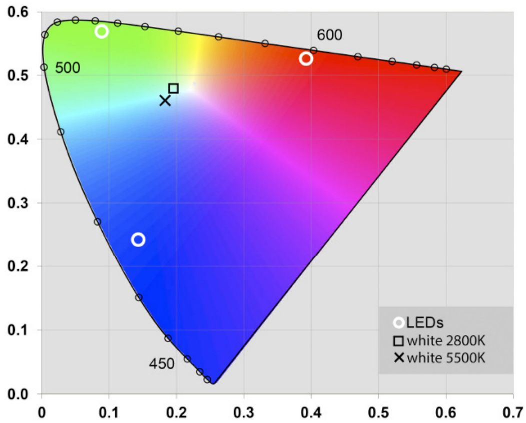

Figure 1. CIE 1976 diagram, positions for red, green, blue LEDs and two types of white lights

At the beginning neutral white tones were identified for surroundings with 5500K (cool visual impression) and 2800K (warm visual impression) ambient light including five different brightness levels. Figure 1 shows the positions of the brightest white tones within the CIE 1976 diagram. Table 1 shows the calculations for the different brightness levels within the white value with a surrounding light for 5500K. For the sake of brevity only the white tones and hues for the cool ambient light (5500K) are presented here. The brightness levels have been determined by comparing it to light intensities of LED curtains using a light regulation unit as reference (Créa-tion Baumann AG, 2014). To generate a well-balanced brightness scale corresponding with the regulation levels of the already existing product it was necessary to add two additional values to it. This is on one hand the maximum (100%) and a 17.65% level.

Brightness level	No.1	No.2	No.3	No.4	No.5
Brightness in %	100.0%	50.20%	17.65%	7.06%	1.57%
R	**213.0**	106.9	37.6	15.0	3.3
G	**255.0**	128.0	45.0	18.0	4.0
B	**133.0**	66.8	23.5	9.4	2.1

Table 1: RGB values for the selected achromatic lights in surrounding light of 5500K

In a second step chromatic values for red, yellow, green and blue were determined with the RGB gamut: 255/000/000, 255/255/000, 000/255/000 and 000/000/255. From these values all transitional chromatic values for orange, green-yellow, cyan, magenta were mathematically calculated. Desaturation was achieved by adding components of hues that were not present in the full saturation version of a hue. Table 2 shows the chromatic values for all hues and saturations from maximum to high, moderate and low, which were determined mathematically.

Colour/Saturation	*Max*	*High*	*Moderate*	*Low*
Red	213/000/000	213/064/033	213/127/067	213/191/100
Orange	213/128/000	213/128/033	213/128/067	213/128/100
Yellow	213/255/000	213/255/033	213/255/067	213/255/100
Green-Yellow	106/255/000	106/255/033	106/255/067	106/255/100
Green	000/255/000	053/255/033	106/255/067	160/255/100
Cyan	000/255/133	053/255/133	106/255/133	160/255/133
Blue	000/000/133	053/064/133	106/127/133	160/191/133
Magenta	213/000/133	213/064/133	213/127/133	213/191/133

Table 2: Calculated RGB values for 5500K ambient light

In the third step an expert panel evaluated visually all predefined values by reviewing every hue in its different saturations. All four main chromatic values and all four transitional chromatic values were contemplated (Figure 2). The expert panel evaluated the chromatic values in their range of colour saturations from almost white to most saturated (horizontal formation on the top) and in comparison to the neutral white tone (bottom right). If the examined chromatic value was a transitional chromatic value (orange, yellow, cyan, magenta), it was reviewed in comparison to their basic colour neighbor red, green or blue.

Figure 2: Eight different settings for all hues in different saturations in a light surrounding of 5500K (hues from top left: red, orange, yellow, green-yellow, green, cyan, blue, magenta)

3. RESULTS AND DISCUSSION

• This research project defined a colour space that suits applications in a surrounding light of 5500K and a second that suits applications in a warmer light of 2800K (the latter not included in this paper). These non-congruent colour spaces offer both 33 hues. Additionally, a range of five white shades for both ambient light conditions was specified.

• Based on the empirical evaluation a majority of the chromatic hues were refined to meet a regular visual perception (Table 2, green fields). The expert panel demanded mostly the less saturated chromatic values to be changed. Full saturated colours res-

pectively main and transitional chromatic values were mostly perceived as coherent and harmonious after the calculation process. Only red required a fifth value within the cool ambient light.
• The results of the empirical experiments indicate that judgments by a panel of human subjects are helpful in adjusting the visual harmony of a chromatic light pallet and its application in a specific colour space. Thus only by mathematical definitions evenly distributed colour hue ranges are not necessarily perceived as equally spaced.

Colour/Saturation	*Full*	*Max*	*High*	*Moderate*	*Low*
Red	*255/000/000*	*255/020/010*	*255/080/040*	*255/140/070*	*255/200/100*
Orange		*244/128/000*	*213/128/010*	*213/128/024*	*213/150/050*
Yellow		*213/255/000*	*213/255/022*	*213/255/050*	*213/255/100*
Green-Yellow		*106/255/000*	*106/255/015*	*106/255/028*	*115/255/048*
Green		*000/255/000*	*028/255/017*	*090/255/054*	*150/255/090*
Cyan		*000/255/133*	*040/255/133*	*090/255/133*	*130/255/133*
Blue		*000/000/255*	*015/015/255*	*045/050/255*	*080/100/255*
Magenta		*213/000/133*	*213/040/133*	*213/095/133*	*213/160/133*

Table 3: Refined RGB values (green fields= adjusted) for a light surrounding of 5500K

4. CONCLUSIONS

Outcomes analyzed from a designers' point of view reveal a potential of the light emitting textiles for future application in textile design, product design and architecture. We are used to see static and dynamic images on screens with highly saturated light dots and lively movements to catch our attention. From a designer's perspective, important findings concern the setting for subtle colour nuances contrasting these existing light images. The most interesting and precious visual results are achieved if textile designs use the pastel hues, whereas the saturated red, green, blue LED colours are by far less suitable for an application in light emitting textiles. This might be influenced by the fact that red, green and blue LEDs are used in a majority of technical products. Therefore, they do not evoke any surprising visual experience anymore.
In the case of light emitting textiles materials and technologies are put together in a way, it has not been done before and therefore these textiles may be ranked as characteristically original (Phillips 2005). Furthermore, both elements are morphing into each other representing the combination of the material and immaterial. If we consider not only white lights but also dynamic RGB-LEDs as components for light emitting textiles, then a single soft surface reveals not only endless light patterns playing with light and shadow but can show endless colour shades. Therefore the here described colour space including 33 hues is the basic element for coloration of innovative and smart textile designs. Those are no longer static but dynamic allowing a playful approach towards textiles now being able to reveal different colour moods and expressions originating from the same soft material surface.

ACKNOWLEDGEMENTS

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Colour Influence on User's Motivation to Press Input Button: Analysis Using Paired Comparison

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ABSTRACT

The aim of this study is to reconfirm the colour influence on user's motivation to press an input button on touch screen equipment. In order to understand the colour influence clearer, paired comparison method was used in this study. The results indicated that the colour of the most pressed button was bright yellow. The button colours, which also gave a high motivation to press, were yellowish, orangish, greenish and white. The results of this study and previous study were similar on high pressing motivation of yellowish and white colours, however greenish colours are pressed more in this study than reddish colours. Correlations between colorimetric values and the scale values of each button were analyzed. There was a high correlation between lightness and the pressed scale value.

1. INTRODUCTION

Since users of touchscreen are growing, graphic design of displayed page is important. It can be consider as a tool of visual communication. Input buttons are very often used on touch screens of mobile media such as during online shopping. Users press an input button to execute a command, thus design of input buttons influence usability and could affect users' visual recognition and therefore pressing behavior.
Colour is well known as an element of design, which can stimulate human emotion and perception. There are many studies about the colour effects on human emotional responses using evaluation forms (eg., Gao and Xin 2006, Hsiao, et al. 2008, etc.). The obtained results tend to be psychological response in terms of the evaluation methods or words. Therefore, the results may not account for physical response of colour stimulus.
In our previous studies, colour influence on user's motivation to press an input button was discussed with the results of visual experiments and a preliminary questionnaire survey. It was found that some colour buttons, mainly reddish colours, were often pressed. There was also small influence from the background colours: white or black, when the buttons were coloured. Reddish and yellowish colours on grey background motivated subjects to press input buttons.
The aim of this study is to reconfirm the colour influence on user's motivation to press an input button on touch screen equipment, the same as our previous studies (Nishiyama, et al. 2013, etc.), and also to understand the relationship between the motivation and colorimetric values. In order to understand the colour influence clearer, paired comparison method was used in this study.

2. METHOD

An experiment was conducted using the mobile phone, iPhone 6 produced by Apple Inc., which is operated through touch screen. The screen size was 67.0 x 138.1 mm, DPI was 1334×750 px. The experiment was conducted indoor under the lighting of fluorescent light.
The subjects were forty-eight Japanese university students (twenty-four male and twenty-four female students, eighteen to twenty-five years old). Before the experiment, their colour vision was checked by the Ishihara test with subjects' agreement and under the rule of the Ethics Committee in Kyoto Institute of Technology. All subjects didn't have colour anomaly.

The paired comparison method was used. Two buttons were presented on the screen. Then, the subjects were asked to press one of them by their finger, which they had higher motivation to press. The colour input buttons were presented in random order. Figure 1 shows the colour input buttons on the mobile phone and the experimental procedure. The experimental conditions were shown in Figure 2. An accessible online webpage to save subjects' assessments was designed for the experiment as shown in Figure 3.
Fifty-two button colours consisted of twelve hues: Red (R), Orange (O), Yellow orange (YO), Yellow (Y), Yellow green (YG), Green (G), Blue green (BG), Green blue (GB), Blue (B), Violet (V), Purple (P) and Red purple (RP). Each hue had four colour tones: light (lt), bright (b), vivid (v), dark (dk), and four neutral colours (N) based on the PCCS (Practical Colour Co-ordinate System). The colours were measured by a spectroradiometer CS-1000 (Konica Minolta Inc.). The CIELAB colorimetric values of the fifty-two button colours were calculated. Colour input buttons were put on grey background (N5) and the shape of the button was circle.
As the paired comparison is a simple sensory test and it is high precision. However, if the number of stimulus increases, each subject will have to conduct more evaluations. Therefore, colours used in the paired comparison were divided into six groups as shown in Figure 5.

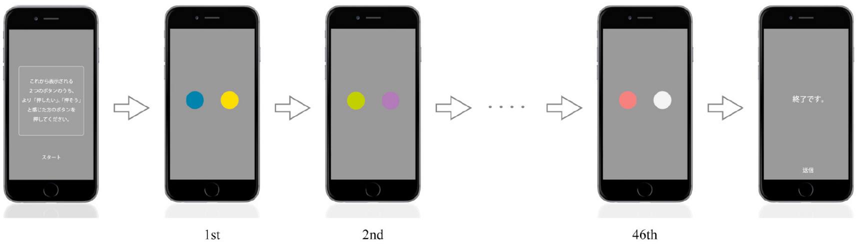


Figure 1: The example of the experimental procedure.

Figure 2: The experiment for pressing colour input buttons

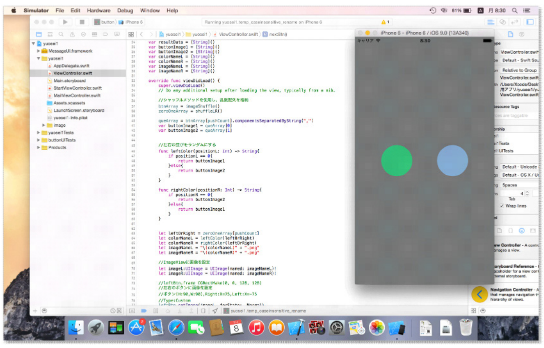


Figure 3: An accessible online webpage and its software

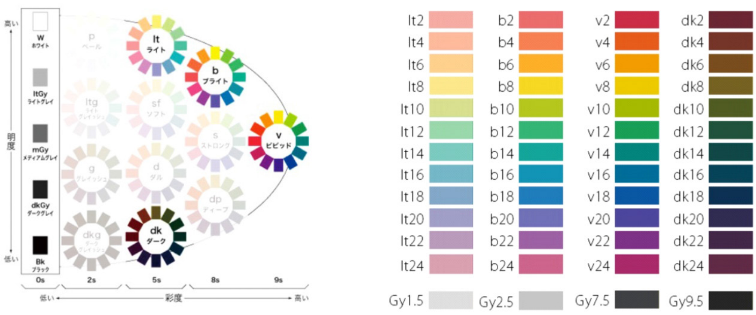


Figure 4: The colours used for the buttons.

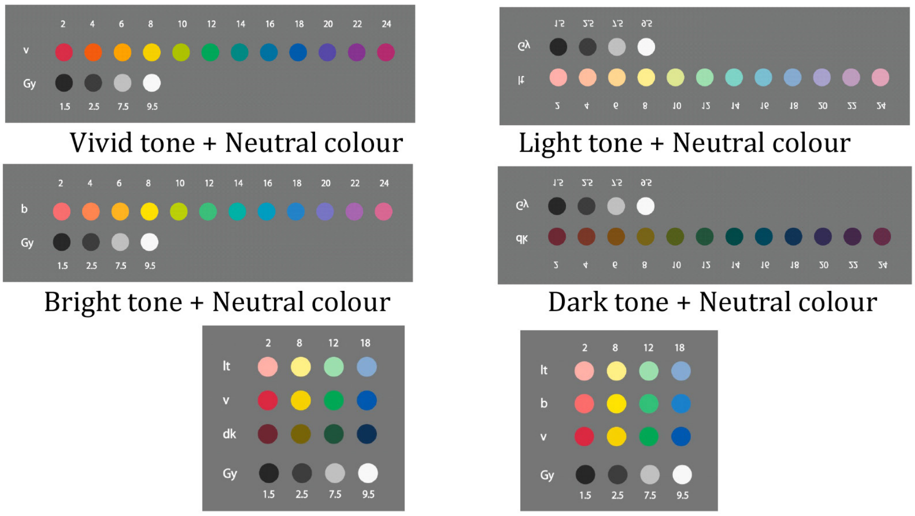
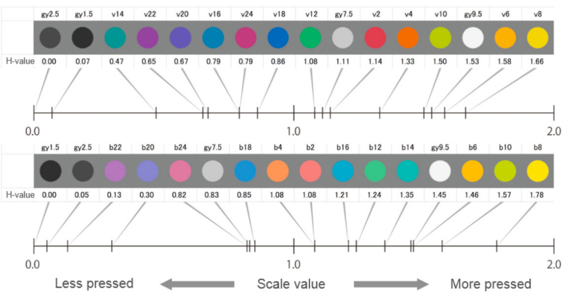


Figure 5: The six groups of the input button colours.

3. RESULT

Experimental results were automatically recorded in the spreadsheet of online storage by an online server. Frequency of pressing of each colour button was defined as the level of pressing motivation. The colours of frequently pressed buttons were considered as the colours, which have high motivation to press. In addition, the scale values of each input button were calculated.



The scale values of vivid and bright tone groups are as shown in Figure 6. The most pressed input button colours are shown in Figure 7. Yellowish, orangish, greenish and white colours have higher scale values. Comparing with the result of a previous study shown in Figure 8, greenish colours are pressed more than reddish colours in this study. This is because the high pressed colours were chosen by the scale values obtained in separate each tone group sessions.

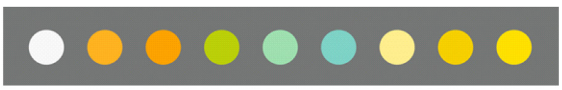


Figure 7: The most pressed input button colours.

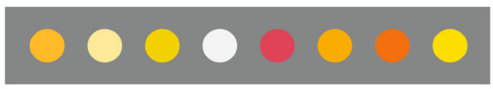


Figure 8: The most pressed input button colours obtained in the previous study.

Table 1: Correlation coefficient between colorimetric value and scale value of vivid tone colour group.

	H	S	V	R	G	B	L*	a*	b*	C*
r	-0.163	0.403	0.945	0.708	0.710	-0.158	0.878	-0.060	0.647	0.556

Correlations between colorimetric values and scale values of each button colour were analyzed to know the relationship between colour properties and the level of pressing motivation. There was a strong direct correlation between L* and the scale value as shown in Table 1. Besides, light, bright and vivid tone colours relatively had higher order, especially, yellow, green and orange colours of the tones had the highest-level motivation.

4. CONCLUSIONS

This study tried to understand the colour effects on human practical response through pressing colour buttons on touch screen equipment.

The obtained results suggested the large influence of the colour on user's motivation to press input buttons. The colour, which had the highest scale value, was bright yellow. Yellowish, orangish, greenish and white colours also had higher scale values. The results of this study and previous studies were similar, however there are some discrepancies in some parts. In this study, greenish colours are pressed more than reddish colours.

Correlations between colorimetric values and the pressed rate of each button were analyzed. The pressed scale values were highly correlated with lightness (V and L*), but not with other colorimetric values.

The subjects' performance and attributes (e.g., different experimental method, background colour, used colour for button) were not completely same in this and the previous experiments. More compatible experiments are needed to understand the colour influence to press input button.

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Relationship between Color and Form Features of Waterscape Drawing and Drawer's Personality

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ABSTRACT

Relationship between image features of the waterscape drawing and drawer's personality was investigated. Eighty university students drew a picture according to an instruction 'please draw freely a scene with water.' They also answered YG Personality Test. Pictures were scanned into digital image, and color feature indices (Ave-L*, Ave-C*, and Ave-h) and form feature indices (ASM, CON, COR, and ENT) were obtained. Correlation analysis between color and form feature indices of the water image (water-depicted area of the picture) and factor scores of YG Test showed that participants having higher Ag (Lack of Agreeableness) and R (Rhathymia) scores drew water in dark blue (resulting in lower Ave-L*, higher Ave-C*, and minus value of Ave-h indicating blue direction), and the image texture of water they depicted tended to have high local contrast (CON) and randomness (ENT). These results were explained as indicating that participants with such personality did the task eagerly, and were highly motivated to draw the water thoroughly in the color he/she chose first (blue in the most case). Different tendency was also found when data were analyzed separately for male and female participants.

1. INTRODUCTION

In modern urban life, proper assessment and improvement of people's mental health is very important. In clinical psychology, client's production of water as a subject matter (e.g., drawing and sandplay) is often used as a clue for the psychological assessment, because water representation is thought to have much information about producer(client)'s mental state. For example, Miyake (2009) investigated relationship between characteristics of waterscape drawing (free drawing of 'any scene with water') and drawer's personality, and found that those who drew a scene of water with motion (e.g., river) tended to have more positivity and extraversion than those who drew a scene of water without motion (e.g., pond).

In the past research of waterscape drawings, as in the case of the above study, assessment was almost limited to a qualitative and subjective analysis such as interpretation of the meaning of depicted water that is told by a client him/herself. Researchers have not paid much attention to, for example, 'how deep' or 'how dense' the water was drawn, since these indices were thought to be ambiguous when subjectively evaluated. However, by employing image-analyzing technique, we can utilize these information as objective image feature indices. Consequently, the present study made a quantitative and objective analysis of the waterscape drawing, and investigated relationship between color and form features of the drawing and drawer's personality.

2. METHOD

2.1 Participants

Eighty university students (31 males and 49 females, mean age 20.3 years old) took part in the investigation. They were not aware of the purpose of the research.

2.2 Personality Test

YG (Yatabe-Guilford) Personality Test (a Japanese version of the Personality Test originally developed by Guilford, J.P.) was employed. This test assesses one's personality on twelve factors, based on Yes/No answers to 120 question items (10 items for each factor). Twelve factors are Depression (D), Cyclic Tendency (C), Inferiority Feelings (I), Nervousness (N), Lack of Objectivity (O), Lack of Cooperativeness (Co), Lack of Agreeableness (Ag), General Activity (G), Rhathymia (R), Thinking Extraversion (T), Ascendance (A), and Social Extraversion (S).

2.3 Procedure

Participants drew a picture according to an instruction 'please draw freely a scene with water.' Picture was drawn by using a black pencil, a black felt-tip pen, and 16-color crayons, on an A4-size sheet of Kent paper. Most participants mainly used crayons. It took about 30 minutes for drawing.
After two months, participants were asked to answer YG Personality Test. It took about 20 minutes.

2.4 Measurement of Color and Form Features

Pictures were scanned into digital image (Epson GT-X830, 24bit color, 72dpi, no color correction). Scan was conducted in two ways for each picture; a full image was obtained by scanning a whole picture and a water image was obtained by scanning water-depicted area in the largest rectangle (e.g., river, sea and pond). Then, using originally-developed image-analyzing software (Mori, et al., 2010), images were converted into L*-image, C*-image, and h-image, therefrom calculating averaged luminance (Ave-L*), averaged chroma (Ave-C*), and averaged hue angle (Ave-h) as color feature indices, and angular second moment (ASM), contrast (CON), correlation (COR), and entropy (ENT) as form feature indices. These indices of form feature are often used in the image-analysis research to characterize image texture, and ASM, CON, COR, and ENT is regarded as an indicator of homogeneity, contrast (amount of local variation), streakedness (linear dependence), and randomness or complexity of the texture, respectively.

2.5 Data Analysis

Results of YG Personality Test were processed according to the test manual, and scores of twelve factors were calculated for each participant. Each score ranged from 0 (minimum) to 20 (maximum). Then, correlation analysis was conducted between YG scores and indices of color and form features of drawings, separately for the full image and the water image.

3. RESULTS AND DISCUSSION

3.1 Full Image

Excluding data of one participant who drew achromatic picture by using only a pencil, data of 79 participants were analyzed. As the results, no significant correlation was found between any YG scores and image indices. The primary reason for this may be wide variety of the subject depicted, since the area of water and things depicted other than water should vary depending on the subject.

3.2 Water Image

Same correlation analysis was conducted for the water image using data of 74 participants; data of five participants who drew a scene of rain were excluded because the rule for specifying water- depicted area was different from other cases.

Table 1. Correlation coefficients between YG scores and image indices.

+ - $p<.01$, + - $p<.05$

	Ave-L*	Ave-C*	Ave-h	ASM	CON	COR	ENT
D	-.023	-.091	-.153	-.119	.053	-.114	.143
C	-.178	.154	-.265	-.254	.176	.075	.329
I	.004	-.010	-.028	.004	-.047	-.143	-.088
N	-.140	.097	-.196	-.066	.101	-.168	.099
O	.073	-.042	-.144	-.127	.017	.085	.110
Co	-.042	-.028	-.143	-.105	-.058	.041	.051
Ag	-.306	.285	-.391	-.203	.235	.099	.324
G	-.132	.136	-.114	-.017	.034	.133	.039
R	-.303	.235	-.171	-.099	.178	.181	.205
T	.005	.018	.141	.109	.108	.197	.024
A	-.104	.145	-.226	-.075	.041	.081	.138
S	-.128	.193	-.219	-.036	.131	.118	.147

The results are shown in Table 1. Among twelve factors of YG Personality Test, C, Ag, and R had significant correlations between color and form feature indices. Because these three factors have positive correlations mutually (C-Ag r=.418, p<.001, Ag-R: r=.620, p<.001, R-C: r=.291, p<.05), and the pattern of their correlations between image indices is consistent, the results can be explained as a whole. That is, participants having higher C, Ag, and R scores drew a picture of water with higher Ave-C*, CON, and ENT, and lower Ave-L*, Ave-h, and ASM. To state more concretely, in terms of Ag that showed the strongest correlation between image indices, participants lacking agreeableness tended to draw water in dark blue (resulting in lower Ave-L*, higher Ave-C*, and minus value of Ave-h indicating blue direction), and the image texture of water they depicted tended to have high local contrast (CON) and randomness (ENT). Despite the negative sound of the factor name (Lack of Agreeableness), question items assessing Ag include rather positive and active ones, such as 'I want to do various social activities,' and 'I seek for something stimulative when bored.) According to Yagi (1989), a person having high Ag score shows positiveness and high motivation as strong points. He also pointed that a person having high R score, which correlated positively with Ag score, shows energies and decisiveness as strong points. Therefore, the present results may be explained that participants having high Ag and/or R scores did the task eagerly, and were highly motivated to draw the water thoroughly in the color he/she chose first (blue in the most case).
Figure 1 is a picture drawn by the participant with high Ag and R scores (19 and 18, respectively). Figure 2 is a picture drawn by the participant with low Ag and R scores (2 and 8, respectively). Different way of coloring the water, in two pictures with the similar composition, may be noticed easily.

3.3 Sex Difference

Correlation analysis was conducted for male participants (n=26) and female participants (n=48) separately, using the water image. As the results, males' data showed different tendency from the whole data, whereas females' data was in line with the whole data in general.

Figure 1. Reproduction of the picture drawn by the participant with high Ag and R

Figure 2. Reproduction of the picture drawn by the participant with low Ag and R scores.

In males' data, Ag and R had no significant correlation between any image indices, but D and N had significant negative correlation between Ave-h ($r=-.424$, $r=-.446$, ps $<.05$, respectively).
D also correlated negatively with SAM ($r=-.545$, $p<.01$) and positively with ENT ($r=.457$, $p<.05$), and D and N had high positive correlation with each other ($r=.732$, $p<.001$). These results mean that depressive and nervous males tended to draw water in blue thoroughly, and the water drawn by depressive males tended to have low homogeneity (ASM) and high randomness (ENT). It is interesting, but difficult to explain, that D and N in males and Ag and R in females resulted in the same drawing characteristics. This problem should be further examined in the future research.

4. CONCLUSIONS

The present study investigated relationship between color and form features of the waterscape drawing and drawer's personality, and found that some personality factors related to the way of drawing water. In the whole data of 74 participants, those who have high Ag (Lack of Agreeableness) and R (Rhathymia) scores tended to draw water in dark blue, and the image texture of water they depicted tended to have high local contrast and randomness. These results were more prominent in the female participants. On the other hand, in the male participants, higher D (Depression) and N (Nervousness) related to the same drawing characteristics. Though this study is only the first step of the research, it opened the door to assess one's personality by analyzing image features of his/her drawing objectively and quantitatively, not subjectively and qualitatively. In the next step, psychological properties related to the drawing characteristics should be examined more widely and deeply by means of, for example, measuring individual's image of the water.

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Adumbrations of Things and Adumbrations of Colors: A Phenomenological Issue

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ABSTRACT

In our daily life, we see an object as being of the same color despite the variations in lighting conditions and the diversity of the shades of color. That is the phenomenon of color constancy. How may this be explained from a phenomenological point of view?
According to Husserl (1983: 237), the manifold shades of a color are adumbrations in virtue of which we see one and the same color. The phenomenon of color constancy emerges out of a process of adumbration.
Husserl's theory of color adumbration is based upon his description of visual perception. He develops his theory of adumbration primarily in order to explain the constancy and identity of the objects of our daily perception. His main thesis is that we see one and the same object through the manifold adumbrations or profiles in which it continuously appears. Through its adumbrations, the visual object presents itself as being itself.
Now, the analogy between the adumbration of colors and the adumbration of perceptual things is not immediately evident. The profiles in which a perceptual thing appears are different from the shades of a color. In this paper, I will present some arguments against Husserl's attempt to extend the adumbration theory from the perception of things to the experience of colors.

1. INTRODUCTION

The phenomenological approach focuses on the experiential dimension of color. The object of the phenomenological research is not the color as a separate and autonomous item, but rather the experience of color.
Husserl's phenomenology distinguishes between sensations and perceptions. Perceptions are intentional, that is, they are directed to an object. In contrast, sensations do not have an intentional object. The nature of sensations is entirely subjective. However, sensations take part in the process of perception. They provide the stuff for an interpretation process in which emerges the intentional relation to the object (see Hopp 2012). In turn, the object of the perceptual experience appears showing certain characteristics that correspond to lived sensations (color, temperature, etc.).
In his description of the experience of color, Husserl highlights the following key features: On the one hand, the lived experiences of color are sensations and take part in perceptions. For instance, the color sensation is embedded in the perception of the red apple on the table. On the other hand, the perceptual object appears showing chromatic properties. For instance, there is a red apple on the table, it appears now, we can see it. Furthermore, the colors of the object appear under specific lighting conditions and in different shades.
In what follows, I will focus on the phenomenon of color constancy. Despite the variations of lighting conditions and the different shades of color, we perceive an object as being of the same color. How may this be explained from a phenomenological point of view?
According to Husserl (1983: 237), one and the same objective color is adumbrated by a continuous multiplicity of color sensations. The manifold shades of a color are adumbrations in virtue of which we see one and the same color. The phenomenon of

color constancy emerges out of a process of adumbration.
Husserl's theory of color adumbration is based upon his description of visual perception. He develops his theory of adumbration primarily in order to explain the constancy and identity of the objects of our daily perception. His main thesis is that we see one and the same object through the manifold adumbrations or profiles in which it continuously appears. Through its adumbrations, the visual object appears as being itself.
In the book Ideas I, Husserl brings together the adumbration of the objects in our daily perception and the adumbration of colors. He says:
The color of the seen physical thing (...) appears, but while it is appearing the appearance can and must (...) be continually changing. The same color appears "in" continuous multiplicities of color adumbrations (Husserl 1983: 87).
Each determination has its system of adumbrations; and each of them, like the thing as whole, is there as the Same (...) despite any interruption of the continuous course of current perception (Husserl 1983: 87).
However, the connection between the adumbration of things and the adumbration of colors is not immediately evident. The profiles in which appears a perceptual thing are different from the shades of a color. Husserl's attempt to extend the theory of adumbration from the perception of things to the experience of color shall be discussed.

2. AN INNER CRITIQUE TO HUSSERL'S THEORY OF COLOR ADUMBRATIONS

In what follows, I will present two objections to Husserl's theory of color adumbrations.
First, the way things appear in our daily perception is quite different from the way colors do. Color is a characteristic of the perceptual thing. Husserl (1970: 559) says: "I do not see color-sensations but colored things". From the phenomenological point of view, colors are not primarily objects of our daily perception, but they are embedded in our perceptual experience. For instance, in our daily life we see red things, but we don't see the concrete red as being a perceptual thing.
Yet, while explaining color constancy in terms of an adumbration process, Husserl draws an analogy between color and perceptual thing. This analogy can lead us to ignore the above-mentioned phenomenological distinction. In other words, this analogy presents colors as being a kind of physical, perceptual things and ignore the fact that in our daily experience colors do not appear as things, but rather as features of things.
Second, the profiles or perspectives in which a thing appears are certainly different from the shades of a color. The profiles belong directly to an object. The shades of a color do not belong directly to an object, but to a characteristic of the object, i.e. its color. Regarding this, G. Nicholson says:
There are two categories of objects adumbrated in sense perception. In the first place, perception affords adumbrations of the qualities of sense, such as color. The color red is adumbrated to us through the shade variations (...). In the second place, it is the material object that is adumbrated in sense perception, the book, for instance (Nicholson 1984:90).
There is another relevant difference between profiles and shades that must be mentioned. The perception of the thing through the profile in which it now appears involves the projection of other profiles in which it can appear later on. Lets take as example our visual perception of the moon (Figure 1). Perceiving the moon in one of its aspects or profiles, we anticipate other possible aspects. Besides, the aspects

or profiles we have already seen are available for new perceptual experiences and in some way predetermine them. Perception is a process that involves both expectation and memory. With the help of both the projective force of imagination and the remembering force of memory, perception builds a coherent system of appearances of one and the same thing.

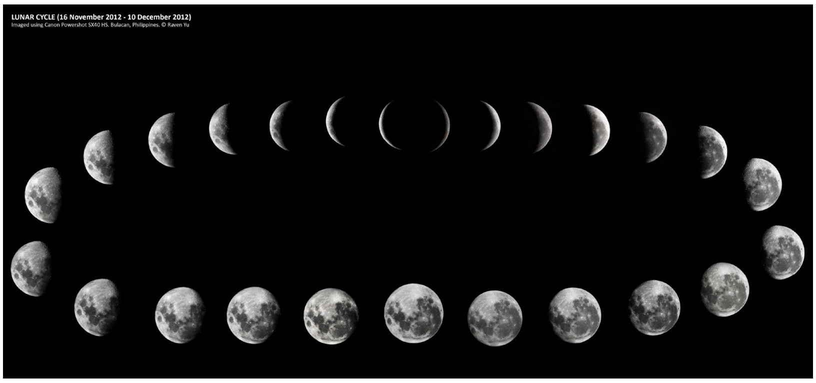

Figure 1. The lunar cycle.

Our daily experience of color –that is, our perception of the concrete colors of things- is differently structured. We do not perceive just one shade of color at a time. Many shades of one color appear simultaneously on the colored surface. A fusion or blending process is here at play. Blending different shades of color in an homogeneous color is thus a different process than synthesizing diverse profiles in one and the same perceptual object. Blending shades of one color is a process that occurs at a pre-empirical, pre-objective level.

3. CONCLUSIONS

Husserl claims that in the perception of physical things as well as in the perception of colors of things, we grasp one and the same item through the multiplicity of its own appearances. He defines that process as "adumbration" and speaks both of adumbration of things and of color adumbration. However, blending different shades of color in an homogeneous color is a different process than synthesizing diverse profiles in one and the same perceptual object. Blending shades of one color is a process that occurs at a pre-empirical, pre-objective level. Consequently, the phenomenon of color constancy is an issue primarily for the so-called "genetic phenomenology", which focuses on the genesis of both the subjective and the objective side of the lived experience.

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What are the Colours of the Words 'Me' and 'Others'?

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ABSTRACT

How do people from different cultures associate colours with certain words? This paper describes a study into how people from two different cultures associate 24 words with colours. The findings can be of interest for professionals and academics working in the remit of visual communication in different cultures. The aim of this research is to investigate if there are distinctive patterns –similarities and differences– in how subjects from two different cultures connect some selected words with colours. From the study it is also possible to see if there are differences in the chosen colours related to the subjects' sex, age, experience of colour and religion, The Nepalese subjects are most Hindu and Buddhists while the Swedish subjects are mostly Christians, although it is not known to what extent the subjects are actually practicing a religion. The reason for conducting this pilot study in Sweden and Nepal is that these two countries obviously differ in term of culture and religious context and that I had access to both. This is a pilot study designed to explore the method. With the experience of this study, a larger study is planned in six more countries with various cultures and religious backgrounds in different parts of the world during 2016 and 2017.

1. INTRODUCTION

Much information today is visual and based on, or including colours. Marketers and designers want to find out what works in different cultures (Jacobs et al 1991). People all over the world receive visual information almost all the time and have to quickly sort and evaluate the messages and judge if they are of importance to them. The perception of colour is immediate and therefore colours constitute important signals to us. But do colours mean the same thing to people living in Stockholm as they do to people in Kathmandu? Colour and meaning have interested researchers artists, designers and marketers for a long time. Various studies have focused on of how emotions are associated with single colours and colour combinations in different cultures and the coherence between different groups of people (da Pos & Green-Armytage 2007; Ou et al 2010).

2. METHOD

In this study, design students and laypersons were given 24 words in English. They were asked to match each word to any colour from a chart with 27 selected colours from the NCS system. The two countries represented in this study are located in different parts of the world (Europe and Asia), with different cultures and religious traditions. From each country there are two groups of subjects, one group is a general mix of people who are not working with colours in their professional life. Another group consists of students of art and design from the Linnaeus University and Kathmandu University. In total 70 individuals from Sweden and 77 from Nepal participated, and the distribution students and laypersons was approximately equal. It is possible to compare the answers from these two groups separately. The subjects speak and understand English well. They do not have any known colour defects and they are born and live in Sweden or Nepal. The words that are investigated have different characteristics; some of them maybe have a more obvious connection to colours, such as the words 'warm' and 'cold'. Others are of a more emotional character, such as 'sorrow' and 'happiness'. A third category may be described as more subjective or abstract in relation to colour, such as the words 'me' and 'others'. The 24 words tested in this study are twelve pairs of opposites: 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.

2.1 Colour samples

For each word the respondents could select among 27 colours from NCS samples that had been placed on a colour chart. The colours consisted of three shades of NCS´s primary colours (Y, R, B, G) and secondary colours (Y50R, R50B, B50G, G50Y). One (B) was the most brilliant colour, one (C) a dark shade, and one (A) a light shade of those eight primary and secondary colours. In addition to these colours there was also an option for the subjects to choose a black, grey or white colour. The colours were:
N: S 0300-N (A1), S 4000-N (B1), S 9000-N (C1). Y: S 0520-Y (A2), S 0580-Y (B2), S 6020-Y (C2). Y50R: S 0520-Y50R (A3), S 0585-Y50R (B3), S 6020-Y50R (C3). R: S 0520-R (A4), S 1080-R (B4), S 6020-R (C4). R50B: S 0520- R50B (A5), S 3055- R50B (B5), S 6020- R50B (C5).
B: S 0520-B (A6), S 2065-B (B6), S 6020-B (C6). B50G: S 0520- B50G (A7), S 2060- B50G (B7), S 6020- B50G (C7). G: S 0520-G (A8), S 1565-G (B8), S 6020-G (C8). G50Y: S 0520-G50Y (A9), S 1075- G50Y (B9), S 6020- G50Y (C9).

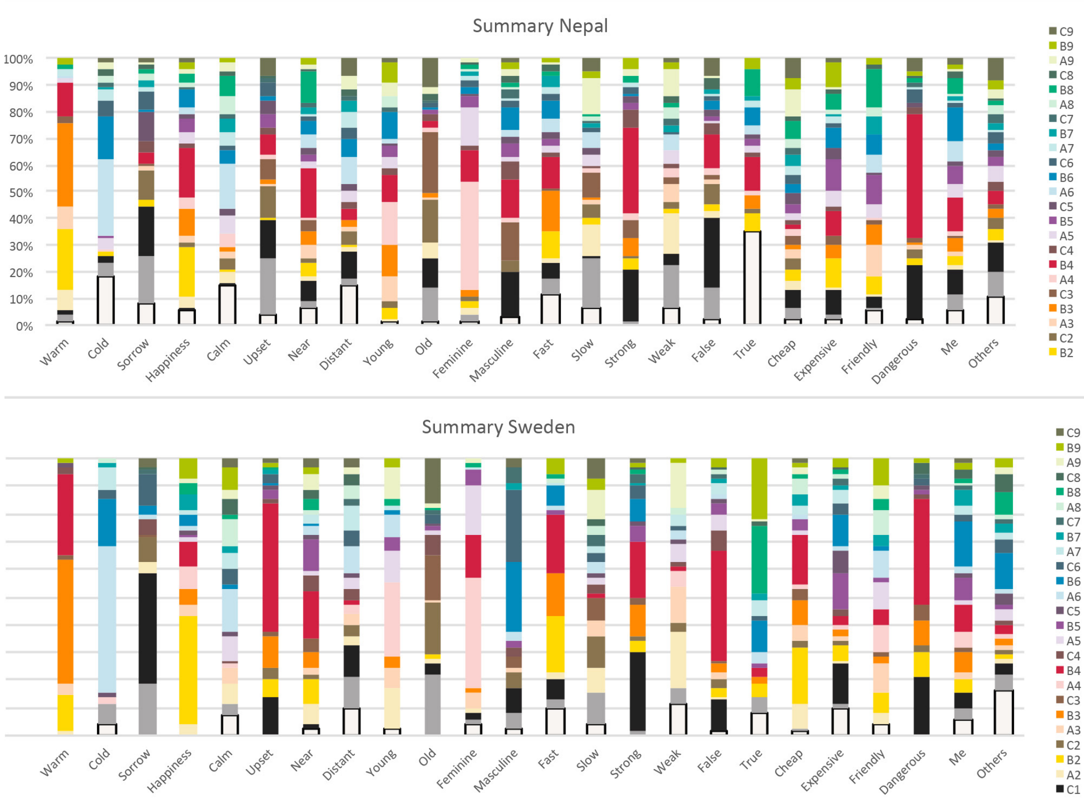

Figure 1. The chosen colours in Nepal and Sweden.

3. RESULTS AND DISCUSSION

The summary of the results divided into the groups of Nepalese and Swedes are presented with diagrams showing all the chosen colours. (Figure 1). The diagrams show that for some of the words there is a strong coherence, where both Nepali and Swedish respondents to a high extent select only a few colours. Such is the case for the words: 'warm', with a dominance of orange the word 'cold', with a dominance of blue colours, and the word 'dangerous', with a dominance of red. In contrast, the colours chosen for other words, like 'me' and 'others' are more spread out over the colour spectrum. The diagrams also show that for some words there is a quite strong coherence between the patterns from Nepal and Sweden. Examples of such words are, 'warm', 'cold', 'calm', 'feminine', 'fast' and 'dangerous'. Another observation is that for the word 'happiness' the Nepalese spread their choses on red, yellow and orange. The Swedes chose yellow to a greater extent. For the word 'false' many Nepalese chose black and grey whilst the Swedes to a higher extent chose red. The word 'true' for the Nepalese is dominated by white and for the Swedes it is dominated by green and blue colours. The word 'friendly' for Nepalese has a various chromatic colours and the Swedes chose more light colours.

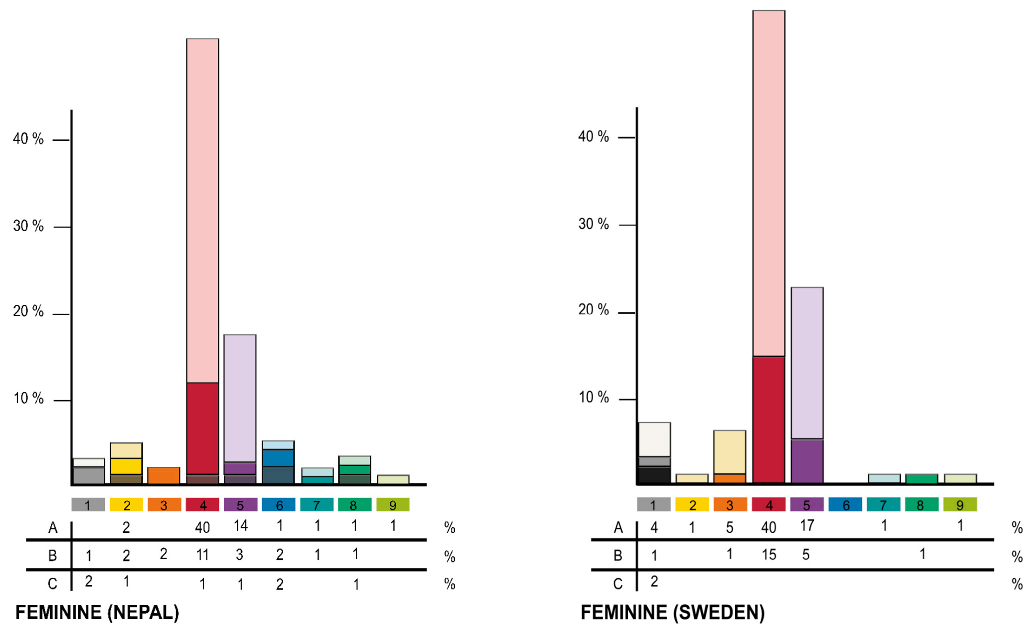

Figure 2. The chosen colours for the word 'feminine'.

For the word 'feminine' there is a relatively good coherence between Nepal and Sweden with light red (pink) 40%, as the most chosen one for both countries. The second largest colour in both countries is light purple with 14% in Nepal and 17% in Sweden. The third largest choice for both groups is red with 11% in Nepal and 15% in Sweden. (Figure 2). An interesting observation as regards the word 'feminine' is that females tend to chose red more often than males who tend to chose light red (pink) more often than the females.

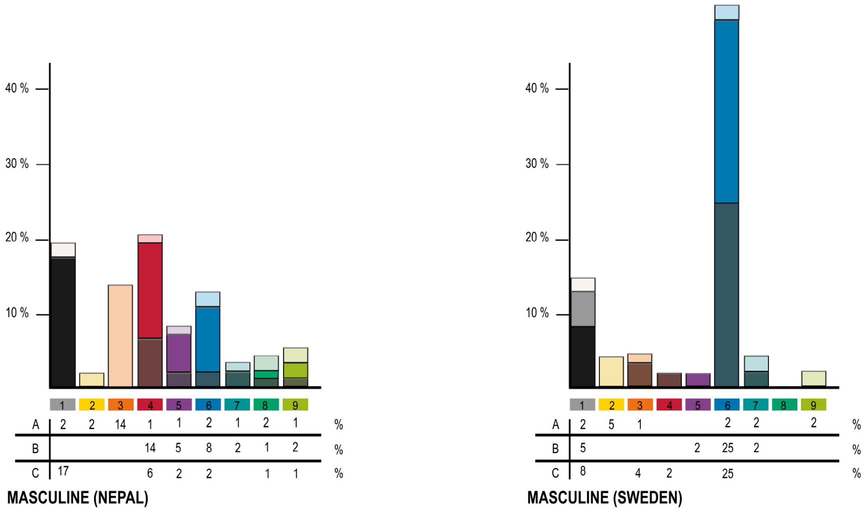

Figure 3. The chosen colours for the word 'masculine'.

For the word 'masculine' there is a remarkable difference where the Nepalese has a wide range of chosen colours and the most chosen colours are black 15%, red 14% and light orange 14%. The Swedes had a lager coherence in their answers, blue 25%, dark blue 25%, and black 8% (Figure 3).

4. CONCLUSIONS

The colour chosen for many of the words are quite similar. Some of the words has a significant difference in the colours chosen. This study does not try to explain the reasons for these differences. However, it is likely that different traditions, religious background, and if the subjects were colour skilled seems to make a difference in certain words. It would be interesting to explore how other cultures in different parts of the world respond to the same words.

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Color: More Than a Physical Attribute

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ABSTRACT

This study describes the results of a psychophysical experiment of perception and emotional connotations of color in a group of Chilean observers (ages 18-30) all tested for normal color vision. First, 30 participants were asked to name basic colors to determine a list of colors recognized by Chileans. Secondly, 60 observers were asked to give at least 3 connotations for the each of the colors selected previously. This type of interview intended to give observers the freedom to choose their own words for description (Clarkeet al., 2008. Ferraro, 2009). Each interview was carried out individually in order to avoid bias. Finally, 60 participants were asked to select, from a range of 8 colored chips, which sample represented the "basic color" and which represented the connotations described for each color. Initial results showed that a total of 9 colors are recognized as basic colors. In addition, the initial analysis showed that each color had a wide number of connotations. Red showed the least number of connotations (32) and purple showed the largest number of connotations (68). This work aimed to establish the basic understanding in color connotation among Chileans and how this findings may improve marketability of new products.

1. INTRODUCTION

Color is an integral component of any product and is often considered to be a primary criterion in the selection of a product, thus significantly affecting sales volume (Cárdenas, 2009). This attribute makes color a powerful visual feature that can be an influential tool for communication purposes such as uniqueness, connotation, novelty, among many others (Suk, 2006). Therefore, color can act as a sign that implies emotions and whether is wanted or not, it determines certain behavior. (Caivano, 1995; Cortés 2014). One of the objectives in color technology is to reproduce and use color in different media. However, color is a personal, physiologically-based experience which has led to research on color choice effectiveness when using color as a strategic marketing tool. (Cárdenas, 2009; Birren, 1945; Hine, 1995; Lee, 2002; Miller & Kahn, 2002). At the heart of color science lies the critical issue about the visual experience. Emotional and connotational responses to color have been widely investigated in multiple disciplines (Suk, 2006). While color can represent multiple elements, it is necessary to understand that most of these associations and meanings depend in great part of social and cultural context (Ferraro, 2009, Komomen 2008). Gao et. al (2007) have also suggested that color not only can be influenced by age and gender of people, but it can be influenced by cultural backgrounds. This phenomenon has been known as color culture. It refers to "shared meanings invested in colors by people of the same culture" (Komonen, Yan, 2007). There is several published work regarding color meaning, preference and emotional connotation (Heller, 2004; Osgood, 1960; Suk, 2006; Ferraro, 2009; Ou et. al, 2004). There is limited information regarding color connotation in Latin America. Rivera (2009) and Ortiz (2014) investigated color connotations in Mexico and Arboleda (2007) in Colombia. Particularly in Chile there is no investigation among color culture, thus it is important to study the meaning that Chileans give to each color, in order to develop a common language through it.

2. METHODS AND MATERIALS

This research was carried out in two phases. During the first phase, an initial survey was used to determine the basic list of colors recognized among Chileans. During the second phase, a visual study was designed to recognized associated concepts to the basic list of colors. In addition, the participants were asked to select from a range of colored samples, the one that represented the basic color and also the hues associated to the concepts described by them.

2.1 Phase I

A group of 30 observers between the ages of 18 and 30, all tested for normal color vision using the Neitz test (Neitz, 2001), participated in this part of the study. Each participant was asked to determine in a short period of time (15 seconds) a list of colors that could not be described other than with its name. In other words, the basic color with no adjectives. A list of basic colors was obtained.

2.2 Phase II

60 observers between the ages of 18 and 30, all with normal color vision, participated in this part of the study. Each individual was asked to defined a concept, a meaning, an emotion, a feeling, etc. related to each of the basic colors obtained in phase I. The observers were asked to described at least 3 things for each color. Immediately after they answered, they were asked to select from a range of colored samples, the sample that represented the basic color, and the sample visualized when they were asked to make an association to the color. The colored samples were selected such that represented a good range of the basic colors. Additionally, colorimetric data from the samples was obtained using a Datacolor portable spectrophotometer. The visual assessment of the color samples was carried out using a costumed made viewing booth painted with a neutral gray equivalent to a Munsell N 7,25. The samples were illuminated at 90o and visually assessed in a 45o degree angle in relationship to the eye of the observer. The custom made viewing booth was illuminated with a daylight simulating lamp with a correlated color temperature of 6500 K. Figure 1 shows an example of the array of colored samples. Figure 2 shows a person during the study.

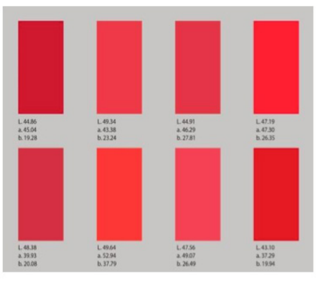

Figure 1, Example of colored samples

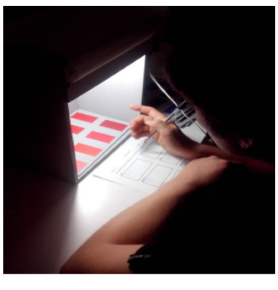

Figure 2. A person during the assessment.

3. RESULTS AND DISCUSSION

3.1 Phase I

Table 1. summarizes the results obtained from phase I. The basic colors that were chosen by more of the 50% of the group were selected. A total of nine colors were recognized as basic.

% Selected	Red	Blue	Yellow	Green	Brown	Orange	Purple	Light blue	Black
	100%	96,7%	93,3%	83,3%	73,3%	70%	56,7%	56,7%	53,3%

Table 1. Summary % obtained for each of the basic colors

Red was the only color recognized by all the participants. It was noticed that often, specific hues were recognized as basic colors, for example, vermillion, carmine, garnet, etc. This may be due to the fact that most of the participants were from a Design school. Such fact could have influenced a superior sensitivity in terms of color perception. In addition, basic colors such as white were not identified as basic by a large number of observers.

3.2 Phase II

Figure 3, shows the samples selected by the majority of observers as the sample representing the basic color. It can be noticed that some colors, such as white were not recognized as a basic color in Spanish.

Figure 3. Referential sample for each of the basic colors

Table 2 summarizes the results obtained in phase II. It shows the size of the semantic network (associations) for each of the basic color, the colorimetric values from the sample associated with the basic color, the most common concept and the colorimetric values for the sample representing the most common concepts.

Color	Semantic network size	Cielab values basic color	Most common concept	Cielab values for most concepts		Number of associations for each CIEL*a*b* code	
Red	32	L*44,91 a*46,29 b*27,81	Passion, Rage	L*44,91 a*46,29 b*27,81	L*44,91 a*46,29 b*27,81	14	10
Blue	46	L*38,38 a*3,36 b*-39,89	Serenity, sea	L*50.59 a*-3.71 b*-40.89	L*36.13 a*-3.27 b*-23.87	18	12
Yellow	41	L*83,59 a*10,12 b*82,14	Sun, joy	L*86.99 a*4.30 b*66.70	L*83.59 a*10.12 b*82.14	6	14
Green	52	L*53,20 a*-39,31 b*31,86	Nature	L*46.15 a*-30.97 b*25.39	N/A	16	
Brown	47	L*38,51 a*8,46 b*15,64	Earth, stools	L*38.51 a*8.46 b*15.64	L*44.90 a*10.24 b*19.13	10	12
Orange	49	L*61,77 a*39,02 b*46,57	Hot, happiness	L*61.77 a*39.02 b*46.57	L*70.15 a*33.66 b*62.81	8	10
Purple	68	L*34,26 a*20,90 b*-15,32	N/A*	N/A*	N/A*		
Light Blue	39	L*77,77 a*-17,88 b*-19,28	Tranquility, heaven	L*82.62 a*-16.67 b*-13.33	L*82.52 a*-15.19 b*-15.71	12	8
Black	50	L*26,92 a*-0.02 b*-0,50	Darkness, elegance	L*26.92 a*-0.02 b*-0.50	L*29.59 a*-0.76 b*-2.19	12	6

Table 2. Summary results from phase II

It can be noticed that red obtained the smallest semantic network, with only 32 associated concepts. Two common associations were Passion and rage. This finding suggest that among Chilean observers, red is a color that represents strong feelings and emotions. Notably, the sample that represented the basic color and the most common associations was the same.

Blue was associated with serenity and sea, even though research has suggested that blue shows great number of concepts associated with sadness and emotional distress.

Light blue, stands out as having very similar associations to basic blue. Therefore, it is not surprising that concepts are repeated such as tranquility. It is important to mention that in Chile, unlike English speaking countries, “celeste” is the word to name “light blue”.

All the associations related to green mentioned by Chilean observers, revolved around nature and natural. This color had many tangible descriptions, but they were not emotional. This suggests that the green is far removed from the interiority of a person and deeply rooted to the material world.

Brown is an ordinary and unappreciated color by Chilean observers. Some of the most common connotations were: dirty, old, stools, dry, trunk, etc. Ultimately, things not desired by people.

Yellow and orange, both are colors associated with uplifting connotations. While yellow is a color that transmits energy and activity, orange exacerbates these characteristics bringing them to a more youthful and festive level. It was noticed that another concept associated with orange was summer. This arises whether the song “An orange summer” by the Argentine singer Donald was responsible for this association.

It should be noted that purple has the widest semantic network with 68 associated terms. The meanings and association were very diverse, so much that it was not possible to generate common concepts associated with this color.

Black has a duality of meanings. It is associated to darkness and elegance.

Even though the number of color samples presented to observers was limited, only one observer could not find the sample that had in mind for Green. Thus, such limitation did not affect significantly the results of this study.

4. CONCLUSIONS

An important observation made during this research suggests that for the participants of this study, it was difficult to define at least three concepts, emotions, etc. This is reflected by the average number of concepts associated with each color (3). Besides, the main descriptors of each color were objects and nouns, while emotions and feelings were barely reported.

This study is a first approach that lays the foundations to a larger controlled study with the aim to generate a Chilean dictionary of color. Such information can be helpful to both the design of products for Chile, as well as the emerging industry.

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Relationship between Individual's Color Preference and Tendency of Seeking Pleasantness and Comfortableness

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ABSTRACT

Following Takahashi and Hanari (2015), relationship between individual's color preference and his/her personality concerning pleasantness and comfortableness, active and passive kinds of our good feelings, was investigated. Seventy-three undergraduates answered the degree of liking of twelve basic colors; red, orange, yellow, yellow-green, green, blue, purple, pink, brown, white, gray, and black. They also answered the questionnaire originally developed for assessing one's personality of seeking pleasantness and comfortableness using five short statements each. Individual's preference score of each color and the degree of seeking pleasantness (P score) and comfortableness (C score) were obtained, and analyzed by the correlation analysis and the multiple regression analysis. The results showed that participants with high P score tended to like pink, red, purple, and brown, and participants with high C score tended to like orange. These results were not explained by the sex difference. Together with the previous results (Takahashi & Hanari, 2015), relationship between pleasantness-want and purple preference was considered to be most reliable, and possible psychological background that links these characteristics was discussed. Different results between the previous and the present studies were also found, possibly reflecting different aspects of the personality assessed; passive sensitivity in the previous study and active want in the present study, of pleasantness and comfortableness.

1. INTRODUCTION

We have investigated relationship between individual's color preference and his/her personality of feeling pleasantness and comfortableness, that is, active and passive kinds of our good feelings. The idea of distinguishing these two types of good feelings has originally theorized in the thermal sensation research (Kuno, et al., 1987). For example, when we move from extremely hot open air to an air-conditioned room, we would feel excitingly good, that is pleasantness. Pleasantness is characterized by properties such as activeness, change, and surprise. On the other hand, when we stay in a room neither hot nor cold (in other words, not being conscious of the room temperature), we would feel calmly good, that is comfortableness. Comfortableness is characterized by properties such as passiveness, stability, and ordinariness. Later, Takahashi (2003) discussed such distinction between pleasantness and comfortableness could be applied to visual comfort, and even to more general concept of human's good emotion and sense of well-being.

Takahashi and Hanari (2015) presented data of an exploratory study, in which a hundred university students answered degree of liking of twelve basic colors and expected degree of feeling pleasantness and comfortableness in the imaginary situation of good affair. The results showed that the individual who is sensitive to pleasantness tends to like black and purple, and the individual who is sensitive to comfortableness tends to like orange, green, and yellow-green. These results were discussed in the light of associative meaning and visual impression of these colors.

In the present study, following the previous study, we make a second step of the research, by employing newly-developed questionnaire to evaluate one's tendency of seeking pleasantness and comfortableness separately and more directly.

2. METHOD

2.1 Participants

Seventy-three university students, twenty-three males and forty-eight females (two unspecified), participated in our research. Their mean age was 19.4 years old (SD=1.6).

2.2 Procedure

All data were collected through questionnaire. The questionnaire was composed of two parts. The first part included twelve visual analog scales on which participant answered his/her degree of liking of twelve basic colors; 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). These colors were presented as printed color chips (6 mm × 16 mm). Participants drew a slash, according to the degree of liking each color, on the line with the left-end indicating 'don't like at all (0% liking)' and the right-end indicating 'like the most (100% liking)' (Figure 1).

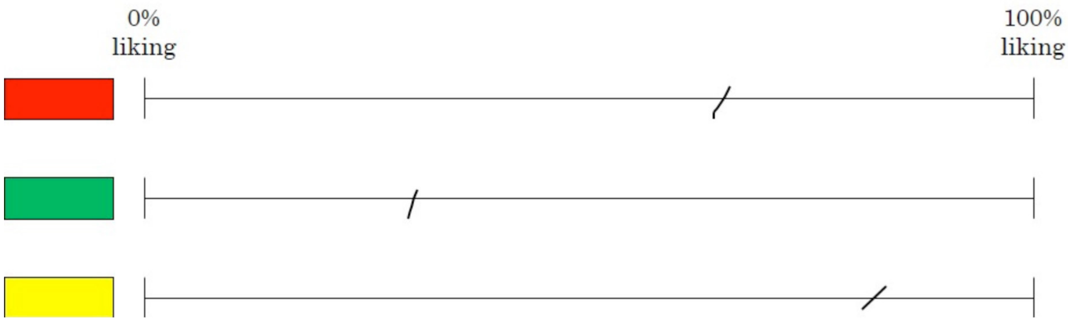

Figure 1. Samples of the visual analog scales.

The second part included ten short statements, and asked participants to answer the degree of his/her agreement to each statement on 11-point scale (0: 'don't agree at all' – 10: 'completely agree). Five of ten statements were intended for measuring pleasantness-want; 'always seek the impression never experienced,' 'want to try new things,' 'prefer eventful life to steady life,' 'unexpected things are intriguing,' and 'want to take a chance even if somewhat risky.' Other five were intended for measuring comfortableness-want; 'want to lead ordinary and steady life,' 'do not want to change the present situation, if satisfactory,' 'usualness makes me feel most peaceful,' 'do not want more than no-dissatisfaction,' and 'prefer comfort of ordinariness to the impression of new things.'

2.3 Data Analysis

As for the results of visual analog scales, position of the slash was visually measured and converted into the preference score ranging from 0 (the left-end) to 100 (the right-end) for each color.
Ratings of agreement to statements underwent factor analysis (maximum likelihood method, Promax rotation), and two factors were obtained, one loaded highly to five statements intended for pleasantness and the other loaded highly to five statements intended for comfortableness. Thus, mean of ratings of five pleasantness statements and mean of ratings of five comfortableness statements were calculated in each participant to indicate his/her pleasantness-want (P score, Cronbach =.854) and comfortableness-want (C score, Cronbach =.909), respectively.

3. RESULTS AND DISCUSSION

3.1 Preference Scores of Twelve Colors

Mean preference scores of each color, separately for male and female participants, are shown in Table 1, which are ordered by the grand mean. Compared to Takahashi and Hanari (2015)'s results, gray score increased by 9 points and showed significant sex difference. As for other colors, results did not change largely. It is the first time for our data in the last twelve years that pink was not preferred more by females than by males.

*Table 1. Mean preference scores in all, male, and female participants. * p<.05*

	White	Blue	Red	Black	Y-G	Yellow	Green	Gray	Orange	Pink	Purple	Brown
All	73.8	70.6	67.1	66.4	66.1	64.1	62.8	61.7	59.9	57.8	54.8	46.0
Males	70.6	75.8	64.8	64.7	71.1	64.6	67.7	70.9	64.5	55.6	58.4	40.9
Females	74.6	67.9	67.6	67.6	63.7	63.2	60.8	* 56.2	57.1	57.9	52.5	47.1

3.2 Color Preference and Seeking Pleasantness and Comfortableness

Correlation analysis between each participant's P score and C score and his/her preference score of each color was conducted. As shown in Table 2, P score correlated positively with pink, red, purple, and brown scores, whereas C score correlated positively with orange score. These results were also supported by the multiple regression analysis conducted with P score and C score as explanatory valiables and the preference score for each color as a target valiable. It was shown that pink, red, purple, and brown preferences were significantly regressed by P score; standardized partial regression coefficient (-) was .452, .408, .374, and .441 (ps < .01), respectively. And orange preference was significantly regressed by C score; -=.421 (p<.01). Interestingly, brown preference was also regreesed by C score (-=.341, p<.01), and orange preference was also regreesed by P score (-=.336, p<.05), possibly indicating similar visual impression of these two colors.

Relationship between pleasantness seeking and purple preference, and comfortableness seeking and orange preference, is in common with the previous results (Takahashi & Hanari, 2015). Since questionnaires for evaluating one's personality concerning pleasantness and comfortableness are quite different between two studies, these results would be reliable to a certain extent. As discussed in the previous study, purple, a color not existing in the spectrum, would have somewhat artificial and surprising impression that might have affinity with pleasantness-want. On the other hand, orange would be viewed as 'nature colors,' having peaceful impression that might be loved by comfortableness seekers. In Takahashi and Hanari (2015), green and yellow-green preferences had relationship with comfortableness sensitivity as well as orange, and these colors were discussed together from the viewpoint mentioned above. In the present results, though in the same positive direction, correlation coefficients of green and yellow-green with C score were not significant.

Notable result, which was not shown in the previous study, is relationship between pink and red preferences and pleasantness seeking. In the results of Takahashi and Hanari (2015), pink had no correlation with P score nor C score, and red had correlation with C score (r=.214, p<.05). Though convincing explanation of this discrepancy is not easily given, it may have been caused by the different nature between the personality questionnaires employed; evaluating one's sensitivity of pleasantness and comfortableness in the previous study and one's want (degree of seeking) in the present study. In other words, the previous questionnaire would have measured passive aspect, and the present questionnaire would have measured active aspect, of one's personality concerning pleasantness and comfortableness.

4. CONCLUSIONS

The present study investigated relationship between the color preference and personality of seeking pleasantness and comfortableness, and found that people with high pleasantness-want tend to like pink, red, and purple. Though less clearly, pleasantness also related to brown and comfortableness related to orange. Considering that preference of any colors did not correlated with both P score and C score, and these scores had negative correlation mutually ($r=-.497$, $p<.001$), pleasantness and comfortableness would be clearly distinguished from each other in terms of the color preference, each having unique psychological mechanism related with the preference of certain colors.

Considering the previous and the present results together, relationship between pleasantness and purple preference would be most reliable. Though it's a matter of speculation, the visual impression and the associative meaning of purple would harmonize with the nature of pleasantness, such as surprise, extraordinariness, and artificialness. The next step of reseaech needs to shed light on the psychological process underlying this relationship by means of, for example, examining reasons of liking/disliking purple and associative meaning of purple.

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Color Preference Study of Snack Package Designs for Children as a Health Communication Strategy

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ABSTRACT

To study the impact of color on the choice of a snack food package, children ages 9 to 13 were asked to select their preferred choice of a snack to eat among packages displayed on a computer in five color choices; green, yellow, red, pink, and blue. The participants were divided into three groups to observe the relationships between the selection of healthy snacks and the impact of color on the packages of the preferred-selections. The result suggests that green is perceived the healthiest color among the five colors, however, green, red, and blue were equally preferred colors on their selections of snacks to eat. When asked a question about the relationship of flavor of their first chosen color, most children's answer was associated with a name of a fruit. Children made their first color choice based on their favorite color to eat; the reason for their second color selection was that the color stood out visually or was bright.

1. INTRODUCTION

Former Research (Neumark-Sztainer et al., and 1999, Story et al., 2002) suggests that taste is a predominant element that influences food selection by children, but the exact motivating factors of taste on their snack food selection is not well understood. Color is also known to be an element that influences the perception of taste (Nyman, 1983, and Clydesdale, 1993). According to a "Blue Seven Phenomenon" study, blue is the most selected color followed by red, purple, and green respectively (Simon and Primavera, 1972). A Katz and Breed (1922) study showed that blue, red, and green were top three picks respectively from boys age 9 to 12 and blue, green, and red were from girls among six colors. However, those studies were not related to food packaging colors or taste perception. A previous study (Walsh and et al., 1990) reported that red and green have the strongest influence on preferences in colors for food, but blue was not included in the study.

The objective of this study is to investigate children's preferences for color on snack food packages that they select to eat and the flavors they associate with the chosen color. This study also evaluates the perceived 'healthiness' of color and how this influences their snack food selections for children between the ages of 9 to 13 years old. This research is a part of the study, "Tailoring Snack Food Package Design to Children as a Health Communication Strategy" in which the goal is to develop a health communication strategy for snack food packages targeted to children ages 9 to 13.

2. METHOD

The subjects were 60 children from a college town in the USA. An existing snack bar package was selected and all of the product information was removed except for the color of the package. Computer simulations of packages in five different colors: green yellow, red, pink, and blue (table 1) were presented for evaluation on a 27inch monitor. This study was approved by the Internal Review Board (IRB) at a State University in the USA and a consent letter from parents and an assent form from the children were both required for participation. The subjects were divided into three groups. Group 1 was asked to select the colored package that appealed to them most for a snack to eat, they were then asked to list the reasons for that selection, and to indicate the perceived flavor of the selected color. Group 2 was asked the same questions as group 1 and an additional question with regard to the perceived healthiness of the snack based on the color of the package choice was asked. Group 3 was asked the same questions from that of group 2 but in the reversed order. For group 3, the perceived healthy snack package color choice question was asked first and the other questions followed.

2.1 Sample Preparation

Table 1 shows the package template used to determine each child's color choice on their preference to eat. The colors presented are based on the existing SoyJoy® snack bar packaging colors. The order of packages was randomly arranged for each experiment.

					
Name	Green	Yellow	Red	Pink	Blue
CMYK	55,0,100, 0	0,24,100,0	2,100,94,0	0,70, 14, 0	100, 95, 16, 4
RGB	127, 194, 65	255, 196, 11	233,29,43	241,114, 153	42, 54, 127

Table 1. Color variables.

The study was equipped with audio taping capabilities and screen capturing was done using screen capture software for the data analysis. The data was analyzed using SPSS statistical software.

2.2 Data Analysis

A total of 60 participants were recruited for the study; 32 boys (53.3%) and 28 girls (46.7%). A total of 40 children participated in the first group (n=22), the second group (n=18), and both 20 boys and girls were recruited in the first and second group. A total of 20 children, 12 boys and eight girls, participated in the third group.
Table 2 shows the first and second group's color choice preferences for snacks to eat. Red, green, and blue were equally selected (27.5%) as the first choice (table 2). However, boys' section rate on those three colors was higher than girls. Especially, 17.5% of boys selected red as the first choice and only 10 % of girls select red as their first choice. Yellow and pink were preferred mainly by girls as the first choice.

Color	Green		Yellow		Red		Pink		Blue	
	M	F	M	F	M	F	M	F	M	F
1st choice	11 (27.5%)		4 (10.0%)		11 (27.5%)		3 (7.5%)		11 (27.5%)	
	6	5	1	3	7	4	0	3	6	5
2nd choice	14 (35.0%)		4 (10.0%)		12 (30.0%)		3 (7.5%)		7 (12.5%)	
	7	7	3	1	4	8	2	1	4	3
3rd choice	10 (25.0%)		14 (35.0%)		7 (17.5%)		4 (10.0%)		5 (12.5%)	
	6	4	6	8	3	4	1	3	4	
4th choice	3 (7.5%)		9 (22.5%)		7 (17.5%)		8 (32.5%)		13 (32.5%)	
	1	2	7	2	4	3	3	5	5	8
5th choice	2 (5.0%)		9 (22.5%)		3 (7.5%)		22 (55.0%)		4 (10.0%)	
	0	2	3	6	2	1	14	8	1	3

Table 2. Color choice to eat without a healthy snack color question.

The color choice (n=40) was not affected by the question related to the perceived healthiness of the color because of the order of the questions in which healthiness of the snack color was asked after the question about which color appealed to them most for a snack to eat. As expected, pink and yellow were selected as the first choice by girls more than boys, however, there is no significant correlation on genders.
Table 3 shows the third group's color choice (n=20), 12 boys and eight girls. The third group's first choice was red (40%) which is higher percentage compared to group one and two. Among the 40% of the first choice on red, seven boys and one girl selected the red as the first choice. After the healthier snack color choice, it showed a tendency for boys to choose a different color other than the their healthier color choice, green (table 3 and 4).

Color	Green		Yellow		Red		Pink		Blue	
	M	F	M	F	M	F	M	F	M	F
1st choice	4 (20.0%)		3(15.0%)		8 (40.0%)		2 (10.0%)		3 (15.0%)	
	2	2	1	2	7	1	0	2	2	1
2nd choice	6 (30.0%)		2 (10.0%)		5 (25.0%)		2 (10.0%)		5 (25.0%)	
	4	2	2	0	3	2	0	2	3	2
3rd choice	3 (15.0%)		4 (20.0%)		3 (15.0%)		2 (10.0%)		8 (40.0)%	
	2	1	2	2	0	3	2	0	6	2
4th choice	6 (30.0%)		6 (30.0%)		3 (15.0%)		4 (20.0%)		1 (5.0%)	
	3	3	5	1	2	1	1	3	1	0
5th choice	1 (5.0%)		5 (25.0%)		1 (5.0%)		10 (50.0%)		3 (15.0%)	
	1	0	2	0	0	1	9	1	0	3

Table 3. Color choice to eat after a healthier snack color question

Green (52,6%) was selected the most as a perceived healthy color by groups 2 and 3 (n=38), blue was the second choice and red and yellow were tied for third. There was no significant correlation (Pearson Chi-Square=.674) between group two and three. This data shows that the order of questions does not significantly affect color choice (table 4) with regard to the choice of their favorite color to eat.

Color	Green	Yellow	Red	Pink	Blue	No Answer
Group 2 (n=18)	9 (50.0%)	2 (11.0%)	3 (16.7%)	0 (0%)	4 (22.0%)	0
Group 3 (n=20)	11 (55.0%)	3 (15.0%)	2 (10.0%)	1 (5.5%)	2 (10.0%)	1 (5.0%)
Total (n=38)	20 (52.6%)	5 (13.2%)	5 (13.2%)	1 (2.6%)	6 (15.8%)	1 (2.6%)

Table 4. Choice on healthy snack colors

3. RESULTS AND DISCUSSION

Overall, the first group (n=22)'s first choice was green (36.4%) followed by blue (27.3%), red (22.7%), yellow(9.1%), and pink(4.5%). When we add the second group (n=18), the order of color choice has changed to green, blue, and red were equally selected as shown in table 2.
When we compared between genders (table 2 and 3); boys (n=32) selected red (44%), green (25%), blue (25%) as the top three colors respectively, girls (n=28) selected green (25%) and blue (21%) as the top two colors and the other colors of red (17.8%), pink (17.8%), and yellow (17.8%) were tied as the first selection. This data showed that boys have a very similar color preference with A Katz and Breed's study (1922), however, girls do not have a strong color preference in their snack color selection.
For the question related to the flavor of the first chosen color, most children's answer was associated with a name of a fruit. Blue was associate with blueberries (70%) followed by raspberry (10%) and chocolate (8%); green was associated with apples (38%) followed by lime (22%); red was associated with cherry (48%) followed by strawberry

(25%) and apple (10%); yellow associated with lemon (43%) followed by banana (35%); and pink was associated with strawberry (33%) and watermelon, cotton candy, bubble gum, and pink lemonade were mentioned. Twenty seven percent of the children could not identify any flavors associated with red. Also, twenty percent of the children could not identify a flavor for the green package.

Children made their first snack package color choice based on their favorite color (33%); the second reason was that the color stood out visually or was bright (16%); and the third reason was related to the flavor and taste (10%). One third of children could not answer the question with regard to the reason for their preferred color choice.

4. CONCLUSIONS

Children were able to identify most flavors correctly from the existing SoyJoy® snack bar packages except for the red. The original red package's flavor was berry and children identified it incorrectly as cherry or strawberry. The findings in this study support Walsh and et al's study (1990) that red and green have strongest preferences for colors for food. Based on this study, blue can also be added as a strong preference color in addition to red and green.

The research aims at improving perception and raising the taste expectation for snack foods based on the use of colors that subtly encourage children to act in their own best interest. The results from this study will help to introduce effective strategies that can be applied to packages and communication materials to promote healthy eating behaviors in children. The results of this research can also be expected to ultimately provide opportunities to develop and implement recommendations to food manufacturers that can be used to improve the health of children and adults by creating food labels that positively effect healthy decision-making and healthy eating habits.

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The Use of Colour in Health Care Facilities

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ABSTRACT

Colour is more than an aesthetic element in interior spaces; it plays an important role related to emotions, feelings and in some cases with biological aspects generated in humans.

It is for this reason, that health care facilities and punctually hospitals should be places where the application of colour is handled in a professional way. It is relevant to take care about psychological, physiological and emotional aspects generated in patients.

Gradually this trend was changed to allow the use of colour, often timidly and incipient. Already in the eighties the Opt Art artist Bridget Riley, was hired to paint murals in the corridors of the Royal Hospital in Liverpool. She proposed a vibrant colour scheme, inspired by Ancient Egyptian Art. She expressed about his work: "The hospital corridors are different, they embrace the whole space: they aim to lift the spirits and to remind one of life outside the hospital."

Riley's work is only one example of how colour can change the appreciation of space according to the user's conditions; today we find more examples to show how important is colour for the patient´s recovery.

One of these is The Phoenix Children's Hospital in which the proposal is innovative and daring. Rich, vibrant colours not only flood the public areas, but also the children's rooms. Orange chairs, violet and green walls are combined in some spaces to boost the energy and cheer up children.

The same conception was applied at the Silver Cross Hospital in Lennox, Illinois where the rooms, corridor and other areas are expressed with unusual schemes, but always respecting the patients and visitors wellbeing.

1. INTRODUCTION

Throughout History, man has linked colours with healing effects. There are records that show the Egyptians and the Greeks using minerals, objects and amulets of different colours to diagnose and cure physical ailments. Hippocrates used coloured ointments to treat different diseases. Likewise, Avicenna related colours to body temperature and its conditions and believed certain colours had some power over the body. In many cultures, the use of colours has been seen to balance body and mind, as well as heal diseases. In the late nineteenth century, we find the first written documents on colour therapy, and also published studies that refer to sunlight exposure to treat diseases such as tuberculosis. Today, many Eastern therapies continue to use colour to heal. For instance, Ayurvedic medicine relates one colour to each of the seven chakras. Qigong associates sounds to colours, and to Feng Shui, colour is one of its basic ideas.

If indeed colours have healing effects on people, hues used in health spaces should, therefore, be analyzed. Do these have healing effects on people? Which colours could be of effective use in health spaces?

For a long time, hospitals, clinics and other health spaces sported white colours that conveyed the idea of neatness and cleanliness. Everything was white: walls, bedding, doctors' aprons, nurses' uniforms and even patients' robes. To enter these places was to access a strange land (Mahnke, 1996). Who could honestly say that they have never felt intimidated in these places? Beyond its meaning of purity and cleanliness, this

colour generated a feeling of coldness, emptiness and fear that would do little to help with patients' recovery.
Gradually, this situation began to change giving way to the use of colours mostly in pastel shades, both warm and cold. Current references show an innovative twist on the application of palettes for health spaces. Some are bold colour proposals like the latest Bridget Riley at Saint Mary's Hospital, or the vibrant colours of Phoenix Children's Hospital. These are not isolated cases; on the contrary, they are bets on new proposals for colour schemes.

2. BACKGROUND

2.1 Bibliographic contribution

Varied literature and documents allow us to draw a variety of hypotheses around the right colours for health environments and their potential effect on patients' recovery. Much of this research is based on the physical and psychological sensations that colours produce in people. It is important to note that the results of these investigations have no scientific validity, either by the size of the sample or the circumstances in which they were made, usually in laboratories and not precisely on health spaces (CHER, 2004).
For hundreds of years hospitals had a negative meaning related to the pain and death. Everyone at some point attended white cold walls, floor and ceiling's hospital, transmitting the idea of cleaning and aseptic space but it was as strange as threatening to people who attended the place. In 1978, in the publication "Color in the Health Care Environment" Dr. Thomas Sisson states: "the use of color in hospital is often inconsistent and potential detrimental to the feeling of well-being of the patient" (Mahnke, 1996:146)
Despite this fact, we found significant contributions that give guidelines and clues to the proper use of colour in these places. Graham (1978), in a document published by the United States Department of Commerce, provides a guide to the recommended hues for different areas. For example, he suggests rooms with soft, relaxing and cheerful colours. Instead, public areas should favour the use of a warm palette, avoiding the use of saturated colours that tend to stimulate and produce visual noise.
Mahnke (1996) presents another contribution by listing a series of objectives to colour application in hospitals and other health facilities. He also proposes some more colours for other areas such as corridors, rooms, intensive care, and recovery rooms, among others. In this regard he advises not to use yellow hues that can be rejected by patients suffering from liver problems. This author maintains the use of warm colours in high values such as peach or pale green for the rooms.
Later, Leibrock (2000) offers a comprehensive guide supported by several authors' proposals. In this guide, some recommendations and remarks are given. For example, one can improve appetite by applying warm colours like coral and peach. On the contrary, green, grey, olive and mustard should be avoided. Likewise, the use of yellow and green should be avoided, as they are colours associated with body fluids. Primary colours: yellow, blue and red should be used with caution for they may initially be pleasant, but can become tiresome under prolonged exposure (CHER, 2004).

2.2 Health spaces reference architecture

A radical leader in the use of colour in hospitals is British artist Riley who, after spending two years caring for her father in a hospital, shows with personal evidence how depressing such environments can become. Her project aimed to fill with colour all of Royal Liverpool Hospital's corridors. For this installation Riley was inspired by her visit to Egypt and colours used in ancient Egyptian art. Twenty years later she proposed a similar idea for Saint Mary's Hospital in Paddington. Horizontal lines in blue, light blue and green tones in the first case; pink, green and yellow in the second, these colours filled corridors aiming to seek rest and relaxation for both patients and visitors. She states about this color application: "It reminds patients that theirs is a transitory state, that they are there to recover and rejoin life - That life goes on and life is outside, and they feel reassured."

Figure 2: Saint Mary's hospital http://www.opart.co.uk/2014/04/new-brifget-riley-mural-at-saint-marys-hospital-London/

Another example of a successful use of colour is the Phoenix Children's Hospital where a colourful lighting bathes with bright colours the walls of the reception area, while playing with coloured shapes on the floor. Similarly, rooms break established patterns of warm pastel colours, by switching to more saturated tones and low values, giving a more youthful appearance. This colour application contradicts the guide suggested by Graham (1978), both for room and corridor colours.

Figure 3: Corridor, Phoenix children's hospital http://www.archdaily.com

Figure 4: Patient room, Phoenix children's hospital http://www.archdaily.com

Another interesting case is the Silver Cross Hospital in New Lenox, Illinois. One can observe an innovative use of colour. This hospital's design sought to create spaces that evoke the idea of staying temporarily in a hotel and not in a health space. There is no exclusive use of hot or cold schemes in the rooms, one can find a wide use of colours: orange, blue, yellow, green combined with neutral ranges in order to create relaxed and radiant environments.

In the waiting room one finds vibrant colours creating a cozy and cheerful atmosphere. Thus, users feel less threatened, more confident and actually their mood improves.

Figure 5: Silver Cross Hospital, waiting room
http//www.spellmanbrody.com/our-work/silve-cross-hospital

Figure 6: Patient room, Silver Cross Hospital
http://www.yelp.com

Figure 7: ICU, Silver Cross Hospital
http://www.yelp.com

3. RESULTS AND DISCUSSION

The action of colours on people will depend on several factors such as society's influence, cultural aspects, symbolisms, personal beliefs and tastes. One cannot predict the reaction of a person facing a certain colour. For this reason, it would be very difficult to determine specific colours for health spaces' different areas (CHER, 2004). The right application of colour wipes out the institutional aspect that causes rejection and feelings of discomfort in many people. As Mahnke noted: "The most important design objective must be to minimize the institutional look as much as possible" (1996: 147). In this regard, it is preferable to avoid white and cold pastel colours like blue and green.

There are contradictions between some authors about the right use of colour; for example, some warn that yellow, green and brown tones should never be used, as they are associated with body fluids, urine and feces, while others advocate the use of yellow for its connotation of joy and optimism.

Architectural references show that there are no fixed rules when applying colour in these spaces. On the contrary, colour must be taken as one more element to create harmonic places together with other conditions such as lighting, spatial distribution and other aspects. We have presented only four cases that have allowed us to observe that established preconceptions can be empirically broken and that the use of flashy and vibrant colours do not only create clutter spaces, but can also produce cheerful environments, very different from traditional health spaces.

Interior Architects must use colour as a powerful tool.

4. CONCLUSIONS

While there are no precise evidence asserting that colour has a healing effect on people, we can state that the proper use of tonal patterns do influence people's mood and therefore, their recovery. The result is even better if coupled with an effective overall design of the space. A sick body seeks balance and harmony, beyond the possible physical and psychological effects that certain colours might have.
From the analyzed cases we can conclude that established models in the use of colour in health spaces must be broken and lead to the design of less institutional spaces.
A Riley states about the colour application her projects: "It reminds patients that theirs is a transitory state, that they are there to recover and re-join life - That life goes on and life is outside, and they feel reassured." This is the goal that all interior architect and designer will achieve in order to create a successful environment that helps patient in their healing. "The problem in the health care facility in not really so much what colour, as how and where to use it. It is of significant importance to the patient, in instance for him to see himself in his mirrors and mind as "looking well" or better". (Graham, 1978)

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Evaluating Mucosal Tissue Color Using Perceptual Scales

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ABSTRACT

The color of mucosal tissue plays a crucial role in disease detection and treatment. Whereas the mucosal color has been measured and described, the quantitative evaluation of the mucosal color as the disease developed has not been researched or well-described as of yet. Psychophysical experiments were performed to achieve perceptual scales of mucosal color perception for medical applications. In addition, a mathematical model relating the physical values and the perceptual scales of mucosal color was derived. Finally, the perceptual color values for the physical measures of any mucosal color could be obtained. The results indicate that the perceptual scales exported from the model correspond well with the visual perception of mucosal color change. By using the perceptual scales, mucosal color can be quantitatively evaluated with commensurate changes in disease and then the disease level can be quantified.

1. INTRODUCTION

The color of mucosal tissue plays a crucial role in disease detection and treatment. Color changes in the mouth might signal the beginnings of oral cancer (Heydecke, 2005:257). Mucosal color change is an important clue in the diagnosis of early gastric cancer (Lee, 2012:510). The chromaticity of the nasal mucosa can be used to detect nasal allergy (Joko, 2002:11). The color of the gingiva is an important component to be assessed in esthetic rehabilitation in dento-alveolar treatment (Kleinheinz, 2005:1). Also, color changes of mucosa often can be seen and felt easily, so the low-cost and noninvasive method is becoming a useful tool in early disease detection.

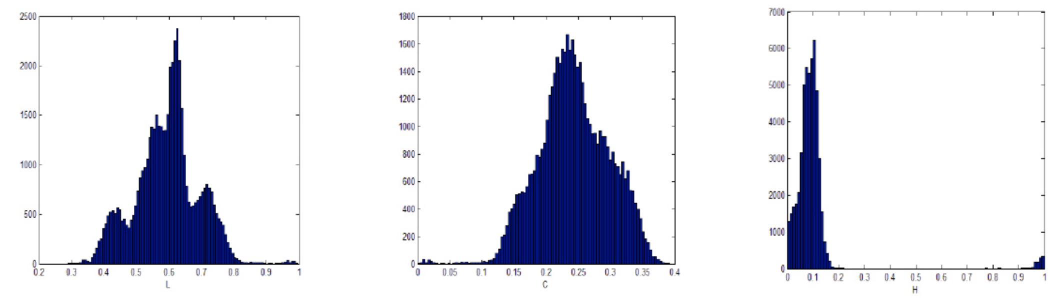
However the mucosal color is always described with three or more channel values in certain working color space (often simply sRGB image color space and sometimes without careful calibration). The corresponding analyses are also carried out in three or more dimensions respectively. Therefore, the extent of the disease based on mucosal color cannot be described with one unambiguous quantitative index. If all mucosal colors could be ranked along one dimension according to a certain objective criterion, then the positions at this dimension, which can be named mucosal chrominance, might be used to represent the mucosal colors and the corresponding disease level. In order to achieve meaningful perceptual magnitudes, psychophysical methods were used for the whole color range of oral mucosal tissue.

2. METHOD

Since color perception is a psychological perception process of color physical stimuli, psychophysics can be used to systematically define the color perceptual magnitudes and analyze the relationship between color perceptual magnitudes and color physical measures. Different mucosal colors were regarded as the physical stimuli that evoked the observers' perceptual responses. Psychophysical scaling methods were used to collect the perceptual responses to the stimuli and facilitate analysis of the relationship between these responses and the physical color stimuli. Through psychophysical experiments, the mucosal colors could be quantified on a psychological scale corresponding to the disease development. In this research, two psychophysical scaling methods, the method of paired comparison and the method of ranking were adopted in different analysis respectively.

2.1 Color Range of Oral Mucosal Tissue

The range of oral mucosal colors needs to be determined so that the physical stimuli used in psychophysical experiments are representative of this range. More than 1000 images of oral mucosal tissue that have been classified as white, pink, red, crimson and purple by doctors with expertise in such judgments were captured. Proper white balance correction was performed prior to each image capture, and the sRGB color space was selected as the representation color model of these images. Then more than 50,000 different colors expressed in sRGB color space were extracted from these images. Because the original RGB color space is not perceptually meaningful, sRGB values were transformed to the CIELAB color space using the standardized definition of sRGB.



a *b* *C*

Figure.1: Samples of mucosal colors in CIELCH

The histograms in L*, C* and h dimensions which represented the cylindrical coordinates of CIELAB color space are shown in Figure 1. In the figure, the horizontal ordinates are normalized to 0-1. It can be shown that oral mucosal colors are distributed in the interval [0.35, 0.99] for the L* dimension. While the distribution of oral mucosal colors in chrome, the C* dimension, is in the interval [0, 0.39], and the distribution of oral mucosal colors in the hue, h, dimension is in the interval [0, 0.22] and [0.95, 1]. Since h is an angular coordinate, the distribution of oral mucosal colors at h dimension can be considered in the interval [0.95, 1.22].

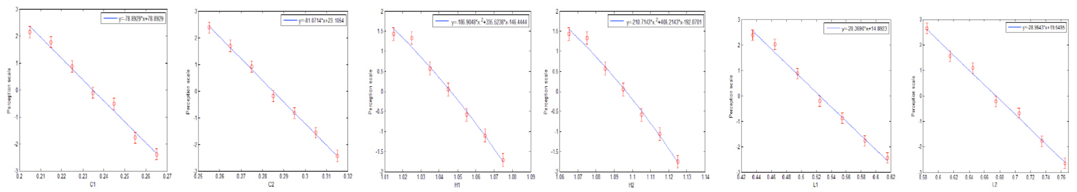
2.2 Psychophysical Experiment

The relationships between values of each dimension in the color space and perceptual magnitudes were analyzed first. That was, with two of these three coordinate values fixed; let another coordinate value change in the interval of mucosal colors to produce different test colors. Six sets of test colors in L*C*h color space are shown in Table 1.

Color sets	Varied coordinate values	Fixed coordinate values
L1	*L*: 0.435;0.465;0.495;0.525;0.555;0.585;0.615	*C*: 0.225 *H*: 1.060
C1	*C*: 0.170;0.185;0.200;0.215;0.230;0.245;0.260	*L*: 0.600 *H*: 1.060
H1	*H*: 1.015;1.025;1.035;1.045;1.055;1.065;1.075	*L*: 0.600 *C*: 0.225
L2	*L*: 0.585;0.615;0.645;0.675;0.705;0.735;0.765	*C*: 0.225 *H*: 1.060
C2	*C*: 0.245;0.260;0.275;0.290;0.305;0.315;0.330	*L*: 0.600 *H*: 1.060
H2	*H*: 1.065;1.075;1.085;1.095;1.105;1.115;1.125	*L*: 0.600 *C*: 0.225

Table 1: Six sets of test colors

The six sets of test colors were converted from L*C*h space to sRGB space, and shown in pairs on a calibrated sRGB display. In order to make sure the sRGB colors were correctly displayed, Day's method (Day, 2004:365-373) was used to calibrate the liquid crystal display for the experiment. 10 color-normal observers from our university, aged between 20 and 30 years, were invited to participate in the experiment. The method of paired comparison was adopted in which the stimuli were presented in pairs to observers. Each observer was asked to select one color, which had higher perceptual value (mucosal chrominance) than the other according to the specified ranking criterion, which was the color order of white, pink, red, crimson, and purple. The frequency matrix and probability matrix were calculated and the probabilities were converted to standard normal z-values via the table of normal probability. Finally the interval scale values were calculated. Montag's method (2006:185-188) was used to obtain error bars corresponding to 95% confidence intervals. The plots of each channel values versus perceptual scales (mucosal chrominance) are shown in Figure 2. By looking at the data distribution, the relation between L*, C* and their corresponding scales are approximately linear. But quadratic curve fittings were used to obtain relations between h values and their corresponding scales. In fact, the relation between h values and their corresponding scales is also approximately linear. Perhaps this is because the CIELAB space is an approximately perceptually uniform space appropriate for this type of human visual judgment.



a *b* *c* *d* *e* *f*

Figure 2: Plots of each channel values versus perceptual scales

In order to construct the relational model between three-dimensional values in color space and perceptual magnitudes, the method of ranking was used to avoid excessive judgments. According to the color range of oral mucosal tissue, some of the test colors were selected from the corresponding color range in the Munsell Color System. The other test colors were typical colors selected from each category of oral mucosal colors. The same 10 observers participated in this experiment, again carried out in a dark room. Each of them was asked to rank all test colors according to the color order from white, to pink, to red, to crimson, to purple. The average rank of each test color was calculated and the probabilities of test colors were converted to standard normal z-values via the table of normal probability. Finally the final rank of the test colors is shown in Figure 3.

Figure 3: The rank of the test colors

3. RESULTS AND DISCUSSION

Based on the perceptual magnitudes obtained by aforementioned rank order method, polynomial regression was used to construct the relationship between three-dimensional values in color space and perceptual magnitudes. According to the relationships shown in Figure 2, quadratic terms of h, and linear terms of L* and C* were included in the polynomial regression models. The performances of eight different polynomial models which included different combination terms of L*, C* and h were compared. For each polynomial model, the regression coefficients were calculated using L*C*h values of all test colors and their corresponding perceptual magnitudes. With the obtained regression coefficients, the estimated perceptual magnitudes of all test colors were calculated. Then regression errors, and the goodness of fit were obtained. Considering the complexity and accuracy, the best model (1, L*, C*, h, L*C*, L*h, C*h, h2) was chosen as the relationship model between L*C*h values and their perceptual magnitudes.
Additional 8 colors selected randomly in the range of mucosal color were used to test the performance of the chosen polynomial model. The observers were asked to insert these 8 colors to the ranked colors in Figure 3, and the measured perceptual magnitudes of these new colors were calculated. With the regression coefficients of the polynomial model, which had been obtained previously, the estimated perceptual magnitudes of these colors, were calculated. The relative regression errors of our model for all 8 colors are shown in Table 2, also including the measured perceptual magnitudes and the estimated perceptual magnitudes. In the table, the relative regression errors δ_i were calculated as Equal. $\delta_i = |y_i - \hat{y}_i| / y_i$.

i	L	C	H	y_i	$\hat{y}_i$	δ_i
1	0.7011	0.1958	0.1254	1.8043	1.6528	0.0839
2	0.6609	0.2631	0.1094	1.8509	1.9254	0.0403
3	0.6057	0.3804	0.0978	3.0023	2.2274	0.2581
4	0.5859	0.3693	0.0977	2.5777	2.3715	0.0800
5	0.566	0.3582	0.0977	2.6527	2.5190	0.0504
6	0.556	0.3527	0.0977	2.3937	2.5940	0.0837
7	0.5381	0.2845	0.0666	2.8236	2.8037	0.0071
8	0.4943	0.3051	0.0551	2.9686	3.0944	0.0424

Table 2: The relative regression errors of the best model

From the results, the model shows good performance in general, but its accuracy for some test samples still needs to be improved.

4. CONCLUSIONS

It is very important to achieve a quantitative index of the mucosal color across changes with disease development. The key point is how to evaluate subjective perception by objective criteria. Psychophysical methods were proposed to investigate the relationships between psychological sensations and physical stimuli in the color range of mucosal tissue. First, the relationships between values of each dimension in L*C*h color space and perceptual magnitudes were analyzed. The results showed the relations between L*C*h values and corresponding scales turned out to be approximately linear. Based on these results, several polynomial regression models were used to construct the relationships between three-dimensional values in the color space and the corresponding perceptual magnitudes. The results showed that psychophysical methods and polynomial regression can be used to obtain the quantitative index of the mucosal color, but the accuracy should be improved further, especially more refined psychophysical experiment with much more actual mucosal color samples should be performed.

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Effects of Environmental Colour Perception among the Elderly. A Critical Review

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ABSTRACT

This study analyses 37 previous colour studies published in AIC Congresses and Meetings from 2002 to 2015. They are selected from various disciplines discussing about colour perception and visual cognition in the Elderly. Focusing on how could the results of these studies affect ageing population in physical environments, as residential architecture or care homes. The study reviews factors such type of setting, method of assessment, type of colors and type of context. How would an interior space change someone's well-being? Could colour schemes influence someone's spatial perception in a particular way?

1. INTRODUCTION

With reference to the several stages of life, the perception of colour in persons changes with age: it is a well known fact that children watch and react to strong contrasts (Torres Barchino, Serra Lluch, and Delcampo Carda 2015). When they grow up, they react to subtler shapes. Later, in adolescence, their reactions and responses to colour mature and are more defined (Millicent 1995). In the third age, emphasis should be made on the fact that there is a loss of pigment in the eye cones (Gramunt Fombuena 2010) and the lens become yellowish (Baget i Bernàldiz and Fontoba i Poveda 2013). Therefore, the reality of older people's colour-schemes becomes yellowish and, as a result, environmental colour perception is altered.
Nevertheless, due to vision complexity, colour among the elderly has been assessed on limited occasions. Until what point is there a loss in the ability to perceive colour and how should we act taking into consideration these facts?

2. METHOD

As part of our review, in this paper a summing-up of recent chromatic experiments about colour perception among the elderly is carried out. This paper has managed to summarize 37 researches on colour related to various perspectives published in AIC Congresses and Meetings and dated from year 2002 to 2015.
Secondly, it discusses how is colour perception in elderly by identifying conclusions obtained throughout the analyzed experiences in order to find its significant impact on ageing population. Factors such as type of setting, method of assessment, type of colours and type of context are reviewed. According to this, we seek to increase knowledge of this field of study.
Finally, this paper concludes by arguing how colours or coloured environments may influence residential spaces for the elderly's colour perception; causing certain behavior; creating negative or positive perception to surroundings and task given; and influencing self- sufficiency and well-being.

3. DISCUSSION OF RELATED RESEARCH

The present table summarizes in a clear and concise way the 37 previous research studies analyzed, focusing in research methods, colour discipline studied and categories of variables featured.

Author	Type of context	Context setting: Actual	Context setting: Made-up	Context setting: theoretical	Assessment Method: Environment	Assessment Method: Psychology (emotion, colour	Assessment Method: Physiology- age effects (desatura,	Assessment Method: Physiology- illumination	Assessment Method: Physiology- colour discrimination- naming- contrast	[illegible]
009)	Residential-housing			x	x			x	x	
o Gomes and Lott Daré 2011)		x			x			x		[illegible]
her 2002)				x	x			x		[illegible]
ong, Seo and Lee 2015)		x			x			x		
2009)	Elderly visual changes		x				x		x	
et al. 2015)			x				x	x		
2003)			x				x	x	x	
ori 2003)			x				x			
ori 2005)				x			x			
r et al. 2003)				x			x			
er et al. 2009)			x				x		x	
t al. 2003)	Cataract vision		x		x		x		x	
2009)		x	x		x		x			
ake et al. 2009)			x				x	x		
i, Ikeda, and Shinoda 2003)			x					x	x	
et al. 2005)			x				x	x	x	
et al. 2007)		x			x		x		x	
et al. 2008)			x				x	x		
Kim, and Lee 2012)			x		x			x	x	
ssamee et al. 2007)			x		x			x		
et al. 2003)			x				x			
, Okajima, and Funai 2005)			x		x			x		
2009)	Chromatic light		x		x			x	x	
-Minoda et al. 2009)			x		x		x	x		
011)			x		x			x		
l. 2011)	Colour emotion					x				
noto et al. 2007)	Colour communication (signs, object, typography…)		x					x	x	
oto 2007)			x		x	x				
Kim, and Lee 2011)		x		x	x				x	
o 2009)				x			x		x	[illegible]
o and Moreira Da Silva 2013)			x						x	[illegible]
kasamsuk 2015)			x					x	x	
a 2003)			x					x	x	
007)			x		x	x				
rawongphana et al. 2013)		x						x	x	
omcheepsawat 2015)			x						x	
Bodrogi, and Schanda 2008)	colour harmony		x			x			x	
7)		6	26	6	16	4	16	20	19	4
research studies		**16,2**	**70,2**	**16,2**	**43,2**	**10,8**	**43,2**	**54,1**	**51,4**	**10**

Table 1. Research summary from the review about colour perception in the elderly.

The analysis of the literature shows several significant factors that should be pointed out -necessarily brief, but we have confident that it has an enough overall picture- as below.

3.1 Made up or actual context setting

Firstly, 70,2% of the research studies had been carried out in made-up or simulated settings. An actual environment is important to provide an actual state of the subjects for better understanding. Thus, in actual setting, subjects probably behave normally and this will contribute to obtain more accurate findings.

3.2 Light and colour

Secondly, it is found that 54% of the studies have shown the importance of light. Illumination is introduced as a changeable factor of their experiments and it allows for creating the experienced atmosphere. Light and colour are inseparable for the visual experience of space.

3.4 Architectural environment evaluation

Interestingly, this review has found only (4) studies focused on residential/housing for the elderly. Nevertheless, it is found that 43,2% of the studies take the effect of the environment into consideration. This fact demonstrates that architecture and interior spaces are present in most experiments. Thus, architectural colour environments are considered an essential factor in order to obtain reliable results. It is relevant to note how indispensable is this factor but researches focusing on architecture for the elderly are scarcely studied.

3.5 Number of participants

The literature review also has revealed that in 56,7% of the research studies have participated between 2 and 50 subjects. In over two thirds of those have participated between 2 and 23 subjects. Only in 10,8% of the research studies reviewed (4) have participated between 50 and 100 subjects. It should be noted that there are only two researches in which participate a large number of subjects, specifically 185 subjects (Fu et al 2009; Wuerger et al 2009). In order to carry out a research that represents a population characteristics, as the elderly population, and to obtain applicable results to this population, it seems logical to think that a substantial number of subjects that participate in the research is required.

4. CONCLUSIONS

In conclusion, this paper attempts to justify theoretically the effects of colour on elderly people through real experiments of literature analysis from several disciplines that demonstrate the high level of importance about colour, light and elderly. As it has been shown, the analysis of the literature make as believe that more studies in actual settings are required and be adapted in further steps of current research, this fact could allowed the participation of a greater number of subjects. Furthermore, most old people in interior spaces, as care homes, are affected by a whole range of visual impairments. The most common problems could affect the design of build environments for seniors, this is why these impairments need to be understood through empiric experiments. Understanding colour perception effects of ageing is necessary because they may all have a profound influence on the way in which older people perceive their environment. Thus, the way of they use their spaces must be adjusted in the formulation of these impairments throughout any design strategy, in order to magnify or minimize the elderly people spatial difficulties. Therefore, the future research direction should be to study on the relationship between environmental colours in interior architecture and the physical (visual comfort), mental (stimulation) and spatial (self-sufficiency) wellbeing of the elderly with a subsequent design of new addressed and complete built environments.

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COLOR, a great topic to learn more. Teaching experience with academically talented kids

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ABSTRACT

As a professor, facing the challenge of creating a course for PENTA UC, (Teaching Program for kids with academic talent, in Spanish) on color. It was structured around the question "What color do we see when we see?" as a way of inviting personal and provocatively to learn from the world through color, its relation with people's, animal's and plant's lives and uses as an efficient way of communication. The teaching methodology combined two strategies in each session: 1) Presentation of an particular topic each session through ideas, images, and examples; and 2) A workshop of practical exercises developed with colorful materials, individually or in groups, following exposition and discussion of the results. Color in this course lends itself to a sort of pretext for stimulating the students and leading them to discuss a wide array of issues from the world, people, communication and art among many other subjects. In this way, color serves as an inductor of reflection, critical thought and practical knowledge about the world.

1. INTRODUCTION

PENTA UC of the Pontifical Catholic University of Chile is a program that seeks to develop creative, critical, and assertive kids and adolescents, as well as promotes and expands their passion for knowledge and learning. The objective is to give an opportunity to children from socially disadvantaged contexts to fully unfold their potential academic talent, and in the way, satisfy their educational needs.

The child and young people whit academic talent exhibit a competence or skill potential much higher than the average in one or more of the areas of human aptitudes, which naturally occurs, but requires an adequate learning environment to grow and fully manifest. These individuals with above-average academic potential exist among the whole population, but in under-privileged contexts they face higher risks of losing this potential.

These students have a great learning potential, and motivation, but generally can't find the opportunities required to develop their talents in the Chilean regular education system (Chile has a state system of poor quality for most of its inhabitants). They face many situations that to them appear as easy and repetitive, so their capacities are not acknowledged and they must follow the rhythm of the rest of the group, which leads to unchallenging learning experience, and eventually the loss of motivation to learn altogether.

They learn quickly, have high motivation, process information deeper and show more energy, imagination, intellectual sharpness and sensibility, even for very precocious ages. They also manifest significant degrees of emotional intensity and social sensitivity, they tend to prefer the company of adults, and many times have problems establishing friendships with their ages peers, given their differences in capabilities and interests.

2. METHOD

The PENTA UC program aims at developing student's higher cognitive skills trough courses in specific and innovative topics, other than the standard school curriculum, chosen by the own students.

The PENTA UC program aims at developing student's higher cognitive skills trough courses in specific and innovative topics, other than the standard school curriculum, chosen by the own students.
The methodologies used are inductive, active and ludic because those are the ones that better adjust to the speed and the way talented students learn.
In the particular case of the course 'What color do we see when we see?' combine theoretical knowledge with practice exercises developed with differents colorful materials provided by the program.
At the end of the semester, parents are invited to an exhibition of the student's work.

2.1 Teachers

PENTA UC gathers academics from the different schools and departments of the university as well inviting professors from other universities or top professionals in some areas. The areas included consider various fields of the knowledge such as sciences, arts and humanities, to produce an attractive offer to the students

2.2 Students

These students come from the publics schools from various Santiago districts, and their concur to the University Campus on Fridays and Saturdays. They separated into four groups according to age and school level: 5 and 6, 7 and 8, 9 and 10 y 11 y 12. Allowing students to choose two courses each semester, one of each day.

2.3 Methodologies

Each session lasts 3 hours, with a recreational space in half, which allows for various activities each class.
The teaching methodology combines mainly two strategies in each session:
1) Presentation of an particular topic each session trough ideas, images and examples exposed in a digital presentation colorfully illustrated.
Each topic is formulated as a question to be explored:

1. How do we see color?
2. How do we talk about color?
3. What are colors for?
4. How are colors on Earth?
5. Why are plants green?
6. Do animals see color as we do?
7. Where do colors come from?
8. What do colors mean?
9. How do we perceive color?
10. How do we use color materials?
11. How digital color is mixed?
12. How is color printed and painted to objects?
13. Can we communicate with colors?

2) A workshop of practical exercises developed with colorful materials, individually or in groups, following and exposition and discussion of the results.
The activities were mainly designed with colored papers, based on a large selection with various thicknesses, types of opacity, translucent, transparent on a broad range of colors, among different kinds of paints, pencils, glue and measurement and cutting materials.

3. RESULTS AND DISCUSSION

Color in this course lends itself a sort of a pretext for stimulating the students and leading them to discuss a wide array of issues from the world, biology, culture, science, psychology, art and among many others subjects.
In this way, color serves as an inductor of reflection, critical though and practical knowledge about the world.
Also, another important objective of the course is to teach young people to observe the world around them, their colors, whether that nature gives us or that we were able to make, understand their meanings and their contributions to our welfare.
In the oral presentation, and in the paper we would show examples and images of the methodological strategies implemented in the course: the presentation of problems to the students in the form of questions and the exercises developed by the students.

4. CONCLUSIONS

The experience of teaching kids with academic talent has been one of the more potent ones I have developed in my academic career, which included over twenty years of teaching color in the university. These students present an significant challenge since they are avid for knowledge, attentive to detail, sensible, and willing to work with enthusiasm. They have even proposed interesting questions to the lecturers, who in turn must research many out syllabus topics to satisfy the student's curiosity. This leads to a course, which demands the highest of dedication from the teacher, but is in turn substantially satisfactory.

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Color and Art Teacher

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ABSTRACT

This article is part of a doctoral research that aims to analyze color in Brazilian elementary Art Textbook. Appointments from Art teacher's testimonials are presented here. The observations were made during the analysis of elementary Art Textbooks that are part of 'Plano Nacional do Livro Didático' – PNLD (National Textbook Plan, in English).

1. INTRODUCTION

Color is one of the most important elements of visual syntax. Some authors, like Rossi (2009) and teachers' practice, point out that in teaching and learning situations involving reading, analysis and comparison of images produced by different cultures or by the students themselves, for example, color is one of the outstanding elements. In daily school life, there are frequent cases in which the students use the choice and the use of color in art work as evaluation criteria to analyze and evaluate their works. Color is also a criteria used by students to group and organize images of artistic works from different periods and styles.

According to 'Parâmetros Curriculares Nacionais' – PCN (National Curricular Parameters, in English) for art education in Brazil, color is part of the general curriculum contents of Visual Arts that should be worked with students of first and second cycle of primary education. It is also listed among the basic elements of visual language: dot, line, dimension, color, texture, shape, volume, light, rhythm, movement, balance. Also, according to the PCN, the general contents of Visual Arts can be "worked in any sequence decided by the teacher, in accordance with the curriculum designed by its school staff" (BRASIL, 1997: 41) . Thus, it is up to teachers to choose what is relevant to the students practice and learn about color in Visual Arts. Staying at their criteria and the school staff to decide when and how to work the color in the teaching and learning of art in elementary school. In this manner, it behooves teachers to elect what is relevant for theirs students practice and learn about color in Visual Arts.

It is known that the textbook is an important resource for teachers in teaching and learning process of art, characterized in Brazil by the practice of polyvalence . Despite the increasing investments in information and communication technology in Brazilian education, printed textbooks still have a very important role in production, circulation and appropriation of knowledge. According to Lajolo (1996: 4), in situations of extreme precariousness, in which some Brazilian school units are, the textbook often "determines content and conditions teaching strategies, postulating decisively what is taught and how to teach what is taught" (LAJOLO, 1996: 4) . From 2015 onwards the 'Plano Nacional do Livro Didático' – PNLD included Art textbook for the second cycle of public elementary school. That means that in 2016 teachers

(1) The Brazilian obligatory primary education system is composed of two cycles. The first cycle receives 6-8 years old children and includes the first, second and third grade of elementary school. The second cycle receives 9-10 years old children and comprises the fourth and fifth grade of primary school.
(2) Translation of the original text made by the authors.
(3) It occurs when one teacher is responsible for working with students the four art languages: Visual Arts, Music, Dance and Drama.
(4)Translation of the original text made by the authors.

and students of fourth and fifth years of elementary school will work with Art textbooks, adopted by Art teachers from a reference guide in which textbooks books pre-approved by PNLD's evaluators are listed.

In order to understand how the teaching and learning of color proposals are a relevant criteria for art teachers during the choice of textbook, we chose to monitor and log a meeting dedicated to the choice of textbook PNLD 2015 of Art teachers enrolled in the 'Curso de Formação Curricular: Arte' – GFC (Group Formation Course: Art, in English), offered by the Education Department of the Campinas City Hall, located at the state of São Paulo, Brazil. Participants in GFC were formed, between 1979 and 2010 in Art degree courses offered by public and private institutions of higher education located at the State of São Paulo. The eleven teachers consulted during the doctoral research said they had already resorted to Art textbook as a reference source to work with color in class. However, during the analysis of the three PNLD collections, it was observed that the conceptual flaws about color theory presented by all three collections, in different levels, were not identified in evaluations made by teachers, not even for PNLD Guide 2015 prepared by PNLD's official evaluators.

When asked about such conceptual flaws, teachers said they had noticed some inconsistencies, but had not considered the possible consequences of such failures could result in the teaching and learning process of color. One of the teachers added she does not discuss much color theory with hers students in class, and when she does it is usually in a short and objective manner due to difficulties in working with color theory. In different levels, the other ten teachers also claimed to have difficulties and insecurities while working with color in class. The teachers themselves have pointed out three important factors that contributed to this situation: (i) Deficiencies in the academic formation with regard to the teaching of color. None of the eleven consulted teachers had specific classes about color along the Art degree course. Although, they claimed they have been in contact with issues relating to color theory through other courses taken, such as paint, plastic etc., they consider that it was still insufficient to work with confidence the color content in class; (ii) Difficulties in working color in interdisciplinary way. Color theory involves important issues for its understanding and demands exchanges between classes of Art, Physics, Chemistry and Biology, for example. This interdisciplinary character of color is presented as a problem for teachers, as far by the lack of color theory in their formation, as the difficulty of maintaining partnerships with colleagues from other areas in the school routine; (iii) Deficiency of equipment and appropriate materials for teaching color. Teachers say the school budget to purchase materials for collective use is often limited and does not cover all the needs of the Art classes.

2. METHOD

From the context presented above, the research group 'Mantis - cor, cariz e sintaxe visual' Capes / UNICAMP, of which the authors of this article are members, structured two proposals for extension's project that will start in 2016 or 2017: (i) 'Arte, Educação e Tecnologia: Inovação no Ensino da Cor' ('Art, Education and Technology: Innovation in color Education', in English), intended for Art Teachers of Education Department of Campinas City Hall, and hosted by the Art Institute of University of Campinas - UNICAMP in partnership with Art Curriculum Component Study group

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(5) In general, the most common misconceptions presented by textbooks involving subtractive synthesis. The red and blue, for example, are often displayed as primary colors of subtractive synthesis. While often magenta and cyan are not even mentioned. Also there are cases in which the pigment equivalent to cyan hue is applied in some textbooks under the name of blue, for example.

and the 'Núcleo de Tecnologia Educacional' – NTE (Educational Technology Center, in English); (ii) 'Arte e educação inclusiva: a inovação no ensino da cor' ('Art and inclusive education: innovation in the teaching of color', in English), to be offered by the Federal Institute of Rio de Janeiro - IFRJ Campus Belford Roxo to Art Teachers of the Education Department of Belford Roxo City Hall and other public and private school systems of Baixada Fluminense, located at the state of Rio de Janeiro, Brazil.
In this way, it sought to Andrea Frova (2008) and Luciano Guimarães the theoretical support to discuss color theory concepts that will be addressed over the extension projects. The Abordagem Triangular (triangular approach, in English) systemized by Ana Mae Barbosa (2012) was adopted in order to subsidize the teaching and learning procedures in color proposed by the extension projects.

2.1 Overall objectives of the extension projects

In general, the extension projects' objectives are : (i) provide basic knowledge that enable the Art Teacher understand color as a sensitive resulting from perceptual process; (ii) enable the Art Teacher in understanding the physical and bio psychosocial processes that provide the sensation of color; (iii) enable the Art Teacher in the understanding of color theory concepts, in which the phenomena of direct light (color light) and reflected light (color-pigment) are studied, that is by understanding the additive and subtractive processes; (iv) enable the Art teacher in teaching these concepts to children and adolescents, developing perceptual thresholds through practical visual exercises that can expand and precise pedagogical practice; (v) enable the teacher to understand the psychosocial mechanisms of non-verbal communication, attraction and repulsion and prejudice in the representation of social groups in textbooks; (vi) relate to color with prominent themes in the Brazilian reality and contemporary teaching through Art education.
Thus, the extension projects are structured the following way: training course; thematic seminar; digital book.

2.2 Training course

Theoretical and practical course for the completion and qualification training of Art Teachers, involving the teaching of color to cross-cutting themes proposed by 'Parâmetros Curriculares Nacionais' – PCN (BRASIL, 1997), such as the Cultural Plurality and Afro-Brazilian and indigenous cultures, in accordance with Law No. 11.645 of 10 March 2008. The training course of the extension project 'Arte, Educação e Tecnologia: Inovação no Ensino da Cor' will have in total 42 hours and the weekly meeting will last 7 hours: 5 hours of face to face classes and 2 hours remotely. And the training course of the extension project 'Arte e educação inclusiva: a inovação no ensino da cor' will total course load of 48 hours-aula and the weekly meeting will last 8 hours: 4 hours face to face and 4 hours remotely. This difference of course load is due to the internal organization of each educational institution that will offer the extensions projects.
Both training courses are divided into six meetings and each of these meetings will be discussed an issue regarding the teaching and learning of color with bibliography and appropriate methodological procedures. Such as (i) lectures with projection digital illustrative material, directed reading, film screenings, discussion and group dynamics; (ii) theoretical-practical classes with analysis' exercises and selection of shades of values and tones for development of color perception, preparation of color wheel, chromatic scales and achromatic (cutout and collage on paper), the analysis

of color concepts presented by Art textbooks, the use of computers with digital games; workshop about 3D glasses and the creating of 3D images.

2.3 Assessment of extension projects

Intended to evaluate the extension projects through: (i) the application to participating teachers, survey questionnaires on the methodological procedures of color teaching and learning applied in the classroom to the beginning of the extension project and after participation in the project; (ii) writing and socialization reports of Art Teachers on the application in the classroom lesson content and methodological procedures worked on the extensions projects; (iii) preparation of a report from the analysis of questionnaires and reports of teachers participating.

3. RESULTS AND DISCUSSION

With the extensions projects is intended to contribute: (i) to the complementation of teacher training in regard to the understanding of color theory concepts in order to be properly explained and practiced in the classroom; (ii) in the qualification of teachers for the analysis of Art textbooks, regarding to color theory, for the appropriate choice of the ones which will be used; (iii) in the training of Art teachers for the recognition and questioning stereotypical aesthetic standards, which tend to exclude the representation of ethnic and racial groups in textbooks.
It is expected to obtain as final products: (i) the organization of thematic seminars that will be allocated to debate with experts in the field and the socialization of Art teachers' reports on the application in the classroom of the methodological contents and procedures taught in extension projects; (ii) and the production and distribution of digital books from the discussions generated by the training courses and the thematic seminars.

4. CONCLUSIONS

From the testimonies collected during the analysis of PNLD Art textbooks, it was revealed that the absence of a specific class on color theory in Art degree courses causes difficulties in working with color in elementary school and contributes to the dependence of teachers on art textbooks. The mentioned factors contribute to perpetuate of color teaching conceptual problems. Training courses in color theory, such as the ones which will be offered by the research group 'Mantis - cor, cariz e sintaxe visual' Capes / UNICAMP, are presented as a way to provide theoretical support to art teachers about the theory of color, while a specific class of color theory is not added to the curricular schedule of Art degree courses. Extension projects that offer training courses in color theory, such as those that will be offered by the research group, with the financial and structural support and partnership of the institutions already mentioned, introduce a way to support Art Teachers about color theory while a specific class on color theory is not added to the Art degree course curriculum.

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Off-Colour: The Lack of Inclusion of Colour in the Formal Education of Arts and Design in Chile

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Colour is an uncomfortable resource. It is and has been for centuries. On numerous occasions, the criticism of art, design and architecture have dared to skip the mention of color and have been entangled in a thicket of wrong words, which is not so surprising. Words often seem to be too blundering or too hasty if the purpose is to objectively describe the colour or to subjectively express its effect on the viewer. It's usual to say that colour speaks for itself in art, architecture and design and that any attempt to do so in its behalf, is doomed to failure. In the case of some countries as Chile, the education of design and architecture has historically been focused on the properties and development of form, drawing and perspective. This have left colour immersed into a greater silence, which is, in itself, significant.

Just to name a few local examples: a recent analysis conducted to the artistic subjects of the curriculum provided by the Chilean Ministry of Education for the primary and secondary education, revealed some worrying results. Colour is poorly included in a few classes of the subject of Visual Arts between the first and sixth grades of primary education (when children are between 5 and 10 years old). The students are exposed to obsolete contents –some of these contents are obsolete for over a century– in terms of nomenclature and teaching methodologies. At the same time, the teachers who have to communicate these contents don't have enough supporting resources, neither theoretical nor practical materials. And after the sixth grade, colour disappears from the artistic teaching, and with that, disappears from the formalized aesthetic experience in the curriculum, and never returns to school education.

Another example, in higher education: from about eighty schools of Art, Design and/or Architecture in Chile, among which are included the most important traditional universities, 10% of the schools considers an obligatory subject about colour –or named "Colour" – in the curriculums of any of these three disciplines or careers. This becomes relevant because these careers are related to aesthetics, urban and environmental planning, visual communication and the design of objects, among others. Of the remaining schools, a small percentage includes an optional subject about colour, which students may or may not take. The rest of schools considers the teaching of colour as part of another subject, in which colour is taught in only a few classes. Some of those schools do not even consider colour at all.

The above leads us to draw the following logical line of thought: in the worst case, a designer or architect who was graduated by one of the schools that has no obligatory subject about colour, or that having an optional subject about colour he decides not to take it, exercises his discipline by applying what he learned about colour in his primary school years, until he was 10, and, as said before, poorly taught. Regrettably, this "worst case" is very far from being an exception.
Colour is an uncomfortable resource. However, its exclusion from the teaching of Art, Design and Architecture does not necessarily mean that it isn't an important resource: indeed, for a long time, colour was important because it was a trouble. And continues to be important because today it still is. Colour has suffered one of the most serious prejudices of the Western culture. Most of the time, this prejudice has gone unnoticed. Colour is almost non-existant, though it exists in almost all things, and in most places.

This research diagnoses the discomfort of colour and provides the state of the art of the teaching of colour in Chile, in what is related to its history, methodologies, didactic resources and formal inclusion of colour in the curriculums of art, design and architecture schools. This research also seeks to propose some ways to contribute to a better and more meaningful teaching of colour, in the primary, secondary and higher education, from a review to particular experiences in some workshops, exercises and training activities carried out until 2016.

NCS and the Hering Heritage. Colour Research, Marketing and Scientific Responsibility

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ABSTRACT

This paper discusses some of the problems involved in maintenance and scientific development of research results when the original researchers are no longer active. With time, there are always problems in communication, and facts and stories tend to become distorted. The organizations, institutions or companies that act as the guardians of once groundbreaking research have a strong responsibility to maintain its accuracy and vigilance, as well as allowing and promoting development and critical analysis.

We discuss these problems regarding the Natural Colour System, NCS, in order to clarify the scientific problems that can arise when research results are owned by a company. Such problems regarding company policy and scientific responsibility might well exist also in other cases, but this is an obvious example that we know well. We also want to make the AIC community aware of the changes from the work honored by the AIC (Judd award 1997) to the present use of the NCS concept.

1. BACKGROUND

In 1874, the German physiologist Ewald Hering showed that colour percepts can be described by their visual properties only, irrespec¬tive of the physical or chemical properties of the stimuli causing them (Hering 1964). In Sweden, the physicist Trygg-ve Johansson realized the value of Hering's work as a tool in environmental design; in the 1930:s he published "Det naturliga färgsystemet" (NFS; The natural colour system) (Johansson 1952) and worked hard to introduce it to architects and designers. After Johansson's death in 1960 – as laborator at the National Institute for Defense Research (FOA) – his assistant Gunnar Tonnquist raised the question of maintaining and developing Johansson's work to FOA general director Martin Fehrm, who in his turn took up the problem with professor Sven Brohult at the Royal Academy of Engineering Sciences (IVA). A committee was set up, representing also the Royal Institute of Technology (KTH), other official authorities and Swedish industries.

In 1964, an institute for colour research was established – funded by the Swedish government (Malmfonden) and manufacturers of paints, textiles, carpets, telephones and other household appliances. Anders Hård was project leader, assisted by a group for colorimetry from FOA under laborator Gunnar Tonnquist. Later also psychologist Lars Sivik was included in the group. The task was to analyze the Hering–Johansson colour space as a basis for colour system and – as demanded by both designers and industry - to develop a colour atlas, and the work was to be supervised by IVA and the Swedish Society of Crafts and Design (Svenska Slöjdföreningen, now named Svensk Form) .

As a physicist and influenced by the CIE colorimetry launched in 1931, Johansson had

(1) All comments and suggestions in this paper have been presented to the owners and management of NCS Colour AB several times for several years. Those issues involving other organizations (Colour Centre Foundation, Svensk Form, IVA, Swedish Patent and Standardization bodies) have also been presented to them, but so far no actions have been taken.

(2)Using the CIE colorimetric system, adopted in 1931, improved in 1964.

introduced the concept of lightness instead of Hering's whiteness and blackness. So did also architect and phenomenologist Sven Hesselgren in his colour atlas (1952). The 1964 research group initially based their work on Johansson's concepts, but a careful study of Hering's work and extensive observations on sets of colour samples led them o abandon that approach and instead to base their further work on the original Hering concepts.
An intense theoretical and empirical work was carried out, and in 1973, the research group could present a systematically structured colour space, based on Hering's theory and called "The Natural Colour System", and a prototype for a colour atlas with systematically selected, logically coded and colorimetrically defined colour samples. As the colour percept evoked by a given colour stimulus depends on the viewing situation, the NCS code of a colour sample is only valid under precisely defined conditions of illumination and observation. For the NCS atlas, CIE daylight recommendations (D65) were chosen.
In 1979 funding for production had been raised and the first NCS atlas was published. Its purpose was to illustrate the NCS system within the part of colour space covered by available non-fluorescent and stable pigments. No material samples can show elementary colours or other colours that totally lack whiteness or blackness.
In 1997 the AIC Judd Award was given to Hård, Tonnquist and Sivik for their decades lasting joint effort culminated in the NCS, the Natural Color System and its atlas. The research was characterized by the phenomenological analysis of the experience of color in the spirit of Hering.

2. THE THREE FACES OF THE NCS

Since its introduction, the notion of NCS has undergone a number of alterations. NCS now denotes three things, that are related to each other but still should be understood separately:
(1) A scientifically based system for describing and denoting colours solely based on their visual properties – below called NCS system. (Hård, Sivik and Tonnquist 1996). Its basic principles are:
- there are six elementary colours (percepts): yellow, red, blue, green, white and black, characterized by having no resemblance to any of the other five elementary colours.
- all other colour percepts can be described by their elementary attributes, i.e. their resemblance to two, three or four elementary colours.
This description is done irrespective of the physical or chemical properties of the colour stimulus.
(2) A selection of colour samples of different size that, under specific viewing conditions, illustrate the NCS system - below called NCS products. The NCS atlas was developed as an illustration of the NCS system. Its first edition (1979) included 1412 colour samples, and after gradual additions its latest edition (2004) includes 1950 colour samples. In the colour atlas, small colour samples are placed hue-wise on white cardboard. Identical colour samples are also available separately in larger formats and in selections for different purposes.
The samples are marked with codes that describe their visual properties according to the NCS system, e.g. 3040-Y10R. These codes denote the true colour of the sample only under strictly standardized conditions, including specified light, white background and specific viewing distance. NCS codes beginning with an S refer specifically to these standardized samples.
(3) A company that owns the trademark NCS and markets the NCS products – below called NCS company. Originally the company was called Scandinavian Colour Insti-

tute, but after a rather recent change of ownership also its name has been changed and is now NCS Colour AB.

3. PROBLEMS INHERENT IN THE CURRENT SITUATION

3.1 Lack of distinction between NCS System, NCS Products and NCS Company

One problem is the lack of distinction between different aspects of NCS. The common name between the colour system, the products and the company creates vast risks of misunderstanding. In spite of the purpose of the research group, the NCS atlas and products are often understood as equivalent to the system, which can lead to judging the system from the beauty or spacing of the colours in the atlas. The fact that also the company is now called NCS implies that NCS is solely a set of products, and obscures the understanding of NCS as a colour system that is based on research and valid with or without any of the products marketed by the NCS company. A scientific research result, such as the NCS System, should always be open for questioning, revalidation and improvements, based on subsequent research result. This is, however, blocked by the identification between the company and the system, as the right to judge what is correct now lies with the company and not with the scientific community.

3.2 Standardization, patent and copyright

When the NCS atlas was released in 1979, the NCS System as well as the atlas were made Swe¬dish Standard. Also the subsequent editions of the atlas are Swedish Standard, and also a number of other countries have accepted NCS system and/or atlas as standard. Here it is impor¬tant to note that the atlas is not standardized as the choice of colours that should be used, but as an illustration of the NCS system valid under the likewise standardized observation conditions.
Besides being Swedish standard, NCS is also a registered trademark, both in Sweden and in the European Union. This means that the owner of the trademark – at present NCS Company – owns the right not only to produce colour atlases and colour samples labeled NCS but also to use the name of NCS in scientific and technological services and to this related research and design, industrial analyses and research services, design and development of computer hardware and software. On its website and in its products , the NCS company expresses this right by a ® after the NCS label. They also use the copyright symbol ©, which, however, lacks legal significance in Sweden.
The fact that the result of the NCS research is standardized can be seen as an insurance to maintain its quality and to keep it available for researchers as well as for practical use. The fact that it is made a registered trademark works rather the other way – it restricts the control over publicly financed research results to a private company that is free to use and interpret the results in any way they want to. It is very strange that such a situation has even been allowed to arise - it can be compared to one where the standardized length unit meter is converted into a registered trademark owned by the company Meter Ltd. Such a situation, if at all possible, would place a huge responsibility on the company.

(3) The currently used Swedish standards regarding NCS includes the atlas (with text in six languages), a description of the colour description system, a specification of observation and measurement conditions and tolerances for NCS-colour samples (both in Swedish). There is also an English language Standard Practice for Specifying Color by the Natural Colour System, developed by ASTM International. (website http://www.sis.se/sok/?q=NCS, 2016-06-23).
(4) Swedish Trademark Database, https://was.prv.se/VarumarkesDb/, 2016-06-23
(5) Trademark register no 009755497, our translation (Swedish Trademark Register)

3.3 Incorrect or lacking information given by the NCS company

The ownership of NCS as a trademark places an enormous responsibility on the NCS Company. They have the unique right to present the results of an internationally awarded research effort – but unfortunately they have not succeeded to act according to this responsibility. The NCS company's official website (www.ncscolor.com, read 2016-05-15) reveals an appalling lack of knowledge about the NCS fundamentals, and there is a risk that the valuable colour understanding expressed in the NCS system is about to get distorted and lost. One reason may be an inevitable shift to a new generation of staff, lacking the knowledge and "know-how" acquired in the initial research. Some examples:
- NCS has made it possible to pinpoint over 10 million colours. Wrong! This figure, often referred to, is derived from the physiology or the retina and has nothing to do with the NCS.
- Blackness is how dark the colour is. Wrong! Blackness denotes the relative similarity to black. A bluish colour with a certain blackness is darker than a yellowish colour with the same blackness.

These, and other statements on the NCS website, contradict the fundamentals of NCS system. An analogy to this would be that the company Meter Ltd, with meter as their registered trademark, would claim that a meter consist of 97 cm.
The NCS products – atlas, colour samples etc. – are presented without the information that their colour codes tell how the colour looks only in the specified standard situation. This obscures the essential design issue of interaction between colour and light and the interaction of colours seen together.
- As all tools are based on the cross-industry colour definition standard – the Natural Colour System – the colours are described just as we perceive them visually. Wrong! They colours of the samples are described as they are perceived in a standard situation, not in the situation where they are to be used. Statements of this kind diminishes the reliability of the NCS products and, as a consequence, of the NCS system. In the above analogy with Meter Ltd it is as if metal rulers were sold with the assurance that they would show exactly one meter irrespective of temperature – a notion that could cause horrible train accidents if applied to the length of rails.

NCS company proudly claims that its system and its products are the result of decades of research. The researchers who carried out this research – Hård, Tonnquist and Sivik – are, however, totally neglected and their names are not mentioned, not even in the passage where the NCS company refers to the Judd award given for their work. (NCS website 2016-05-14) Moreover, as shown above, the research results are presented in a way that is far from their original logical strength and sometimes totally wrong. The official NCS website gives no references, neither to scientific or tutorial works, nor to the standard documents. Without such references, it is impossible to judge the validity of what is claimed on the website and in other marketing channels. References are also needed to enable the critical evaluation that all scientific work must be open to, and for future development or the system.

3.4. Lack of accuracy in the production of NCS atlas and tools

In later years, several users of NCS products have noticed fluorescence from the supposedly neutral white background on which they are mounted. This leads to intolerable shifts in colour appearance under many modern light sources. When the prototype was developed in the 1970-ies, it was a strict requirement from the research group to avoid all fluorescence.

4. CONCLUSIONS

The statutes of the International Colour Association (AIC) present its objects to encourage research in all aspects of colour, to disseminate the knowledge gained from this research, and to promote its application to the solution of problems in the fields of science, art, design and industry on an international basis. One aspect of promoting this is to recognize outstanding work in the field of colour science through the biannual Judd award, which was in 1997 given to the team behind the NCS. As has been shown above, the outstanding qualities of their work are not present in what is now marketed of the NCS. This corrupts the value of the Judd award and AIC's reputation as a scientifically reliable organization. Therefore it is important for the AIC to state that the Judd award was not given for what is now marketed as NCS. We suggest that the executive committee of the AIC considers a statement with the following contents, and that it is published in the AIC annual report.

In 1997 the AIC Judd award was given to the team behind the Natural Colour System NCS. Since then, the term NCS has obtained other meanings that partly contradict the originally awarded research results. We are concerned and worried about this and want to clarify that AIC:s judgment of the NCS research as outstanding does not apply for what is now marketed as the NCS. We sincerely hope that the present owner of the NCS label will in the future fulfill the responsibilities involved in the guardianship of important colour research, and we urge our Swedish regular member Svenskt Färgcentrum to work actively in support of this.

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Self-developed Methods for Working with Colour Due to the Lack of Training by Chilean Artists, Architects and Designers. A Critical Approach

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ABSTRACT

There is a strong concern in the Chilean academic art community regarding the actual condition of colour training in design and art related schools. In spite of the incorporation of some aspects of colour education in the curriculum of art and design careers during the last decade, these changes don't seem to be sufficient and, as a consequence, most students don't reach the basic academic skills for a satisfactory use of colour.
This research seeks to demonstrate the lack of colour training in Chilean universities. Accordingly, this study shows the existence and the need of self-developed methods of working with colour by students and graduates of art and design related majors. For this purpose, an online survey was taken, proposing a brief diagnostic test to evaluate the collective and individual level of colour knowledge. As preliminary results, from the sample of 50 participants, 42 of them (84%) answered to have knowledge on colour theory and application, but from this group, only an alarming 12% answered correctly the diagnostic test, confirming the hypothesis of this research. Furthermore, three participants who failed the diagnostic test were chosen to be interviewed individually, asking them to prepare a colour composition in order to understand and expose their self-developed colour method. Here, all of them indicated that the first step in their method was to imagine a colour palette right after the indications, an intuitive approach. Secondly, some interviewees recalled some of their previous work and others looked for references on Internet to complete the task. Then, some of them were modifying intuitively their initial palette by contrasting colours and deciding if any modification was needed, giving further information regarding their self-developed methods, showing that their process is mainly supported by intuition and experience.

1. INTRODUCTION

In the Chilean academic art community, there is a strong concern regarding the actual condition of colour training in design and art related schools. During the last decade, some aspects of colour education have been introduced in the curriculum of art and design careers, but these changes don't seem to be sufficient and, as a consequence, most students don't reach the basic academic skills for a satisfactory use of colour.
However, there is no record to assess the actual knowledge of students and graduates in the country, it is a matter of fact that Chilean students have insufficient theoretical and practical colour classes available. Wherefore this research would like to address the following questions: Would the insufficient colour training have an impact in students and graduates of art and design related majors? If so, how do they work with colour in spite of their lack of academic training? Do they develop their own technics to handle colour compositions? And if they do, how are those self-developed technics?
This research seeks to demonstrate the lack of colour training in Chilean universities. Accordingly, this study shows the existence and need for self-developed methods

of working with colour by students and graduates of art and design related majors, which evolve out of a formal academic training.

2. METHOD

This study has been conducted in two steps. The first stage was to take an online survey, proposing a brief diagnostic test to evaluate the level of colour knowledge of the respondents. In the second stage, three respondents were chosen to be interviewed individually. The answers of these interviews were analyzed as study cases, asking them to prepare a colour composition in order to understand and expose their self-developed colour methods.

2.1 Survey and colour test

In order to reach a wider amount of people and a better spread, the survey was taken online within 8 days to 50 Chilean students or graduates of design and art related majors. The survey had 15 questions to be answered in an estimate of 6 minutes, and it was structured in 5 items, that are described as follows:
I. Personal and Contact Information: Five questions were asked in order to identify the respondents.
II. Colour Training: Three questions were chosen to inquire regarding if they had academic formation in colour theory and application, if so, how much time were they trained and the respective institutions.
III. Colour Diagnostic Test: This section had three questions about colour theory that were asked to the respondents who answered they had colour training in the previous section. Those who didn't, had to go directly to section IV.
The questions regarding colour theory are detailed in table 1 as follows:

Table 1 – Colour Theory questions:

1. What are the primary colors of the additive mixing color model?[1]	2. What kind of contrast is described in the image below?[2] 	3. In the following image there is a change in one of color's properties that is described as[3]: 
a) Red, blue and yellow	a) Contrast of Hue	a) Hue
b) Cyan, Magenta and yellow	b) Warm and Cool Contrast	b) Saturation
c) Red, blue and green	c) Simultaneous Contrast	c) Luminosity
d) None of the previous answers	d) Contrast of Saturation	d) Bright

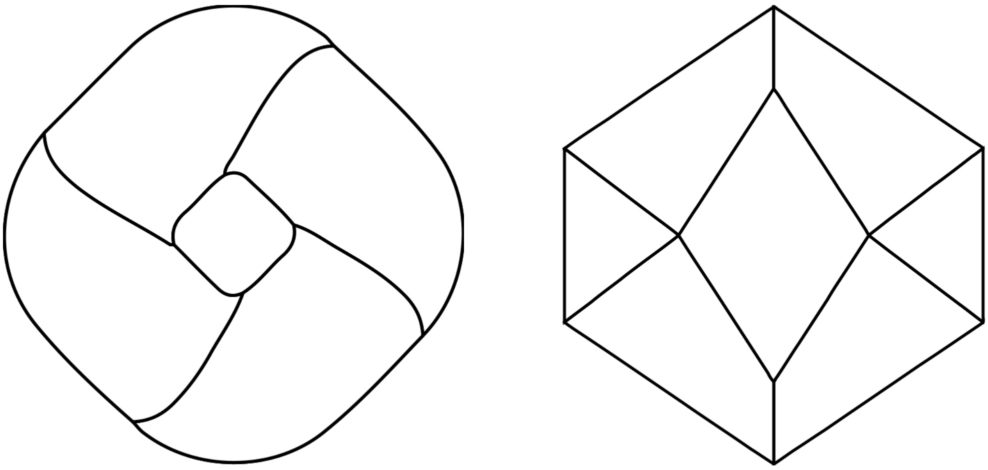
IV. Description of Their Colour Selection Methods: In this section, the respondent was asked to describe in detail the methods they use for working with colour.
V. Self-assessment of Colour Knowledge: The respondent had to answer three questions regarding their colour training level and if they intend to deepen their knowledge in this area.

2.2 Interview

In order to investigate how the respondents work with colour compositions in spite of a lack of formal academic knowledge, three study cases were selected from the survey participants who failed the diagnostic test. The criteria to select these cases

was to analyze the answers of section IV, and determine the most detailed descriptions of colour usage.
The interview was performed in two stages. Firstly, the interview had the purpose of complementing the answer in section IV of the survey, asking the respondent further details regarding their self-developed methods of colour use. Secondly, the participants were asked to make a colour composition within 5 minutes using the shapes described in figure 1. The participants had no restrictions to look for references or ideas to inspire their work, having access to books and Internet, among other resources. Later, each interviewee had to explain comprehensively the process used in the selection of colours for this exercise. Finally, the results where collected and analyzed.

Figure 1.Shapes used in the interview of the study cases. The shapes were selected due to their opposite contour composition, thus the colour selection would not be correlated to the shape in both figures.



3. RESULTS AND DISCUSSION

From the sample of 50 participants, 42 (84%) answered to have knowledge on colour theory and application and from this last group, 76% declared to have acquired this knowledge from the major's mandatory courses. However, 17% answered that they learned this topic by their own studies and the remaining 7% said that they took an optative course. Nonetheless, no participant declared to have undertaken courses outside their majors. From the participants who answered to have colour training, the 38% declared to have undergone 2 semesters of colour courses, while only a 12% answered to have taken 3 or more semesters. Although, from the participants who declared to have colour training, only an alarming 12% of this group answered correctly the diagnostic test, a 26% had two correct answers and 41% had only one, confirming the hypothesis of this research, shedding lights that the time dedicated to colour training is not enough, is not being correctly taught or the teaching methods are not effective.
Section IV of the survey also provided evidence that art and design students and professionals, without proper colour training, can still sufficiently perform a composition in spite of their lack of academic knowledge on colour theory and application. Three study cases were selected to detail their self-developed methods for working with colour. These three cases were named as subject one, two and three, detailed in figure 2. In the interview, all the participants indicated that the first step in their method was to imagine a colour palette right after the indications, showing that they had a previous idea of what they wanted to develop in the exercise. In the next step,

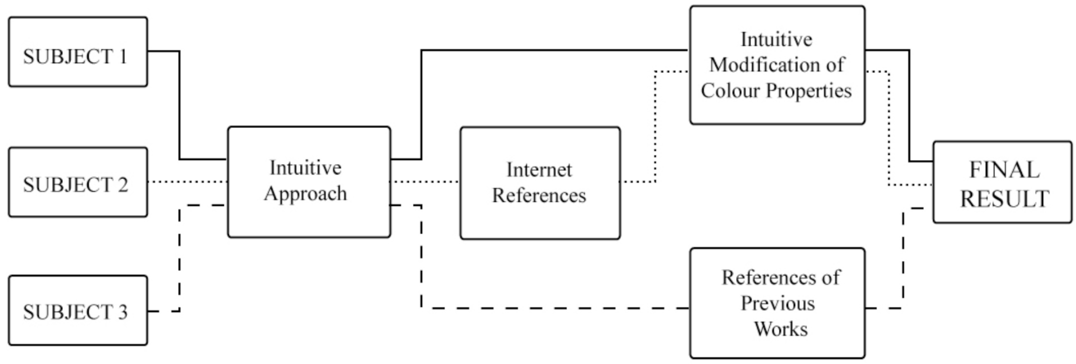
the interviewees evaluated different colour options, and their strategies are depicted bellow:

• Subject one, preferred to modify intuitively their initial palette, testing the changes and deciding if any modification was needed in hue, saturation or luminosity to get the final result.

• Subject two continued looking for references, mainly through an internet search, and then followed her intuition for modifications of colour properties of the palette, similar to what was observed with subject one, but adding references to his composition.

• Subject three decided to modify the colour properties of the initial palette recalling his previous work, and therefore these changes are based on his experience.

Figure 2. Scheme of the interviews performed.



It is important to clarify that although the study cases had several similarities, it doesn't imply that those are the only possible approaches to work with colour. Furthermore, these are simply the methods observed in a small sample.

4. CONCLUSIONS

This research is a first diagnostic of the lack of formal colour training in design and art schools in Chile. This situation seems to compel students and graduates to develop their own methods to work with colour.

Also, this research suggests that the process of learning colour theory and its application might not be limited to the academic domain and that its learning can be accomplished, with different degrees of success, by each individual and without the need of taking formal courses. In this sense, each student undergoes a unique process of colour training, and the design and art schools should be working to adjust their current curriculum of colour training to incorporate a more realistic and student-focused approach.

Additionally, it was documented that many of the self-developed methods are a result of experience. In fact, it is possible to argue that the intuitive approach of the participants represents the outcome of their need to use colours in their daily work. And then, the intuition exposed in this research might refer to a cognitive process where the individual incorporates the knowledge acquired through experience, in order to be used later without a conscious thinking4.

Additionally, it is considered that further investigation on colour training is needed. Furthermore, it seems that the incorporation of intuition into the curriculum would allow for a more meaningful and functional learning. This strand of research would allow to have ground for new methodologies that would improve the colour training in the Chilean art and design schools. Likewise, since these new methods would incorporate intuition, they might be used with children and people with lower formal education, expanding colour training to schools and the Internet, among others.

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Colour Education: a Basic Methodology and a Framework of Experiments for Colour and Lighting Design Teaching

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ABSTRACT

In this article, a series of basic experiments on the visual perception of light and colour are presented. They are intended to provide practical verification of, and experimentation on, three fundamental aspects that govern the relationship between light, colour and humans: the light's physical traits, visual-optical aspects and cognitive aspects, which influence our perception of objects and the environment.

1. INTRODUCTION

Since the time of the Bauhaus, experimentation as a way to teach design has been notably important, especially relating to research. In terms of education and training, basic design is a fundamental subject, which creates dialogue between the formal, expressive, technological and scientific aspects that form the foundation of the discipline encompassing the creation and design of products, spaces and communication. From a practical standpoint, this methodology was introduced to the Colour & Lighting Design educational programme at the School of Design at the Politecnico di Milano for the master's degree in Lighting and Colour Design. In fact, a series of experiments carried out with the contributions of those same students is still available at the school's Laboratorio Luce (light laboratory). A few of the experiments may seem commonplace for those who have intimate knowledge of parameters such as illuminance, colour temperatures and colour rendering, yet it is worth noting that these themes are all but intuitive and are highlighted to students during their design coursework. The purpose of these experiments is to join the theoretical and methodological aspects with the practical aspects of design: knowledge and know-how.

Know-how is essential; it helps us to understand why, in teaching design, basic design is treated with a practical-experimental methodology whose purpose is to involve the student in the experimentation to develop an idea. Basic design was fundamental to the didactic methods of the important design schools that arose over the course of the twentieth century: in the vorkurs (foundation courses) of the Bauhaus at first, then in the grundkurs (basic courses) at the Hochschule für Gestaltung later on. At the Bauhaus from 1919 to 1923, Johannes Itten was the instructor for the vorkurs, where students were asked to touch and experiment with, hands-on, simple objects and materials until they had committed their visual, tactile and emotional qualities to memory (Itten 1975). The students were also assigned simple elements such as wire, cardboard, razor blades, newspapers, matchboxes and other discarded materials and given the task of improvising, creating something instinctively, pitting their imagination and creativity against the limits imposed by the material characteristics of the objects available to them. These experiences were also extended at the Bauhaus by the lessons in form and colour theory taught by Paul Klee (Klee 1961, 1973).

Gestalt psychology (the psychology of shape and form), which developed in Germany at the start of the twentieth century, has had a strong influence on basic design (Wertheimer 1938). As Kurt Koffka states, it creates a relationship between perception and phenomenological experience. "In reality experimenting and observing must go hand in hand. A good description of a phenomenon may by itself rule out a number of theories and indicate definite features which a true theory must possess. We call this kind of observation "phenomenology"...For us phenomenology means as naive

and full a description of direct experience as possible" (Koffka 1955).
Gestalt psychology, along with the scientific method and representational-geometric aspects, ensure that basic design includes the foundations for creating the balance and connection between a project's rational aspects and the creative act, whose equilibrium is always at the base of successful designing. In the development of our experiments, we pursued similar aims, adding the theme of control over artificial light, as it is essential to visual perception in modern society.

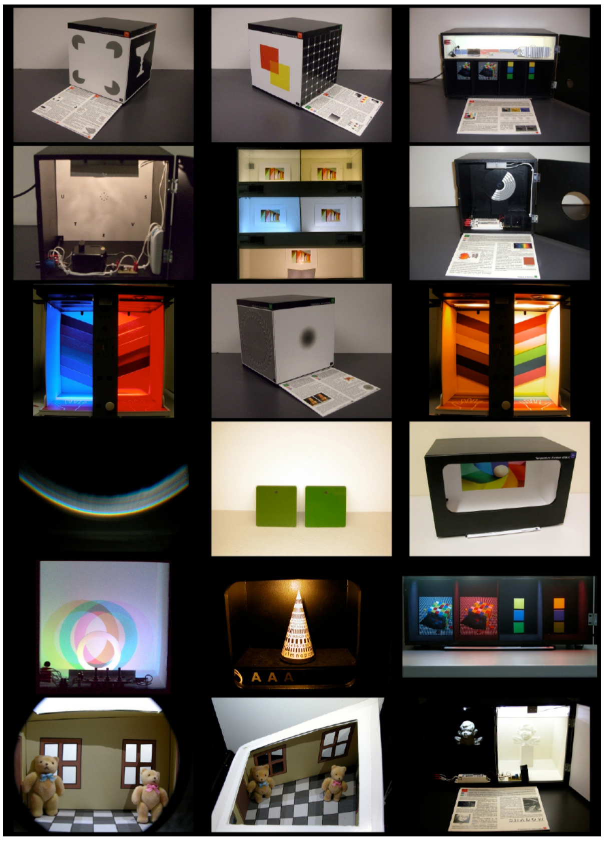

Figure 1. Some of the experiments made by students Barbara Ripamonti and Paolo Pezzotta at Laboratorio Luce.

2. METHOD

Every day, we live, work and study in changing light conditions due to natural or artificial illumination (or both). Changing light may influence the experiments' conditions, so experimental wood and cardboard boxes were built which allowed us to limit and control the quantity of environmental light that otherwise could alter the perception of the resulting effects. One of the walls of the boxes may often act as a screen to present samples or to see the results of lighting effects. Of course, we mustn't forget that light is invisible and that we can only see it when a surface reflects it or otherwise directs it towards our eyes.

2.1 Physical aspects of light and colour

The first group of experiments concerns the physical aspects of light and colour. These aspects are the characteristics that we usually describe when light interacts with matter. Such experiments are the base of understanding the interaction between light and matter, which happens daily with objects and environments, albeit on various scales. In these interaction phenomena, we can see aspects that are of a geometric and chromatic nature. For the experiments concerning these effects, we used white LED light sources with various correlated colour temperatures as well as coloured light sources. These experiments include the reflection and transmission of light on the material, and the phenomenon arising from the wave behavior of light, such as refraction, diffraction, interference, dispersion and phenomena caused by the polarization of light. Lastly, they include the concept of the correlated colour temperature of the white light and the fundamental theme of the lighting colour rendering.

2.2 Optical and visual phenomenon

A second group of experiments dealt with the theme of vision as it relates to optical and visual phenomenon. These phenomenon mainly regard the behavior of the eye and of the retina in particular, and they are able to explain a few interesting optical effects that we find in our everyday sight. These retinal phenomena are also very important to understanding four fundamental elements of seeing an environment: glare, contrast, visual acuity and a few aspects of colour vision. We know that the retina is made of layers of cells. The innermost layer is composed of photosensitive cells, cones and rods. The top layers contain other nerve cells that process and transfer the signals produced by the photoreceptors to the optic nerve. These nerve cells are layered starting from the photoreceptors in horizontal, bipolar and amacrine cells, ending in the ganglion cells in which axons are connected to form the optic nerve. Each ganglion cell collects information from a number of photoreceptors. The retina contains approximately 7 million cones and more than 100 million rods, while ganglion cells number only 1.2 to 1.5 million. On average, each ganglion cell gathers information from more than 80 photoreceptors, but this relationship is variable. In the central part of the retina, the fovea, there may be only 1-5 photoreceptors for each ganglion cell, while in the peripheral zones there are many more. In addition, the fovea contains many more cones than rods. This is why we are able to see details of objects and colours only if they are in the centre of our field of vision. What's more, the ability to distinguish colours depends mainly on the fact that there are three types of pigment in the retina, which react to different light wavelengths, allowing us to distinguish between hues. The experiments in this group allow us to understand terms such as visual, static and dynamic acuity or foveal and peripheral vision, but also themes such as additive and subtractive colour synthesis, problems related to metamerism and the generation of chromatic signals on the retina. Another fundamental subject that was experimented is that relating to contrast and glare, such as simultaneous contrast, the contrast rendering factor in relation to the lighting, after-images and, lastly, the phenomena of colour and lightness assimilation.

2.3 Cognitive vision

The third group of experiments relates to cognitive vision, which is the question of how the creation of an image's perceptive sensation happens in our cerebral cortex. Of course, this is a complex question and an area of constant research worldwide. In fact, vision of the environment that surrounds us is a mental representation that isn't necessarily correlated to its physical and radiometric nature. This has been shown by numerous laboratory experiments and optical illusions alike. Such experiments highlight the diversity between the physical reality of an object and the subjective perception of it. Light carries the visual information about the environment, such as geometric shapes and colours, to our brain, but this luminous information may be extremely variable, changing according to the position of the observer, the time, the weather, the season and the physical properties of artificial light, such as its spectrum, direction and intensity. Such a complex set of information must be adapted to our evolutionary needs to see it in a stable manner, where possible, which is exactly what the brain is tasked with doing. In this group of experiments, the themes of perceptual constancy, with reference to the colour and brightness of surfaces, and even the brain's ability to insert imaginary, inexistent parts into reality or to perceive real or represented transparency. All lighting effects that are favorable or unfavorable to perceiving the three dimensionality of objects, spatial perspective and the consistency of shape and size that our brain makes us perceive (even when not correlated by the geometric reality) also comes into play here.

3. RESULTS AND DISCUSSION

Starting from the introductory assumptions, we took into consideration the fundamental elements that come into play in designing lighting and colour: the visual-perceptive aspects and the material-colourimetric aspects of the objects in relation to the physical-phenomenological aspects of the illumination. This arose from the experiential and even scientific observation that one's visual perception does not register the surrounding environment in the same way that a tool for measurement does, but rather interprets it. Josef Albers confirms that "...experience teaches that in visual perception there is a discrepancy between physical fact and psychic effect" (Albers 1975). But it is Edwin Land that supplies the reason behind a few phenomena, including perceptual constancy (Land 1977). According to him, the human visual system evolved to allow us to see the world in stable lighting and colour conditions, compensating for the variations in the colour of illumination within certain limits. Furthermore, he states, humans have the ability to establish a close relationship with the external world that a photographic camera cannot. Thus, our experiments raise the question of the relationship between a light source and visual perception of space and colours as a central point. Such investigative methodology is not simply carried out to produce an inventory of strange phenomenon, but to establish a cause and effect relationship, as upheld by Gaetano Kanizsa, who emphasizes the importance of the method and the aims of the experiment's investigation (Kanizsa 1977). He posits that experimental phenomenology is not limited, as one may tend to believe, to a mere description or inventory of phenomena. Rather, its scope should be more ambitious. It should promote the discovery and analysis of necessary causal connections between visual phenomena, the identification of conditions that determine, favor or hinder their appearance, and the degree of their obviousness.

4. CONCLUSIONS

Approaching the lighting and colour design through education that, at its core, favors this type of experimentation allows us to bolster a more secure methodology and strengthen fundamental skills in the ability to manage multi-disciplinary design, moving between photometry, radiometry, colorimetry, physiology and the physiology and psychology of perception. These individual disciplines may then be further unpacked in the context of a training programme.

ACKNOWLEDGEMENTS

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COLOREARTE: School Competition of Dyeing and Creativity

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ABSTRACT

This document aims to raise awareness and give value to the work of COLOREARTE, a school competition that promotes creativity, teamwork, reflection, observation and expression, all capabilities that enrich the color learning in primary and secondary education.
First, the most important aspects of the program will be defined, to continue with its methodology and explanation of the supporting materials.

1. INTRODUCTION

· COLOREARTE is a shibori-dyeing contest developed for schools, intended to contribute to education through art as well as to an integral development of children.
· COLOREARTE is a program focused on non-formal education, which takes a place inside the space of formal education. It is a project organized by the Foundation Gabriel & Mary Mustakis with Anilinas Montblanc. In addition, it is supported by the Chilean Ministry of Culture (CNCA) and Chilean Ministry of Education.
· COLOREARTE was born in 2004 with the goal of teaching color theory through dyed with aniline. The contest evolves every year and has become a powerful educational tool that contributes to the self-formation of the students, as well as the entire class and the teachers, by encouraging the enterprising spirit, observation and reflection. In 2015 we made a research in relation with the teaching of color in each year of the curriculum of the subject of Visual Arts, in schools. The result confirmed color, as a lesson, is not present in the school program. Based on this research, COLOREARTE supports the potential of dyeing as a resource for teaching and learning the color theory in schools, the main objective throughout these 13 years.
· COLOREARTE innovates every year in its topics and in its requirements for artistic creation, considering the technique of dyeing as a tool for the construction of collective art, and relating this technique to specific topics that are linked to the identity and heritage of our country. This has been possible thanks to the educational material that has been especially prepared for the event and distributed free to the participating schools.

Every year all Chilean schools are invited to participate in three different categories, based on their ages. More than 100,000 students together with thousands of teachers, all coming from different places throughout Chile, have taken part in this event, for more than 13 consecutive years.
Along these 13 years, COLOREARTE has considered topics such as Pre-Columbian Cultures (2004-2008), Myths (2009), Native people (2010), Roberto Matta in his centenary (2011), Bugs (2013) or Local Heritage, the color of us (2015). In 2016 the main theme is Discover: the color of our emotions.
The reason of implementing the shibori dyeing is because it is an ancestral dyeing technique, which allows working with color and provides endless creative alternatives as well as wonderful results. In relation with the dyeing technique, COLOREARTE is always innovating about different artistic supports and formats: patchwork, performance, textile sculpture and intervention in an urban or rural landscape.
Regarding to the practice of dyeing, COLOREARTE:
- Promotes the use of shibori technique amongst students and their families.

- Considers this practice contributes to a more experiential learning.
- Spreads knowledge and educates important topics of global relevance.
- Encourages teamwork.
- Strengthens the development of creativity.
- Promotes a cross-cutting, inclusive and diversified activity.

· COLOREARTE Project, according to our commitment with the environment, works with companies interested in making products and dyes in an eco-way. Our main partner has 150 years of experience in the chemical and textile industry. Its policy is focused in making their products and processes under the strictest worldwide environmental standards.

Due to that we try to make our different working process with the better carbon footprint. In fact, the product of the companies we work with, have an econfidence® seal of guarantee.

· COLOREARTE ends with an exhibition of the contest results, held in a museum or cultural space, allowing the community to appreciate the dyeing process, the investigation on colors and the final artwork. After that, it becomes a travelling exhibition and it is showed in different places of Chile with the aim of reaching as many people as possible.

2. METHOD

· COLOREARTE is a unique program in the world that was designed to teach the color theory practically. For that reason the working procedure is not based on a specific methodology, but in these 13 years it has been developed and refined through experience and practice.

During the project's formulation we did not have any references of similar works or bibliography, due to that we used an empirical method, giving priority to the investigation, reflection and team work. Over time, generated, overall, the following guidelines:

1. Work planning
2. Promoting the research as a learning method
3. Thinking and analyzing images
4. Dialog, a constant exercise
5. Team work
6. Promoting the divergent thinking
7. Experimenting with different materials
8. Setting up roles and responsibilities in a democratic way
9. Making a collective art work

In general terms, every teacher adapts it depending on their context and interests. In this way, they can take advantage of this experience as a transversal tool to address the process from different areas.

The last step of the program has included the training of teachers and the support of a visual artist. It makes the learning process of collective and creative work easier.

The references focused on art and education about COLOREARTE program, are a sort of guarantee of our work developed during all of these years. For instance, our work has been highlighted and published at:

- The International Shibori Symposium, in 2013
- The Sixth Congress Education, Museum and Heritage. Quality, Equity and Inclusion: The Contribution from Non-Formal Education, in 2015 (CECA-ICOM Chile)
- The X Seminar for Teachers Classroom and Museum Visual Arts: Creative Spaces for Transformative Experiences. National Museum of Fine Arts, DIBAM Chile.

2. METHOD

The material is distributed among teachers, and it varies annually depending on the concepts and learning areas that are relevant to the main topic and the artistic formats. Every year we first train the teachers so that they are able to reproduce the exercises with their students.
For instance, the supporting material for COLOREARTE 2015 was structured in the following categories:

1. Local Heritage: The Color of Us
From the observation, research and reflection on the most representative topics of their communities (traditional festivals and games, values, gastronomy, flora and fauna, among other things) students worked together in teams in order to develop their creativity and to create an artistic intervention in the landscape. The materials were dyed textiles, which the students previously designed.

2. Color
Color is essential in the development of our art project, especially because it helps to communicate and express different ideas. The supporting material allows going deeper into the characteristics and qualities of color.
The meanings of colors have historically been constructed in a collective way, through conventions. These conventions, as culture, are in constant change and development: are dynamic and complex. COLOREARTE promotes the investigation, reflection, association and work with communication through color.

3. Dyeing
Information about the history of Shibori: its origin, development and main characteristics. In the supporting materials the students can also find the ways to dye and also practical details to dispel any questions about this process.

4. Art intervention in a landscape and photographic register.
After dyeing the textiles, inspired by their emotions, the participants created an art intervention in an urban or rural landscape, which must be submitted as a photographic register. This intervention is the collective work of art that the students and their teachers made to COLOREARTE. To do this, we provided them some additional materials, which included some examples in order to visualize and understand what to do.

In 2015, COLOREARTE convened more than 20.000 students from all over Chile. The results were very surprising and imaginative and managed to reflect their identity.

The supporting material always maintains the same structure, except for the theme of the call. In 2014, for example, the theme was “The Color of Freshwater”. We proposed water because it has become a more and more valuable resource over time and life depends on it. Furthermore, we consider the awareness about water scarcity must rise, so we can enhance its conservation. In that year´s competition, we decided to invite students to take a moment to observe water around them with all its details. The challenge was to take water as a source of inspiration for creating their interventions in the landscape.
In summary, through the process of participation in COLOREARTE and developing a collective art project, the students learn:

- Integral knowledge: color theory, recognition of contemporary artistic trends, local heritage.
- Disciplinary skills: application of dyeing techniques, creation of a collective work.
- Social and emotional skills: organization and planning of a collaborative project, teamwork, respect, tolerance, self-esteem.
- Attitudes: rating ideas and different experiences to their own, observation of reality and context from a reflective artistic perspective.

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Research on the Relationship between Sky Colour and AQI (Air Quality Index)

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ABSTRACT

"Blue sky" has always play an important role in human civilizations, has necessarily related to environmental aesthetic and wellbeing. With rapid development of industrialization and urbanization, the blue sky appears rarely because of the heavy smog especially in developing countries. This subject based on the interdisciplinary research and the dual advantage of art and science, to explore the relationship between the air quality index and the blue sky index by working on the sky colour and measurement which collected in two years as well as all the data of air quality index in two years.

1. RESEARCH CONTENTS AND SIGNIFICANCE

1.1 Sky Colour and Air Quality

Atmosphere demonstrates "different possibilities" in scattering process of coloured light with different wavelengths. The shorter the wavelength is, the stronger the scattering process. When sunlight is scattered in atmosphere and the blue light with short wavelength is scattered, the quantity increases and distributes all over the sky, so that the people on the earth can watch the sky demonstrating with blue. However, apart from being scattered in atmosphere, sunrays shall also be absorbed by ozone molecules and water vaporization. The sunlight reaching the ground finally shall consume much energy and be scattered or absorbed during the process. The purple light rays have short wavelengths and cannot reach the ground due to the less quantity. That's why the sky is blue, but not purple. The drier and purer the air is, the stronger the sky blue will be. But if the sky is too purer without atmosphere and other particles, the people on the ground cannot see the sky blue.

Air pollution has become an inescapable reality the world urban citizens confront. The sky is not blue any more, but grey mist like packed space by a thick quilt. Thus, the value of Air Quality Index (AQI) would directly affect the sky colour demonstration. The main pollutants affecting the air quality assessment have 6 items that is, inhalable particles (PM10), fine particles (PM2.5), ozone (O3), CO, SO2 and NO2. Among the all parameters affecting human environment, PM10 and PM2.5 are the maximal indicators endangering the human health. Especially PM2.5 is called as the "particles inhalable to lung. PM10 and PM2.5 are the significant indicators affecting the sky colour and producing significant role in air quality and visibility.

1.2 Research Status

The sky blue is necessarily connected to the human environmental aesthetic and psychological comforting.
In 1859, English physicist, John Tyndall, 1820-1893, proposed "that blue light with short wavelength was apt to be blocked by the particles floating in air, particularly the particles of water drops and ice crystal radiates to all directions", that is the Tyndall scattering model. In 1880, scientist (John Rayleigh, 1842-1919) proposed that, the oxygen and nitrogen particles with the diameter smaller than 0.3 nanometer in

air scatter the sunlight. Scattering mainly affects the lights with short wavelength, as the reason shaping sky blue. In 1899, Rayleigh published paper, On the Origin of Sky Blue, making “Rayleigh Scattering” as the mainstream of “Blue sky” theory. In 1910, Einstein, through the statistical thermal dynamic theories, demonstrated that, even though the purest air fluctuates, air density change would cause scattering and blue light is apt to be absorbed. After that, Chinese-origin scientist, Mr. Gao Kun won the Nobel Prize project of physics. That is, optical fiber communication is an important application in “blue sky” physics. In “blue sky” subject, the sky shows blue in that the earth surface has atmospheric layer. In “fiber communication” of Mr. Gao Kun, the first physics formula to be cited is “blue sky” Rayleigh scattering formula (Einstein-Smoluchow ski formula)1. Thus it can be seen that the blue sky exists substantial essence of science at the background of most direct visual image. Briefly speaking, in the air humankind survives on exist different kinds of matters, the particles produce physics phenomena of scattering, refraction and diffraction to different extent against the sunray spectrum, so that the sky demonstrates different colours. The atmosphere is colourless. The blue sky is the space prospect jointly created by water drop, atmosphere molecules and other air particles and light rays2.
In 2014, the air quality is satisfactory during APEC meeting in Beijing, sky in blue. After that, a new noun appeared, “APEC blue”, expressing human’s expectation on blue sky and aspiration for fresh air. It can be seen that, as for the relevance research between sky color and environment, particularly the research on atmospheric pollution and PM2.5 is a subject with historical background and historical significance.

1.3 Research Significance

The correlation study between sky colour and air quality is the purport of this research. This research tries to keep a foothold in the combination of art and science. Through the interdisciplinary research methods of physics, arts, design science and psychology, upon the definition and measurement of sky colour information, this paper explores the internal relation between sky colour and air quality from the perspective of direct visual aesthetics. There is little involvement in domestic academic field on sky colour and air quality incidence relation. Upon this research, on the one hand, it is beneficial to understanding the relationship and law between sky colour and air quality. On the other hand, it is beneficial to form a new visual evaluation parameter in air quality, giving rise to mass attention on air quality with direct visual perceptive mode and putting into the air quality improvement with positive mentality.

2. METHOD

2.1 Establish the Objective Shooting-defining the Data Model of Sky Colour

The model defines that the connotation layer, specific contents and image-taking way of the objective information and subjective information is the basis to establish data model. In order to correctly get the sky colour, firstly, verify the camera and calibrate the shooting parameter of camera; and then fixe the shooting places, sights and shooting time. These aspects are the most direct factors affecting the sky colour and also the foundation basis of this subject.

Collecting Facilities of Pictures
Equipment type: NIKON D800 silent frame digital single-lens reflex camera; Effective pixels: 36,300,000

Lens of the camera: Nikon AF-S Nikkor 24-70mm f/2.8G;Tripod: Manfrottor MK293A4-A3RC1

Camera Parameter Setting
Shooting mode: automatic exposure (P shift); Focal distance: 24.00 (focal distance fixing at 24 ends); White balance: sunlight mode; Sensitivity: ISO 100; photometry mode: central average photometry

Shooting Time and Position
Shooting time: shooting pictures at 12:30 or so; shooting period the whole year of 2014 and 2015
Shooting position: shooting position is illustrated in Figure 1, shooting the blue sky with some perspective.

Figure 1 shows the blue-sky image sample specimen shot from different perspective.

Figure 1: Shooting pictures

2.2 Structure the Measurement Database of Sky Colour, Forming "Blue Sky Index"
The contents of database are established on the research results of the first part. DigiEye Digital Insight system, the professional colour analyzing software, is used to analyze the physical value of the shot sky colour. According to some logic sequence and hierarchy, the objective information of sky colour may be edited. The database includes the physical database and air quality database of sky colour.

Photos Selection
To guarantee that sky colours are not affected by shooting process, comprehensively consider the area-occupying proportion of the sky in the shooting scene. Through research, the due reference substance shall be determined (building, trees etc.); the shooting angle shall be kept consistently. The second sample in Figure 3 shall be confirmed as the standard picture of sky colour measurement standard.

Colour-measurement and Conditions
Colour-measuring Facility: take DigiEye system as the major equipment.
Colour-taking conditions: colour-taking area 50×50; the colour-taking position is close to picture above (apart from the white-cloud shielding). Get the average value for three times.

Result Output

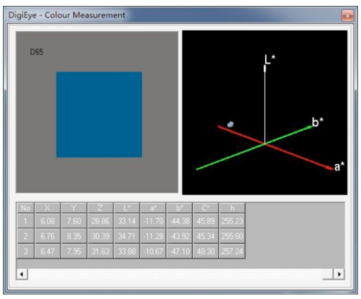

Figure 2. Colour value output

As illustrated in Figure 2, the output results include X,Y,L and C representation colour. This subject is applied to L,C and H to represent the sky colour space. L represents lightness, the brightness degree of colour. C stands for purity, chromaticity and gray level colour. H stands for hue. Figure 3 shows the reflectivity curve, as the reflectivity curve value R of sky colour. The sky colour measurement data in 2014, 2015 is tidied up as per the shooting time, so as to form “blue sky indicator” database.

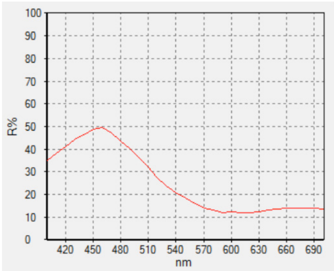

Figure 3. Reflectivity curve

Monitoring Database of Air Quality Index

AQI: Air Quality Index is the index of qualitatively describing air quality status. The larger the value is, the more severe the air atmospheric status of pollution will be, and the more severe the harm to human health will be3. The air quality index data of this subject comes from “weather hindcasting” website, http://www.tianqihoubao.com/. Air quality includes the real-time data of all monitoring stations at all districts, with the value unit of μg/m3(CO as mg/m3). The specific format is illustrated as Table 1, AQI (Air quality index). Air quality index can be classified as six levels of pollution, excellent, fairly-good, light, medium, severe and most severe contamination.

Table 1 Air quality index (AQI)

Date	AQI index	Quality level	PM2.5	PM10	Co	No2	So2
December 13, 2014	244	Severe contamination	190	176	2.85	84	74

Daily AQI data and PM 2.5 concentration data are the average results from calculation according to the hourly data at the environmental protection station.

Figure 4. Legend of air quality index levels classification: 244 means Severe contamination

2.3 Internal Connection Exploration of Sky Colour and Air Quality

Based on the above analysis, in combination of the air quality research contents in environmental engineering, it explores the internal relationship between “blue sky coefficient” and “extent of air pollution”. Taken the Figure 10 air quality histogram for example, it can be known that AQI mainly concentrates from 50 to 200 in 2014.

Meanwhile, it can be known from the applying frequency statistics that air quality value accounts for 50.6% of the number of the whole days from 0 to 100, 37% from 100-200 days. The other 17.4% of the rest days are in severe or most severe pollution.

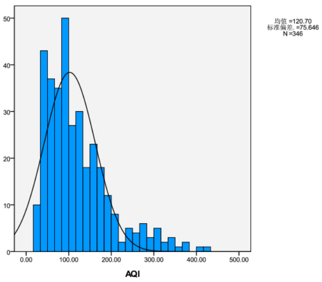

Figure 5. Air quality AQI histogram

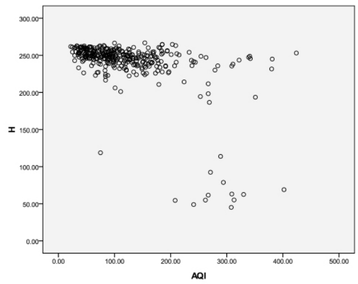

Figure 6. Scttatter diagram between AQI and sky colour hue H

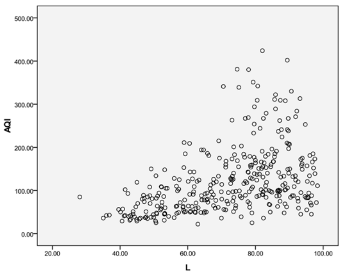

Figure 7. Scatter diagram between AQI and sky colour lightness L

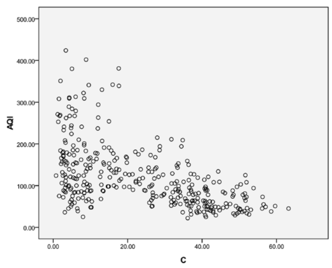

Figure 8. Scatter diagram between AQI and sky chroma C

Figure 9. Contrast pictures of the sky colour at different time

Through the scattered point pictures, it can be known that sky colour hue H scarcely changes with the air quality index, 250 or so all the time. The relationship among lightness L, chroma C and air quality AQI is very complex. The utilization of SPSS fitting primary, secondary and cubic curve has relative small R2 value. The fitting effect is not satisfactory. It can be seen that the same air quality AQI is corresponding to many different lightness L, chroma C, with complex relationship.

3. CONCLUSIONS

Through the website data analysis of "weathering hindcasting", there are about 50% of time air quality in Beijing district in 2014 reaches the excellent standard, air quality as severe or most severe pollution about 17.4% of days. As for the "blue sky index" and air quality AQI scattered relation graph, sky colour hue H barely changes with AQI, 250 or so all the time. The relationship between lightness L, chroma C and AQI is complex. The fundamental reason is that the calculation of AQI is complex. The compositions include inhalable particles PM10, fine particles PM2.5, ozone O3, CO, SO2, and NO2, etc. The same AQI value has different compositions. Different particles and different diameter values influence the movement forms and paths of spectrum, for example, scattering, reflection and refraction, etc., so as to cause the change of sky colour. Thus the same AQI corresponds to different lightness L and chroma C.

Above all, it can be concluded that, with the change of AQI, the sky colour hue H changes slightly; lightness L, and chroma C change greatly. The corresponding relationship between colour representation parameter and air quality relation graph is complex. Hence, the further research needed to be explored in the near future.

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Material Perception and Surface Properties

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ABSTRACT

Color Research has developed prosperously in these years, particularly on "color appearance", which had made a significant breakthrough. Among them, textures, which are intimately related to color appearance, have got little attention. Features of textures possess enormous influences on surface color perception. Interactions between colors and surface materials have big stake on the accuracy of color display. Recently, the uprising of "material perception" researches has gradually filled up the insufficiency. The present research aims to explore the influences of material properties on the appearance of surfaces. Based on authors' previous study (Lan, Lee et al. 2015), and adopting the Cesia's theoretical model (Caivano 1996), which proposed three elements of material properties: Permeability, Absorption, and Diffusivity (P-D-A scale), with the utilization of rotary color mixer devices, in adjustment with properties combined of various ratios of mirror surfaces, matted surfaces, and transparent surfaces, we investigate each element's influences on the appearance for a variety of building materials collected through professional architects, and inspect influences of various textures on subject's psychological feelings. The aim is to build a workable Cesia scale for a series of representative building materials, and is to perform a quantitative survey on perception about material surface features in systematic ways, and to deliver results of practical data for subsequent researches on Cesia theory.

1. INTRODUCTION

Based on authors' previous research (Lan, Lee et al. 2015), in which the P-D-A scales were built for a series of rotating disks, the present study aims to measure perception of surface properties for a variety of glass samples using similar psychophysical tasks.

Professor Jose Caivano, former chairman of International Color Association (AIC), coined the term "Cesia" in an article published in the journal Color Research and Application (Caivano 1991), which suggests a system describing the visual and optical property about texture. As mentioned in the article, the system was initiated by Argentina scholar Jannello in the 1960s (Jannello 1963) as an effort to introduce texture as a feature of surface perception.

Texture, which refers to the perception about material properties of a surface, is intimately connected to color appearance but got less attention in the field of color appearance study. Features of texture possess enormous influences on the perception of color. Interactions between color and surface texture have big stake on color appearance. If we can figure out patterns of connection between texture and color, or between texture and material, it's not only beneficial to material perception research, but also can be practically applied to business commodity.

Studies demonstrate that, surface material of products directly affects sales consequences, which indicates that besides color, texture is another important factor affecting user's psychological evaluation. Texture itself is a huge research issue, and it will be bigger and intriguing when adding into color factor. There are thousand kinds of combinations as objects are composed of different colors and textures, but few researches had figured out the variation or tendencies of this phenomenon. In the present research, we intend to figure out a systematic way to evaluate the perception about visual textures.

2. METHOD

With the efforts of Dr. Caivano, Cesia has been used as an effective system to describe visual textures, which are defined as surface material perceptions, including features concerning glossiness, reflectance, and transparency. From physical measurement perspective, Cesia can be presented with light permeability and diffusivity, plus the reflectance factor, forms a three-dimensional Cesia space composed of permeability, diffusivity, and absorption. Just like color order systems, such as NCS or Munsell, Cesia is an order system describing surface perceptual characteristics.

Cesia is basically a way to describe visual perception. Under different illumination and observing conditions, different Cesia P-D-A indexes will turn out to represent different visual sensation toward surface textures (Caivano 1998). Under standard measurement conditions, Cesia data can be used as surface characteristics sensation indexes, besides a 3-D color order system, to further expand the perceptual dimensions of color (Figure 1).

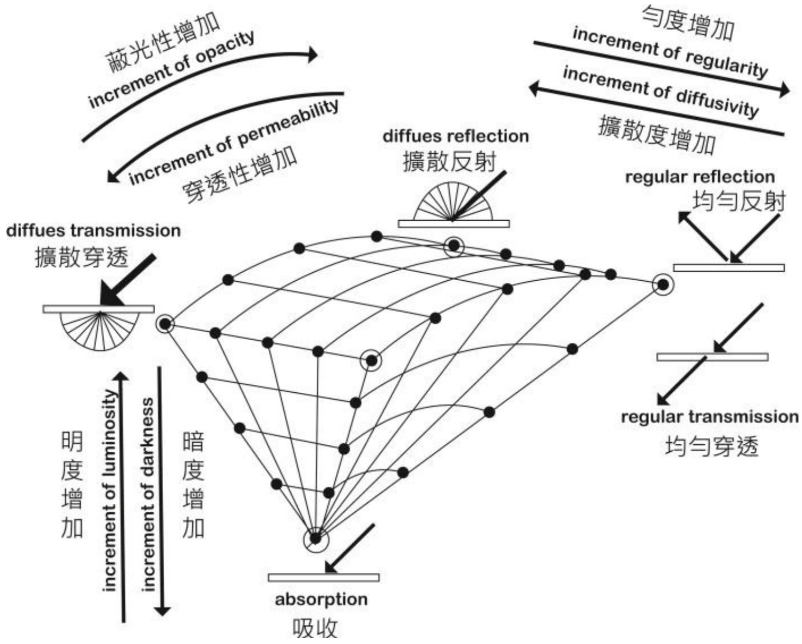

Figure 1. The solid of Cesia with the five primary sensations.

2.1 Sample Preparation

In the previous study, disks with various proportions of specular, matt white, translucency, and black surfaces were used (Figure 3). Those disks were mounted on rotary motors and were spinning at speeds high enough to form a uniform appearance. The observers were asked to rate the degree of mirror-ness, matt-ness, transparency, and blackness for designated samples respectively, with an anchoring sample for each condition. The resultant data show positive correlations, if not linear, between the physical magnitude and psychological estimations (Figure 3, Lan, Lee et al. 2015).

In the present study, the samples used to be rated are 23 glass plates provided by Taiwan Glass Inc. (www.taiwanglass.com). Those glass samples have various permeability, surface reflectance, and translucency on physical scales as given by the manufacturer. They are chosen based on availability.

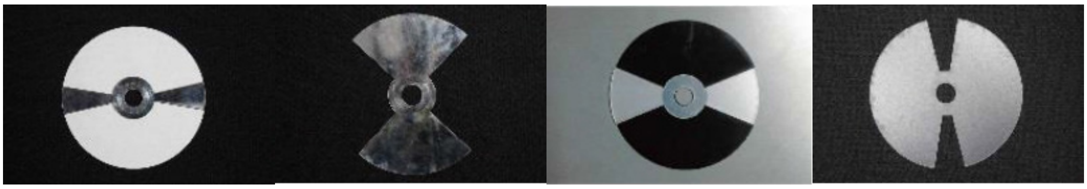

Figure 2. Disk samples used in the previous study.

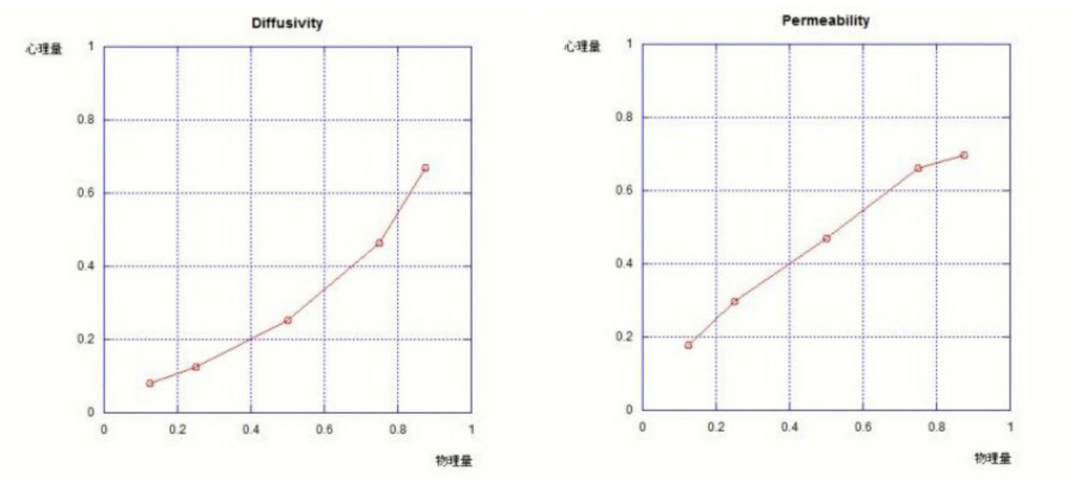

Figure 3. Permeability and Diffusivity psychophysical data obtained in the previous study.

2.2 Psychophysical Experiment

The experiment set-up of the present study is shown in Figure 4. The test samples (plate glass) was placed on an slanting shelf (45°), covered by an black cardboard with an 3"x3" square opening, where samples can be observed (Figure 4). Observers were instructed to rate their perceived glossiness, mirror-ness, and transparency to the samples they looked through the square opening. Two spinning disks on the right side used as anchors for minimum and maximum references.

Figure 4. The experimental apparatus.

3. RESULTS AND DISCUSSION

Generally speaking, the observers showed evidence that they could understand what the terms glossiness, matt-ness, mirror-ness, translucent and transparency mean, and made correspondent and relatively consistent ratings. There are individual differences for the response among the observers. The perceived glossiness and matt-ness show near linear positive correlation with the physical ones of the samples. For transparency in the previous experiment, the observers usually felt a great amount of transparency with a small portion of slit on the spinning disk. However, this phenomenon does not present in the current study. For glass samples, the perceived transparency positively varies with the physical transmission data. The results suggest that the spinning disk paradigm should be revised and tested with more combinations for more materials.

4. CONCLUSIONS

The present study provides practical data for Cesia, on both the system and theory. The study shows that the indexes in the Cesia system are understandable for human observers, and can generate rather consistent results for Cesia indexes. The present research suggests that even for solid samples, such as the plate glasses used in experiments, Cesia is still a valid system to describe the material texture perception, and the use of spinning disks can also serve as a standard references for Cesia indexes.

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Atlas of Architectural Concrete: Colored Cement Mixtures and their Interaction with Wooden Molds

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ABSTRACT

The architectural concrete is a construction material composed of cement, admixtures, sand, stone, chemical additives, etc. The architectural characteristic of this type of concrete is provided by its surface, which presents several aesthetic aspects, such as color and texture that provide different finishes. Color is the consequence of cement and pigments incorporation. Systems or Atlas were elaborated following diverse principles that sketching figures, classify colors according to their different lightness, saturations and hues. For that, a systematization of the color-surface finish concepts and the ingredients involved in their production is proposed. The present work presents diagrammed pictures with information summarized to develop an Atlas. Two groups of mortars were elaborated, each group with red, yellow and black pigments. The color was defined by CIELAB color space and their evolution was compared by CIEDE1976 and CIEDE2000 color difference formulas. The gloss was analyzed too. Results were represented in six pictures to allow quantification and visualization of the different colored mortars. An important color variation was observed from day 7 to day 28. The strong formation of calcium carbonate deposits associated to an increasing gloss was a discouraging result.

1. INTRODUCTION

The aesthetic aspects are an alternative, beyond the traditional ones, that is chosen to build monuments, sculptures, decorative objects and urban furniture. However, the desired color is sometimes not attained by the different proportions of the used components. This fact and high cost of the pigments make attaining new colors difficult. Both reasons justify research studies using mortar mixtures (without stones) since they constitute a rapid and low-cost alternative.

The technological evolution of the construction industry demands the use of steel molds. However, wood is still the most common material used to make molds due to its lower cost. Primary information states that the clearer colors are obtained in steel molds and the darker colors in wood molds, after analyzing the way in which cement particles move (Mindess 2004: 568). Another research study suggests several color alternatives regardless the material used for the mold. Molds should be carefully prepared, taking care they are free from dust and that release agents recommended by manufacturers are used. Regarding the color, available literature reveals different alternatives to systematize this property, and pursues the purpose of ordering the colors according to some criterion. Scarce information about the classification of surface finishes or mentioning these attributes in relation with the cement mixtures is available in the pertinent bibliography.

This lack of information justifies the elaboration of an Atlas of Architectural Concrete. Information gathering is performed on the base of three tips that should interact to outline the scope of this material. One of these tips is the design of mixtures with their main parameters as start point: the water/cement ratio - which defines the mechanic strength and durability- and the pigment/cement ratio -which contributes with color; another tip is related to the surface geometry, where the material of the molds and the treatments performed are assumed as main factors that modify and define the different texture. Finally, the third tip involves the decision regarding the tolerable limits of color and roughness changes, based on color and gloss measurements and visual evaluation.

2. METHOD

2.1 Evaluation of the aesthetic aspects: color and its evolution, gloss and visual inspection

BYK-Gardner spectrophotometer programmed to measure with the CIELAB Color Space was used. Saturation (C*) and hue (h*) were calculated with a* and b* values. This instrument also informs the gloss data. The color difference among different pigment contents and the color evolution were compared with the CIE1976 and CIE2000 color-difference formulas (CIE 15.3, EN 12878, López 2016, Melgosa 2004, Sharma 2005). Finally, mortars` samples were photographed in visual comparators so that all the images were captured under the same condition, Figure 1.

Figure 1. Gardner BYK (left), visual inspection (middle) and wooden mold (right).

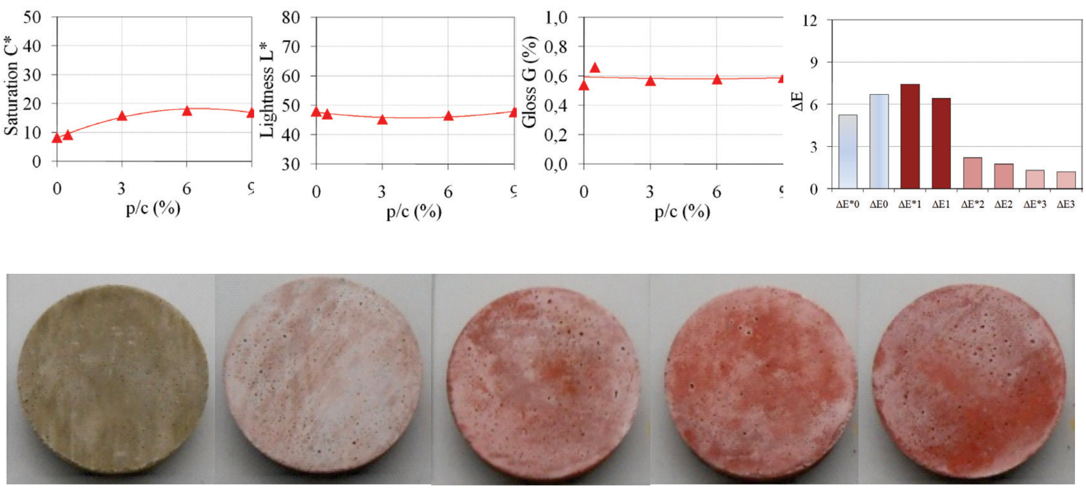
2.2 Samples' preparation

Two groups of mortars were elaborated. Mortars of the first group were elaborated with a 0.40 water/cement ratio while the corresponding to the second group with a 0.50 ratio. A mortar without pigment was elaborated for each group and then red, yellow or black iron oxide pigment was added at 0.5, 3.0, 6.0 or 9.0 % ratio by weight of cement. The mortars were identified as 40R, 50R, 40A, 50A, 40N and 50N. Cement, pigment, water and sand were mixed according to the sequence indicated in the Argentine standard (IRAM 1622) and packed in cylindrical recipients (10 cm in diameter and 3cm high), whose base was made of wood treated with a release agent. This surface was treated with 1 mL of release agent placed in 78 cm2. The molds were manufactured especially for this test and in a way that allowed the replacement of the wooden base by another one made of different materials. After passing the mortars to the molds these were kept in the laboratory for 24 h, and then placed in a chamber at 21 °C and 95 % of relative humidity (RH) for 28 days. These conditions are suggested by the Argentine standard (IRAM 1534) to obtain a uniform cement hydration (wet curing). After the curing period, all the samples were kept in a room at 21 °C and 50% of RH up to start off the tests (see wooden molds, Figure 1).

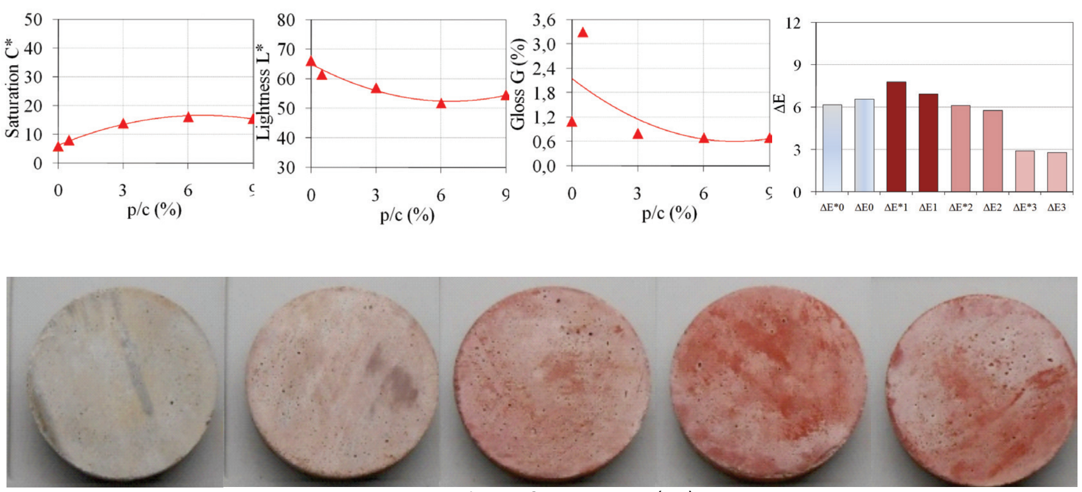
3. RESULTS AND DISCUSSION

Results were summarized and represented in six pictures to allow quantification and visualization of the different colored mortar groups. However, by lack of space is this paper is only shown the figure for the group 40R (Figure 2). At the top of the figure, a header appears in a table forms with the following data: the pigment color, the pigment/cement relationships (p/c :%), ages of color measurement and visual inspection, wet curing conditions, the volume of mortar paste (pigment, cement and water), and the mold material type. Then the graphics C* vs. p/c, L* vs. p/c, G vs. p/c, and ΔE* (CIEDE1976) y ΔE (CIEDE2000) values appear. Finally, photographs of mortars without pigment and with 0.5, 3.0, 6.0 and 9.0% of pigment contents are shown. The information is summarized for 7 days (up) and 28 days (down). The wood grain could also be observed on the surfaces due to the mortar mixture-wood surface interaction. At 7 days, C * changed from 10 to 20 units as increased red pigment, instead L* (47 units) as well also the gloss (0.6%) remained unchanged. The color differences (ΔE* and ΔE) were < 2 units when changing the pigment content from 3.0 to 6.0% (see ΔE*2 and ΔE2), this suggests that it is unnecessary to add pigment since the color changes very little.

Color	Pigment/Cement (%)	Age (day)	Wet Curing	Vol. of Paste (%)	Mold
Red	0.0, 0.5, 3.0, 6.0, 9.0	7, 28	21 ºC, 95 % HR	46	Wood



7 days of wet curing (down).



28 days of wet curing (up).

Figure 2. Red mortars (40R). Water/Cement = 0.40

At 28 days, the changes were very noticeable in the L* as it increased in each mortar values was > 50 units. In turn, as more pigment was added, L* decreased from 50 to 70 units. Furthermore, color differences were very important. I should be noted that the G values increased dramatically at first and reached similar values (0.6%) than at 7 days. Finally, the mortars appearance is shown: left unpigmented mortar, to the right it can be seen as mortars are saturated at increasing the pigment content. This analysis allows suggesting that the addition of more than 6% of red pigment is not meaningful. An important color variation was observed from the 7th up to the 28th day of the curing period. However, associated to the strong formation of calcium carbonate deposits, the gloss increasing was a discouraging result. Such evaluation was also performed for the 50R, 40A, 50A, 40N and 50N mortars group (not shown in the work).

4. CONCLUSIONS

The present work shown pictures about summarized information on architectural mortars necessary to develop an Atlas of Architectural Concrete. The color was defined from the Lightness (L*), Saturation (C*) and hue (h*) values. The color difference among different pigment contents and the pigment color evolution were compared with the CIE1976 and CIE2000 color-difference formulas. The gloss was also evaluated. Surfaces in contact with wood shown a mottled appearance and it was very noticeable the increase in brightness over time curing. This study allows to determine the optimum pigment content and thus avoid an unjustified increase in its content.

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How the Brightness of Relief Wall Depends on Colour, Surface Geometry and Illumination?

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ABSTRACT

The paper focuses at brightness of modern relief walls. It starts with the reference to the ancient stone reliefs from Egypt and Persia. Then modern architectural examples of relief walls are shown and characterized.

In the experimental part the paper presents analysis of small relief plates (24 x 24 cm); each of them having a uniform surface colour and a simple rectangular design with a linear pattern. The plates were made with three degrees of deepness: 1:0.5; 1:1.0; and 1:2.0 and were painted with a matt spray painting in colours: red, blue, green and yellow. The average reflectance of the relief plates was measured with a spectroradiometer in the artificial sky simulating overcast sky and was calculated using Sumpner's formula for calculation of effective reflectance of the relief lowering considered as cavities.

The main conclusion from this study is that the brightness of the relief wall decreases with increase of the total area of lowering in relation to the total area of the relief wall and with the relief deepness. The colour of the relief material or paint has also strong impact as brightness increases with its reflectance. The use of Sumpner's formula in reflectance calculations gives about 5% accuracy for rather dark colours and about 10% for light ones.

1. INTRODUCTION

The concept "relief" was originally used for describing the sculptural technique used for creating rather flat sculptures on the surface of the stone or wood i.e. shapes with very limited deepness. In this paper the notion relief refers to all types of building surfaces having rising and falling surface geometry. As the deepness of a relief is rather small comparing to the size of the surface, the shape of a relief can be described as small movements in between two surfaces, the outer and the inner.

The traditional relief has been created by cutting in from a flat surface of stone or wood and lowering of the background field, leaving the unsculpted parts seemingly raised. The technique involves considerable chiseling away of the background, which is a very time-consuming exercise. Over the passage of years three main types of relief have been developed, sunk, high and mid relief, the first two are exemplified in Figure 1.

Figure 1. A sunk-relief depiction of Pharaoh Akhenaten with his wife Nefertiti and daughters to the left and a Persian high-relief from the Qajar era, located at Tangeh Savashi in Iran.

Figure 2. Examples of modern relief walls. The bow wall in the foyer of the Oslo Opera House to the left and the wall installation in the St. Olav Hospital, by Edit Lundebrekke, to the right.

We may also find examples of relief walls in modern architecture, e.g. in the opera building in Oslo or wall installations in St. Olav Hospital in Trondheim, Figure 2. Those walls are made of wooden sticks assembled together on a background wall. Here also only one material is used resulting with colour nuances that are genuine for this specific material, namely oak. Instead of chiseling away a material, the tectonic variation on the surface is made by using profiles with different cross-sections or by keeping a small distance between them. This method invites to creation of abstract compositions rather than figurative motives. For architects and interior designers considering a relief wall in interiors the important question is: how bright the relief wall appears, in other words:
What is the average reflectance of a relief wall, as compared to a flat surface made of the same material?
This question is important from the light-technical point of view since a lower reflectance has to be counterbalanced by a higher intensity of illumination, meaning also higher energy consumption.

2. METHOD and PROCEDURE

According to (Tregenza, 2011) and (Littlefair, 1991) the effective reflectance of a cavity is recommended to be calculated using the Sumpner's formula (Sumpner, 1983):

$$Pc = k*P/(1-P*(1-k)) \qquad (1)$$

were:
Pc is the reflectance of the cavity
P is the reflectance of the material, and
k is the relation between the area of opening and the area of surfaces within cavity

It has to be underscored that this formula was developed using the theoretical concept of integrating sphere, also a sphere having perfectly diffuse and white inner surface. Such a theoretical model can be used to represent enclosures, which are fairly regular in shape, like many interiors actually are. The question is if it can be used for calculations of effective reflectance of a modern relief made of liner elements where the cavity is a long and linear lowering, a shape not similar to a sphere? And how large differences can be expected between calculated and measured reflectances?
To answer this question numerical calculations of the average reflectance of the relief using the Sumpner's formula have been made for a series of relief design. In calculations the linear lowering have been considered as cavities.

The results were compared to the results of the average reflectance measurements for the same relief series. For this purpose a series of small relief plates was produced at the NTNU, Light & Colour Group (http://www.ntnu.edu/bff/lightandcolour) with the help of the laser cutter at the Faculty workshop. The plates were 24 x 24 cm and were painted with a spray painting resulting with very even and matt surfaces. The relief alternatives developed for this study are: flat, 1:0,5; 1:1; 1:2, see Figure 3. The spectral power distribution of the colours chosen for the study, yellow, green, blue and red, can be found in Figure 4.

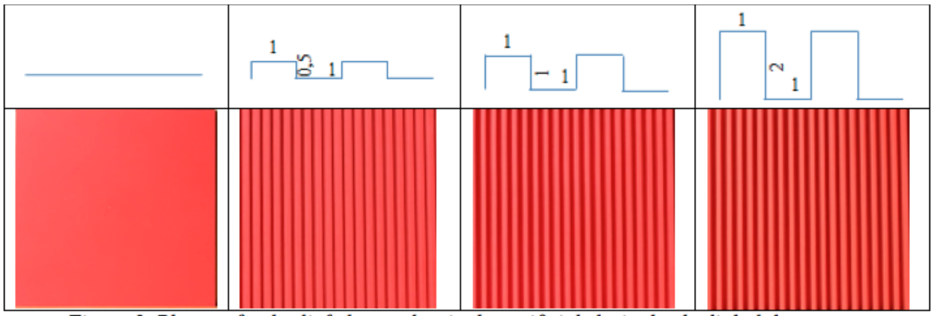

Figure 3. Photos of red relief plates taken in the artificial sky in the daylight laboratory.

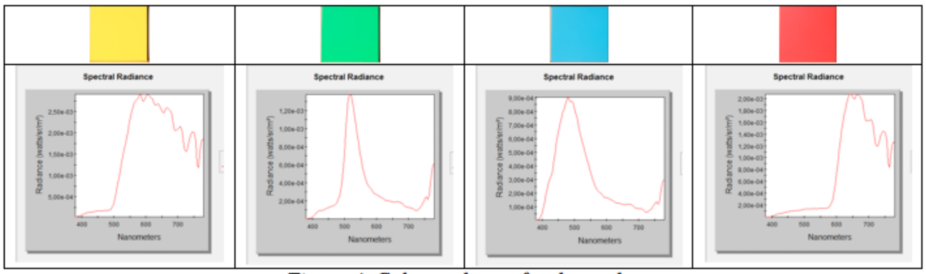

Figure 4. Colours chosen for the study.

During measurements the relief plates were successively positioned vertically in the artificial sky, which is a simulator of the overcast sky. The mean reflectances of the plates were measured with the SpectraScan® PR-655 from the distance of about 3,0m, see results in Table 1.

3. RESULTS AND DISCUSSION

As expected, increasing of the relief deepness, follow the horizontal axis in Figure 5, causes reduction of the mean reflectance of the relief. The same tendency can be observed for all colours. We may observe that the relative reduction from flat to 1:2 relief varies; for the yellow colour, i.e. Ry(1:2)/Ry(flat) is 0.66, while the similar relationship for the green, blue and red is about 0.63.

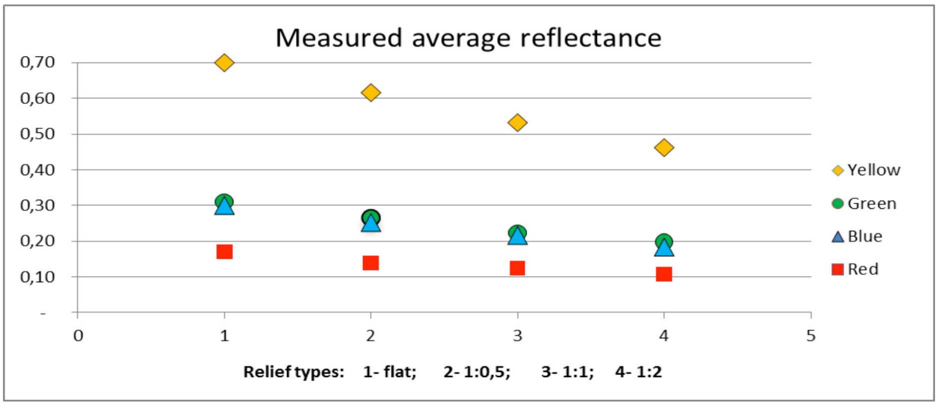

Figure 5. Average reflectance measured in the artificial sky at NTNU.

The average reflectances of the relief calculated with the help of Sumpner's formula are very close to the measured i.e. the difference is maximum 5% for all relief alternatives and colours: green, blue and red. In the case of the yellow colour the difference between measured and calculated average reflectance reaches 10%, the calculated value being higher.

Table 1.Measured and calculated average reflectance.

	Flat	1:0.5		1:1		1:2	
	Measured	Measured	Calculated	Measured	Calculated	Measured	Calculated
Yellow	70%	61,6 %	61,9	53,2 %	56,9	46,2 %	50.9
Green	31%	26,4 %	24,7	22,3 %	22,0	19,8 %	19,6
Blue	30%	25,2 %	23,8	21,6 %	21,3	18,3 %	18,9
Red	17%	13,9 %	13,1	12,4 %	11,7	10,7 %	10,5

From the Sumpner's formula it is evident that in the calculation of the effective reflectance of a cavity two parameters have positive impact: the reflectance of the material (or painted) and k, which in our studies is respectively: 1/2 for 1:0,5 relief, 1/3 for 1:1 relief and 1/5 for 1:2 relief. With other words, deepness of the relief has negative impact on the effective reflectance.
Another important parameter is the area of lowering in relation to the relief area. In the studied reliefs both, the outer surfaces and lowering, make 50% of the relief area. As the effective reflectance of the cavity is lower than the reflectance of the material (or paint), the average reflectance of the relief decreases with the increase of the lowering area.
The study was limited to the overcast sky conditions, which is characterized by very diffuse and evenly distributed light. The relief walls may appear differently in illumination having strong direct component, as for example sunlight. Especially the excessive and repetitive luminance contrast between the sunlit and shadowed strips may be perceived as very stimulating.

4. CONCLUSIONS

The main finding from this study is that for linear reliefs with about 50% area made by lowering the Sumpner's formula can be used for simplified calculations of the effective reflectance of lowering with accuracy of about 10% for bright colours, like the yellow having reflectance about 70%, and with accuracy of 5% for reliefs having darker colours, like green, blue and red which had reflectances 17-31%. This finding will help architects to easily calculate the mean reflectance.

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Perception of Gold Materials by Projecting Solid Colour on Black Materials

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ABSTRACT

Gold gives a unique luxurious impression and therefore golden objects are often desired. As Gold is an expensive metal to start with, it is not feasible to produce objects made of gold at reasonable prices. In this study, we have developed a simple representation method that makes real objects appear to be made of gold using projection mapping technology. In recent years, this technology has been extensively explored, mainly in the field of entertainment. Most of these studies have been focusing on technologies where a target image is superimposed onto an object. Our method, unlike the conventional approach, does not project a target gold image but simply projects a solid colour onto an object, thereby giving the perception that the object is made of gold. We have conducted two psychophysical experiments to confirm our representation method. Our results indicate that objects were easily perceived as golden objects when a solid colour was projected onto black objects rather than white objects. Furthermore, a few samples were perceived as metals, even though they were actually paper or fabric. These results suggest that not only the colour but also a change in material was perceived when superimposing a solid colour onto an object.

1. INTRODUCTION

Recently there has been significant interest towards measuring, analysing, and reproducing specific optical properties of various material objects. In particular, perception and reproduction of gold objects with special glossiness and value adding characteristics like beauty and richness were focused (Okazawa et al., 2011). Shiny golden objects have a special appearance. The visual sensation usually associated with gold is its metallic shine, and not the solid colour. Our previous studies have shown that solid colour stimuli presented on an LCD monitor were identified as gold in colour naming (Tanaka et al., 2015), and the perception of gold in rendered images was improved when noise was added and contrast was enhanced (Horiuchi et al. 2016). However, a precise image representation of a golden object is not easy to achieve even with computer generated models. In this study, we develop a simple representation method to create a gold appearance on real objects using projection mapping technology. In this study, we hypothesised that the luminance deviation and contrast of the object surface influences the gold perception. In order to realise the desired properties, we prepared black and white objects and verified our hypothesis.

2. METHOD

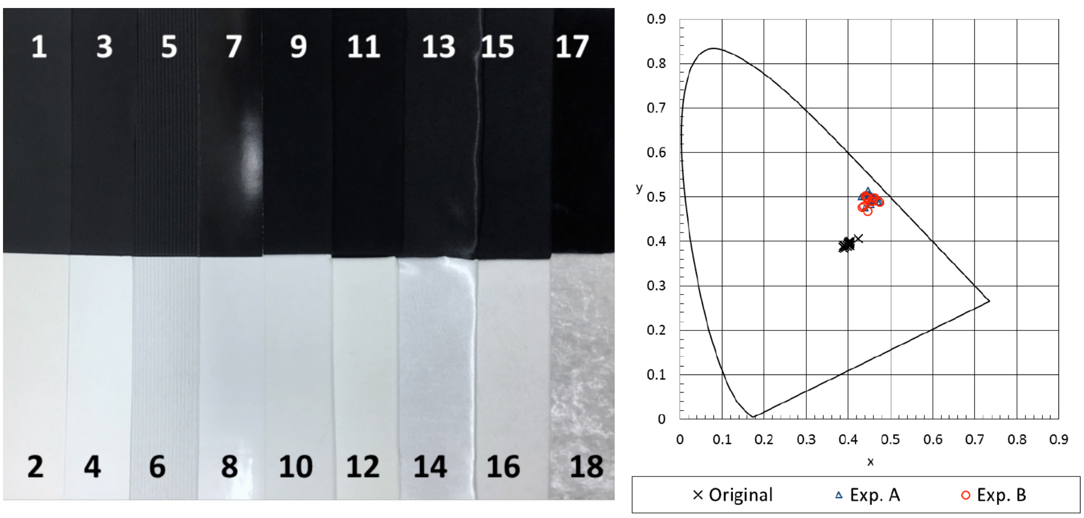
To evaluate the gold appearance using a simple projection technique, we conducted two experiments under different illumination conditions. Experiments A and B were conducted in a darkroom and a room with fluorescent lamps, respectively.

2.1 Experimental Stimuli

In our experiment, we prepared 18 sample objects made from paper and fabric, in black and white colour. Table 1 shows the specifications of the sample objects. The glossiness was measured using a glossiness checker (HORIBA IG-410), which showed a glossiness of 1000 for a sample with 100% specular reflectance. For each material, both samples have similar characteristics except for the colour. We projected a solid colour onto black and white objects using one of the two liquid crystal projectors (EPSON EMP-TW1000 or EPSON EB-G6730) depending on the colour of the sample object. By controlling the projected intensity and projected colour for each object, the CIE tristimulus value of the reflected colour from the upper half of the samples was adjusted to be almost adjusted (Y [cd/m2], x, y) = (450, 0.45, 0.49) for all samples. Figure 1(a) shows photographs of sample objects under fluorescent lamps and Fig. 1(b) shows the CIE xy chromaticity diagram for sample objects under fluorescent lamps and with a projected solid colour, respectively.

Table 1. Specifications of sample objects.

No.	Samples	Material category	Object colour	Glossiness
1	Leather-like paper	Paper	Black	2.2
2			White	5.4
3	Canson	Paper	Black	1.0
4			White	3.2
5	Ripple board	Paper	Black	0.6
6			White	1.7
7	Glossy paper	Paper	Black	57.2
8			White	89.6
9	Broadcloth (cotton 100%)	Fabric	Black	2.5
10			White	2.5
11	Canvas (cotton 100%)	Fabric	Black	2.6
12			White	2.6
13	Satin (polyester 100%)	Fabric	Black	11.3
14			White	12.7
15	Felt (wool 60%, rayon 40%)	Fabric	Black	2.5
16			White	2.9
17	Velour (Polyester 100%)	Fabric	Black	1.8
18			White	1.2



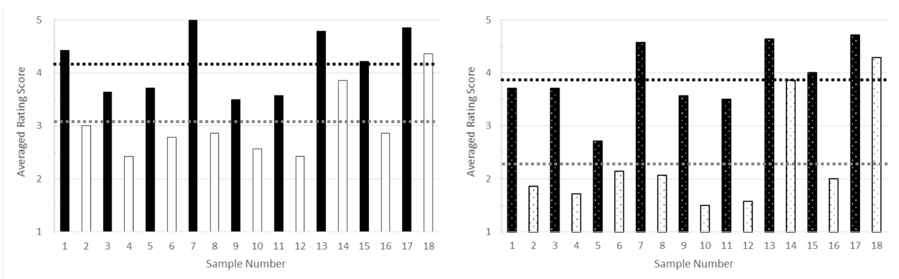
(a) 18 sample objects under florescent lamps. *(b) CIE xy chromaticity diagram of objects.*
Figure 1. Sample objects.

2.2 Psychophysical Experiment

In Experiment B, the CIE tristimulus value of the illumination around the stimuli was (Y [lx], x, y, Tcp [K]) = (180, 0.39, 0.39, 3800). The distance between the projector and object was 50 cm, and the projected area was 21 cm wide and 14 cm high. An observer sat behind a partition with an observation window (square 3.5cm on a side) and evaluated the projected stimuli across the window. The viewing angle of the stumuli was 5 × 5 degree when the viewing distance between the observer's eye and the window was 40 cm. The distance between the observer and the sample was 130 cm. In the bottom half of the sample, the observer perceived a lustre due to the reflection. Eighteen stimuli were randomly observed by the observer. For every stimulus, the observation window was opened for a few seconds for evaluation. The observer rated each stimulus on a scale of 1 (It did not appear like a gold material at all) to 5 (It looked very much like a gold material). Moreover, for stimuli with scores of 4 or 5, the observer also indicated the name of the material. For stimuli with scores 3 or less, the observer also specified the colours. The evaluations were done with one eye closed and the observers were also instructed to keep their heads steady during the experiments. A total of nineteen observers participated in this experiment.

3. RESULTS AND DISCUSSION

We averaged the rating scores after removing the outliers using the Smirnoff-Grubbs test with a significance level 0.05. Figure 2 shows the averaged rating scores for both experiments. The black and grey dotted lines show the averaged rating score of all projected stimuli on black materials (Exp. A: 4.19, Exp. B: 3.90), and white materials (Exp. A: 3.02, Exp. B: 2.33) respectively. As shown in Fig. 2, the stimuli on black materials were strongly perceived as gold materials than the stimuli on white materials. In particular, all observers rated the sample 7 with a score of 5 in experiment A. In contrast, the stimuli on white materials were hardly perceived as gold materials even though the CIE tristimulus value was equivalent to the stimuli on black materials. Luminance contrast due to micro facets on the material surface might cause the perceptual difference regarding its gold-like appearance. Especially, the glossy surface texture (sample number 7 and 13) was perceived as golden materials. It was interesting to note that, although some black materials had matte surface texture, observers still evaluated them as gold materials (sample number 1, 3, 9, 11, and 15).



Experiment A (in darkroom). *Experiment B (in lighting room).*

Figure 2. Averaged rating scores for each stimulus.

When the observers were asked to specify the colour for the cases with scores 3 or less, most of the answers were yellow. All the participants were interviewed after the experiments and almost every observer said that they distinguished between gold and yellow based on whether the sample was shiny or not. For scores over 4, the observers also guessed the material names (shown in Fig. 3). Almost all projected stimuli on black objects were named paper, even though half of the stimuli were actually fabric. A few samples were recognized as metal, when they were actually fabric or paper. These results indicate that not only the colour but also the material was perceived differently when a solid colour was superimposed onto an object.

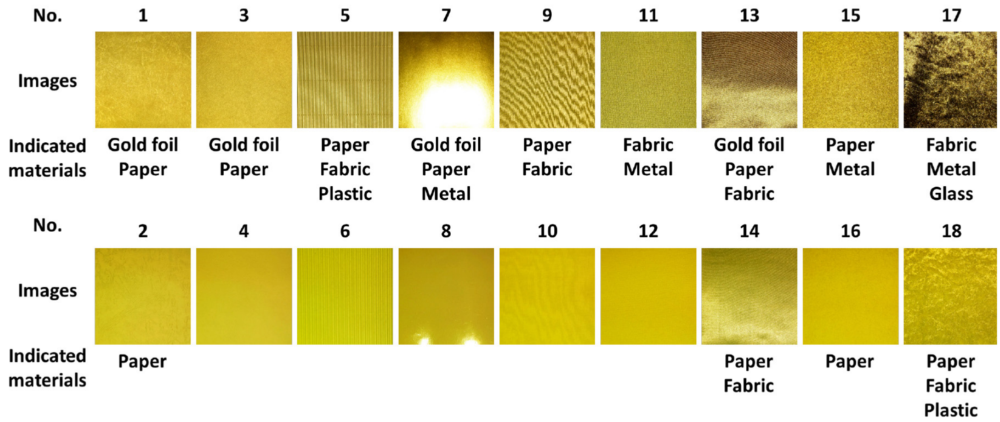


Figure 3. Answered material names.

4. CONCLUSIONS

In this study, we developed a simple representation method to create a gold appearance on real objects using projection mapping technology. Our method does not project a target gold image like in the conventional approach but simply projects a solid colour onto an object. To verify the effectiveness of this method, we conducted two psychophysical experiments with different illumination condition using eighteen black and white objects. Our results indicate that objects were easily perceived as golden objects when a solid colour was projected onto black objects than on white objects. These results revealed that the luminance deviation and contrast of the object surface strongly influenced the gold perception. Furthermore, a few samples were perceived as metals, even though they were actually fabric or paper. These results also suggest that not only the colour but also the material was perceived differently when superimposing a solid colour onto an object. As our method is simple to implement, it can have various applications in the field of entertainment, visual display or interior decoration in urban life.

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Metallic Reflections in the City

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ABSTRACT

After a short but fundamental description of the optical properties of metals, semi-metals and alloys based on the example of the Luxor Obelisk, we describe a certain number of visual effects and link their origins to the fundamental optical properties of the complex indices of refractions of metallic materials. Conceived as a beacon in ancient Egypt, the obelisk today is erected in Paris and oriented according to the cardinal points. Formerly topped by an electrum-plated pyramidion, but now covered in gold leaf, this small pyramid situated 23m above ground level reflects the sunlight in such a way that it was, and still is, visible from dozens of kilometers away. By focusing on this concrete example, we demonstrate that the aspect of materials, in this case metals, cannot be reduced to the concept of color, and even less to that of trichromatic color. Our goal is to outline the entire predictive rendering process and, via a concise demonstration, to present the key concepts of physics that must be met to generate a computer image that is identical to a photograph of an actual scene.

1. INTRODUCTION

For many years our research has focused on realistic materials rendering based on solid-state optic and theoretical models. Our aim is to accurately qualify each step in the predictive rendering process. To do so, spectroscopic ellipsometry is used to precisely characterize a perfectly smooth metallic material. Using these measurements and physically-based illumination models, we can accurately render a 3D scene whose description includes the spatial and spectral properties of the materials and light sources. As the interaction between light and matter depends on shape and surface state, complex and surprising visual effects occur. Such effects are highly evocative and deeply alter our understanding of what happens when light and metal simultaneously interact. In this paper, we rely on a unique example: the pyramidion of the Luxor Obelisk, at the Place de la Concorde in Paris. Computer graphics have only recently taken into account the polarization of natural light and metallic reflections (Berger 2012), whereas the usage of formal optical properties for simulation, via virtual metallurgy modeling, was introduced in the early part of this century (Callet 2002). Combining measurements of light polarization, complex indices of refraction, high-dynamic-range imaging (HDRI) and spectral imaging allows us to obtain accurate new simulations called predictive renderings. A set of spectrally-computed images, digital pictures and data curves give us a good understanding of the phenomena involved in the interaction of light and metal.

2. METALLIC MATERIALS AND DATA ACQUISITION

The only proved way to scientifically simulate the optical effects of metallic surfaces is to use the complex index of refraction (real (n) and imaginary (k) parts); yet little highly-accurate index data is available. To guarantee material property characterization, we sampled a particular gilt surface similar to the aforementioned famous

(1) a natural gold-silver alloy
(2) n = n + ik

monument. Offered to France in 1836 by Mehemet Ali, vice-regent of Egypt, Luxor Obelisk is erected in Paris, Place de la Concorde. In Egypt, the monument acted as a beacon and was oriented in relation to the cardinal points. The electrum-plated pyramidion, at the top of the obelisk 23m above the ground level, reflects the sunlight in such a way that it is visible from dozens of kilometers away. As the pyramidion of the Luxor Obelisk was originally covered by electrum, we used spectroscopic ellipsometry on a very tiny piece of natural electrum belonging to the Museum of Mineralogy at Ecole Nationale Supériure des Mines de Paris (Figure 1). At this stage, we are able to simulate the optical appearance of any element described in the periodic table as long as its complex index of refraction is known. As the optical properties of alloys are more complicated to compute, we studied models, which are relatively easy to comprehend for simple binary alloy cases such as brasses and bronzes; we furthermore conducted a more complex generalization of the n-ary alloy based on plasma physics. Since it is difficult to predict complex indices of refraction (mainly due to the multiple crystallographic arrangements of atoms), we chose to use spectroscopic ellipsometry to measure these essential indices. For more than fifteen years we have been measuring and compiling the complex indices of refraction of numerous physical samples of metallic materials. This method can also be used to acquire excellent optical data for minerals with a metallic sheen (sulphides, oxides, hydroxides, etc.). We also studied their surface states and produced spectral simulations that can be of use in a wide array of fields, including automotive, architecture, design, science and technology. This allowed us to clear up a certain number of misconceptions, such as "the only characteristic of specular reflection would be those of the light source". When light is reflected several times over by a material surface according to Snell-Descartes law, we can observe a phenomenon we will call "spectral multiplication". In such situations, the observed color saturation increases exponentially with the number of inter-reflections.

Figure 1: Electrum. Ellipsometric measurements were made on a very small scale (center piece of the picture) of alloy from the Museum of Mineralogy at Ecole des Mines de Paris.

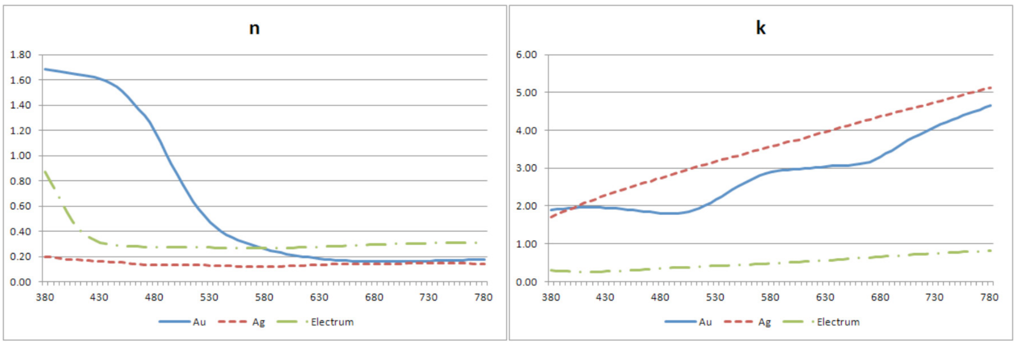
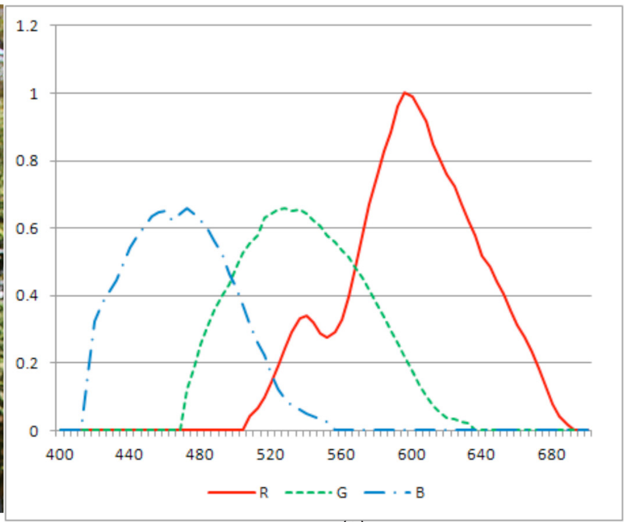


Figure 2: The compared real parts (optical indices) of the complex indices of refraction of Au, Ag and electrum (left). Idem with the imaginary parts (absorption indices) (right). Au (blue), Ag (red), Electrum (green)

3. LIGHT AND ENVIRONMENT CHARACTERIZATION

Having determined an accurate method for predicting the optical properties of metallic materials, we now need a spectrally-defined lighting environment for the rendering phase. As scattered atmospheric solar light is also polarized according to the sun's position, we need to create new kinds of environment maps. Two methods are taken into consideration to produce these environments: models and measurements. In this paper we use the Preetham sky model (Preetham 1999), updated by Hosek and Wilkie (Hosek 2012). In the next step, we will compare the models to the measurements provided by to a device we are currently developing, the SPLIS (Spectral Polarized Light Image Sensor). It is designed to acquire half-environments in two minutes, using 16 spectral bands and 4 polarization directions in HDR mode. A picture of the SPLIS device is given in Figure 3(a).



(A) (B)

Figure 3: The SPLIS (Spectral Polarized Light Image Sensor) device during tests – still under development (a). The spectral sensitivities of the Canon EOS 5D Mark II camera (b)

4. RESULTS AND DISCUSSION

To obtain the final image presented in Figure 4 and 5, we applied the previously-described method to the spectral computations of an electrum, a gold and a silver plated pyramidion. Then, the results are converted to the RGB space according to the camera's relative spectral response curves, Figure 3 (b). In this case a Canon EOS 5D Mark II was used to take the actual photograph of the obelisk. The camera parameters (F/11; 1/400s; Iso 200; focal length 24mm) are also applied to the rendering, as are those of the sky model (Hosek 2012), in order to obtain the correct illumination of the actual sky on September 23, 2015, at 10:14am, in Paris. The surface state is described with a moderate roughness according to Beckmann model. With the SPLIS device we shall compare the direct spectral measurements of a real sky to the aforementioned models, and we shall reproduce a more accurate simulation of the optical properties of metals. This device, what is more, would also allow us to simulate a wide range of dielectric materials, which may be visible in the city at any given time. The SPLIS device can also notably detect the absorption of light in narrow spectral bands due to pollutants or water vapor.

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(3) Ocean bidirectional path tracer - Eclat Digital Research
(4)https://confluence.lsstcorp.org/display/SIM/Cerro+Pachon+All-Sky+Camera+Project

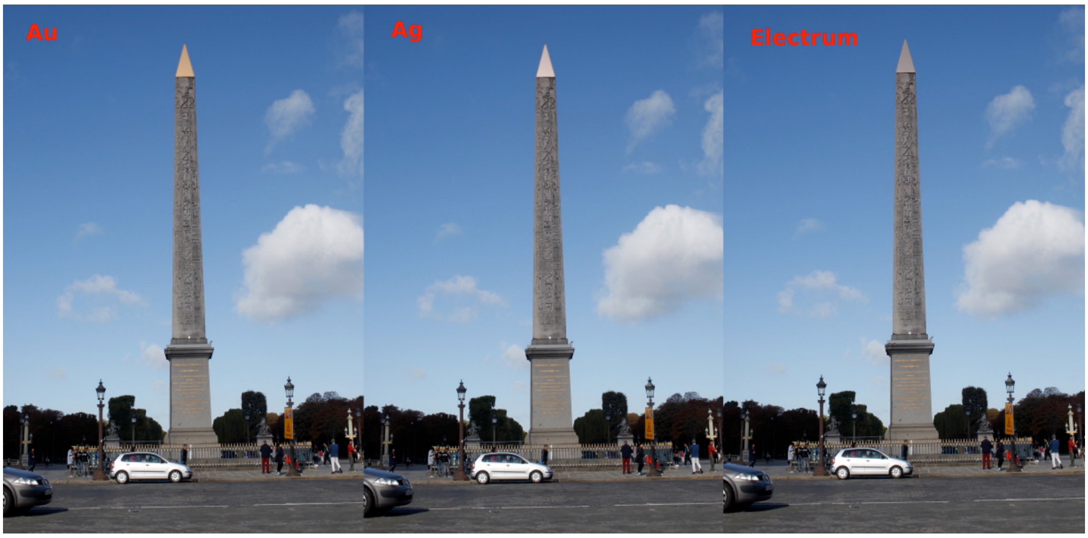

Figure 4: Retrieving the original optical aspect of the electrum plated pyramidion of the Louxor obelisk in Paris. Comparison is made with a gold and silver plated pyramidions placed in the same viewing and illumination conditions.

Figure 5: Simulation of electrum plated pyramidion under two exposure time (1/800s (top) and 1/3200s (bottom)) illustrating the obelisk acting as a beacon.

5. CONCLUSIONS

To correctly render the optical properties of materials, mainly metallic in this example, we use spectral computations requiring specific acquisition processes, from spectral material data (complex indices of refraction) to natural light, including its polarization states. We then built a new device, the SPLIS (Spectral Polarized Light Image Sensor), for computing the interaction between light and materials. This real light captured in urban spaces can be useful in many predictive situations (for building, lighting, thermal properties, pollutants characterization, etc.), as when light and metal simultaneously interact with shape, orientation, state of surface, and curvature, whether concave or convex, complex and surprising visual effects occur. Such effects are highly evocative and deeply alter our understanding of our perceptive experience. To conclude, a set of spectrally-computed images, digital pictures and data curves are proposed to allow us to more clearly and precisely perceive the phenomena involved in the interaction of light and metal.

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A Study On The Effectiveness Of White Leds With High Colour Rendering As A Substitute Of Daylight

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ABSTRACT

Daylight has high colour rendering and provides natural appearances of paintings. However, it is difficult to control and its component would damage paintings. Because of these negative characteristics quite a few museums in Japan have suspended their daylighting system use. Recently, white LEDs have started to be introduced in the field of museum exhibits for their low emission of UV rays and heat, which are harmful for artworks. However, the spectral distribution of white LEDs is completely different from conventional museum lightings and the effect on the appearance of artworks is yet to be fully known. The purpose of this study is to examine whether white LEDs could be substitutes for daylight through subject experiments. Results show the possibility that some of the white LEDs, especially with low colour temperature and high CRI Ra, would become substitutes for Daylight.

1. BACKGROUNDS AND PURPOSES

Daylight has always been one of the major light sources for museum lightings. It has high colour rendering and provides natural appearances of paintings. On the other hand, it is difficult to control and its component, such as ultraviolet and infrared rays, would damage paintings. Quite a few museums in Japan have suspended their daylighting system use, because of these negative characteristics. Some museums has started to examine the possibilities of using white LEDs as substitutes for daylight, for white LEDs have the advantage that they do not contain both ultraviolet and infrared rays, and their light intensity and colour can be easily controlled. Some current white LEDs have extremely high colour rendering, however, their real effects on appearances of paintings have not yet been clearly revealed. Therefore, it is necessary to examine the effects on the appearance of painting through the painting assessment experiments. The purpose of this study is to check whether white LEDs could be substitutes for daylight for museum lightings in future.

2. EXPERIMENT METHODS

2.1 Lighting Conditions

Comparative experiments between daylight and white LEDs are carried out in the experimental boxes. Table1 shows the illuminants used throughout the experiments. It listed light source, LED chip, correlated colour temperature (CCT) and colour rendering index CRI/CQS. CCTs selected in the experiment were 4000K, 4600K, and 6000K. Light sources used were [Blue-White LEDs] (white LEDs stimulated by a blue LED chip, coated with yellow phosphor layers), [Purple-White LEDs] (white LEDs stimulated by a purple LED chip coated with red, green, and blue phosphor layers) and [Daylight]. Figure 1, 2 and 3 show the relative spectral distribution of white LEDs and the example of daylight. CCT of each daylight were close to the 4000K, 4600K, 6000K, respectively.

Table 1– Illuminant information

Light source	Daylight			Purple-White LEDs			Blue-White LEDs		
Types of LED chip				Purple LED chip			Blue LED chip		
Colors of Phosphors				RGB Phosphors			RG Phosphors	Yelllow Phosphors	
CCT	4000K	4600K	6000K	4000K	4600K	6000K	4000K	4600K	6000K
Ra	98	98	99	98	97	91	98	81	84
R1	99	98	100	98	95	88	99	79	83
R2	98	98	99	100	97	92	98	86	91
R3	98	98	98	95	97	98	95	90	94
R4	96	95	98	99	97	91	97	81	83
R5	98	97	99	98	97	90	99	79	83
R6	99	99	99	98	97	92	96	80	85
R7	96	97	98	99	97	95	98	87	88
R8	97	97	98	98	95	86	99	65	70
R9	97	95	97	99	89	59	97	1	11
R10	97	97	98	96	97	86	95	66	77
R11	97	96	99	99	98	89	96	80	82
R12	93	92	98	84	84	87	81	52	59
R13	98	98	99	98	95	88	100	81	85
R14	99	99	99	96	98	97	97	95	97

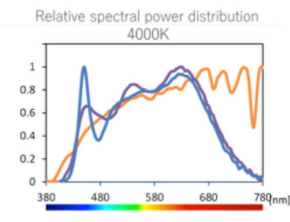

Figure 1 – S.P.D 4000K

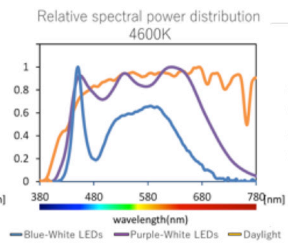

Figure 2 – S.P.D 4600K

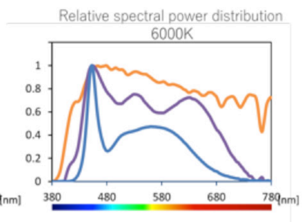

Figure 3 – S.P.D 6000K

2.2 Experimental box

The upper body of subjects was positioned in a box (800mm width × 450mm depth × 1000mm height), which had a single aperture with a black-out curtain to shut off the light, and a hole in the ceiling to place the light source. In the case of daylight, the hole was covered with louvers for dimming daylight. Ultraviolet rays were cut by filters. CCT was adjusted using colour luminometer installed in the box (Figure 4). In the case of White LEDs, a hemisphere with the same diameter of the hole was put above the box and light from the LEDs was scattered in it (Figure5).

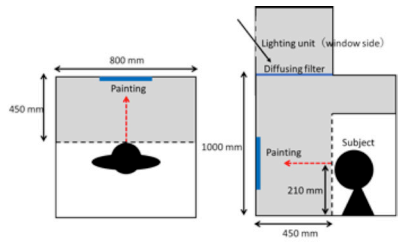

Figure4 Plan (left) and Section (right)

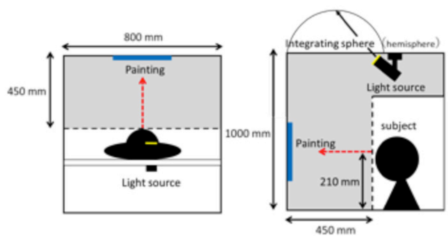

Figure5 Plan (left) and Section (right)

2.3 Luminance distribution

Figure 6 shows luminance distributions in the box under daylight and white LEDs. The luminance distributions were always controlled to be similar among different lighting conditions.

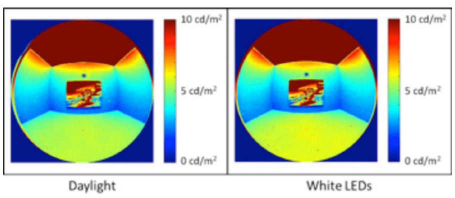

Figure 6: Luminance distribution

2.4 Painting

The oil painting (Figure 7) was placed on a front wall at 210mm height above box-floor level. The viewpoint of the subjects was 450mm distant from the painting. The painting used was "Mediterranean" drawn by Masao Mizuhara. Painting illuminance was 100lx, and background reflectance was N4.5 (Neutral Gray).

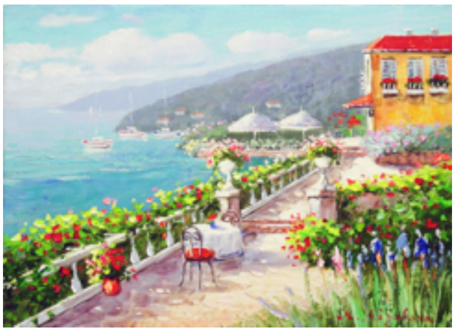

Figure7: Painting

2.5 Subjects and Evaluation scales

15 students aged 21-25 without vision problems volunteered to participate as subjects in this study. The appearance of the painting was evaluated regarding 14 items as follows; "colourful", "easy detail discrimination", "moist", "preferable" and so on. They evaluated the appearance of the overall painting with bipolar scale of 9 steps (-4~4). Table 2 shows the evaluation scale.

Table 2: Evaluation scales

Evaluation scale (+4- -4)		
Entire evaluation		
colorful	-	drab
easy detail discrimination	-	difficult detail discrimination
enoght brightness of painting	-	not enoght brightness of painting
contrasty	-	not contrasty
clear	-	fuzzy
having a sense of depth	-	not having a sense of depth
composition is appropriate	-	composition is not appropriate
exhilarating	-	depressing
glossy	-	not glossy
moist	-	dry
natural	-	unnatural
living	-	not living
preferable	-	not preferable

3. RESULTS

The results of the experiment are as follows;

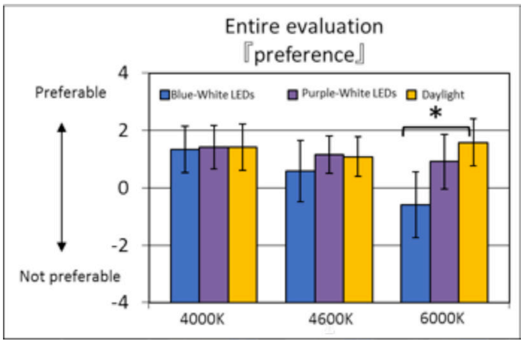

Figure 8: Entire evaluation "preference"

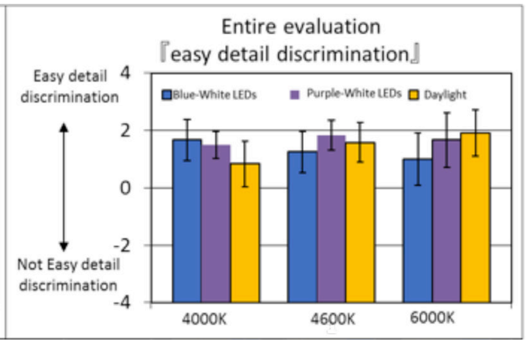

Figure 9: Entire evaluation

3.1 Analysis: "preference"

Figure8 shows "preferable" appearance of the painting in entire evaluation. When CCT of the light sources was 4000K, there was not a significant difference in the appearance of the painting among the light sources, whereas when CCT was 4600K, there was a tendency that the evaluation under [Blue-White LEDs] was lower than the others, this may be caused by the low colour rendering index (CRI: Ra81) of [Blue-White LEDs]. When CCT was 6000K, [Daylight] got the highest evaluation. As to the "preferable", there was a significant difference ($p<0.05$) between [Blue-White LEDs] and [Daylight]. The low evaluation under [Blue-White LEDs] was also caused by the low colour rendering index (CRI: Ra84).

3.2 Analysis: "easy detail discrimination"

Figure9 shows "easiness in distinguishing detailed discrimination" in entire evaluation. When CCT was 4600K and 6000K, the result was similar to that of "preferable". However in the case of 4000K, [Blue-White LEDs] is evaluated slightly lower than the others.

4. CONCLUSIONS

In the case of [Blue-White LEDs], this result shows that [Blue-White LEDs_4000K] would become a substitute for [Daylight], however, [Blue-White LEDs_4600K] [Blue-White LEDs_4700K] in this research could not be used as a substitute for [Daylight], because their CRI Ra is much lower than [Daylight]. In the case of [Purple-White LEDs], [Purple-White LEDs_4000K], [Purple-White LEDs_4600K], [Purple-White LEDs_6000K] would become a substitute for [Daylight]. We could prepare white LEDs with high colour rendering at only low colour temperature, therefore further investigation using white LEDs with high CRI Ra and high colour temperature should be carried out in future. It is also necessary to examine the effects of daylight and LED lighting under the conditions that their light intensity and colour are changing.

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Colors across Indian Cultures: A Dialogue of Color Association with Visual Identity

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1. INTRODUTION

Colors manifest cultural values and have always been associated with emotional context. We can see over 7 million colors. These are formed by mixing three building blocks; red yellow and blue in different proportions, are termed as primary colours. A single color can have diverse meanings in varied cultures. A vast range of colour association and symbologies are present in India due to its multifold cultural background. Context is everything: a group or community of people wearing black might be part of family function or may be mourners. The traditional meanings associated with colors in various cultures of India have a significant associations and their reflection on the society.

The global impression of India beholds its colorful culture, streets, and stories and it always seems like a page out of an ancient folk tale. India represents simple expressions of colors, holding together multitude of outlooks, lifestyles, and traditions. A peculiar colour symbology is an integral part of all cultures and it holds a significant space in different aspects of life, be it religion, politics, festivals or celebrations. In India, it the north, south, west, or east, color and culture go hand in hand. Just like many other cultures across the world, a distinctive taxonomy of color associations is treasured in India.

Samples of 100 professionals (male and female) with diverse cultural background in age group of 25 to 35 were randomly selected. Questionnaire and personal interview tools were used to collect the information. By using descriptive research method a number of conclusions were drawn by analyzing the collected data.

COLOUR AND RELIGION

With so many diverse religions, still few colours travel parallel in all. Considering the bridal wear, red is always preferred as an auspicious colour in Hindu as well as in Muslim communities. In Hindu religion, red is of utmost significance and the colour most frequently used for auspicious occasions like marriages and festivals, etc. A red mark is put on the forehead during ceremonies and important occasions. The universal application of red dot Bindu on the forehead is the outward token of psychic energies. White is considered as colour of mourning, contrary to this, white is adorned by male members of the family while performing various rituals pertains to childbirth and sacred thread ceremonies. In Christianity, black is considered as the colour of mourning, red represents blood and war and white is considered as auspicious, pure and the colour of righteousness.

In present context, India is observing a subtle shift in colour preference patterns due to the presence of contrast between pre conceived notions inherited from ancestors and influence of other cultures with contradictory wisdom. For instance white being considered as mourning colour or “no colour” in Hindu culture, is nowadays preferred as a prevalent colour in combination with other vibrant hues in ritualistic ceremonies. In contemporary view, white is accepted to be used for bridal wear in north Indian Hindu culture that was forbidden in earlier time.

KALEIDOSCOPIC ALLURE

Being heterogeneous in nature, varied colours are used together creating a layered effect, which expresses the Indian philosophy of living together and exchange of colours between cultures. In keeping with the philosophy of synthesis, violent contrasts are everywhere harmonized in all aspects of lifestyle. One colour seen through the other creates an almost kaleidoscopic effect. The Indian designers with inherited design and colour sensibilities always try to bring back the peculiar traditional colours and techniques, presented in contemporary form based on western trends, are always cherished by population. In digital era with the presence of social media and online shopping, people have access of global trends on their tabs and phones. What a Hollywood or Bollywood celebrity wore today afternoon will be out on media in the next hour. This makes people to rethink on their colour choices, in spite of having traditional preferences. Presently the cross cultural population is well aware of global fashion through social media hence they observe and adapt global colour trends easefully. The presence of Indian celebrities on red carpet in Cannas Film Festival showcased a new colour palette to be followed by masses. Aishwarya Rai Bachchan, Miss World 1994 and an Indian Bollywood actress, who completed her 15 years at Cannes this year, shocked everyone by putting up a Purple lipstick. While the majority found it amusing, there were others who praised her experimental look and the colour was followed by the people appreciative of trendy chic. The Economic Times also stated that "Neons are a thing of past as pastels takes over" India may be the most colourful country with vibrant colours dominating our Indian dresses, festivals and even streets, yet the country's fashionists are giving up their bright, in-your-face neons for soft, milky pastel hues this summer season."

COLOUR AND GENDER

With presence of chalk and cheese societies, metro cities play an important role in setting the trends and preferences of colours in India. Majorly, gender differences in color sensitivity are not prominently related to cross-cultural localization. A closer look, however, will reveal that these are found in every society, each with some specific characteristics. The brands staging of blue and pink associated with male and female, had a great impact on choices of colours. Unconsciously the parents are also responsible in cultivating the notion of gender biased colour preference in their wards. From the childhood the notion of boys preferring blues and girls appreciating pinks is prevalent in society.

Indian contemporary fashion stylists are paying an important role in changing these norms. For example, a Bollywood actor, Ranveer Singh, has changed the entire classification of colours and prints for men. By wearing a pink Chinese collar men suit with a brown flared skirt during the promotion of his highly awarded film "Bajirao Mastani", he has introduced a new dictionary of colours for Indian men and broke the boundaries of stereotypes.

COLOUR AND WORK

In the new era of cooperate world with more working professionals, people accepted neutrals and saturated tones such as black, grey and white in their wardrobes apart from bright hues. Indian women in metro cities are adapting neutral look as per the demand of the working environment. The definition of "being dressy" is also changing in the psyche of contemporary masses. For instance the Indian woman's wear sari traditionally worn in bright hues, at present adorned in neutral colours also during formal occasions. Contrary to this, in earlier time, the neutrals coloured saries were worn by widows and elderly females of the family.

CONCLUSIONS

A descriptive research was carried out to explore the various facet of cross cultural impact on colour preference. However a generic notion about certain colors associated with specific characteristics appears in different versions speaking universal language of togetherness. The results reveal that colour preference pattern is changing in present scenario retaining essence of traditional beliefs and meanings. The society is observing exchange of colour beliefs and mutually valuing the colour associations between cultures with a modern twist.

ACKNOWLEDGEMENTS

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Colorful Narratives

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ABSTRACT

This article discusses whether film pictures may be considered an object itself and therefore they are influenced by color. To make an aesthetic and creative use of color, several filmmakers have resorted to colors and presented inventive solutions to use them in film. Manipulate the colors of a film also requires an understanding of specific technologies. Analyzing two works of Brazilian authors (The Boy and the World from Ale Abreu and Here is so far from Eliza Capai), aims to understand how the use of saturation and black-and- white duality versus color can be used to generate sense and meaning to the films.

1. A HISTORY OF COLOR FILM

The advent of color film brought new perspectives to the seventh art, not only concerning this specific technological advance, but also the artistic field, with new possibilities for filmmakers. The present article intends to paint a small picture of this technology (coloring) in movies, and discuss ways of inserting and manipulating color in cinematographic works.

In early movie history, the approximation of cinematographic image to reality was sought through a mimetic representation (Costa 2011). Therefore, color played a fundamental role in this context and starts to be added to film through a wide range of techniques - hand-painted designs and dyeing are some of them. In the 30´s, the company Technicolor was the holder of the technology that filmed, edited and reproduced color films. Its main technique consisted in using 3 black and white negatives, filmed with colored filters in blue, red and green; these negatives would later be dyed in yellow, cyan and magenta, and, after combined, would color the film. A lot has changed with the advent of digital technology, not only the attempt to get a mimetic image of what is real, for digital image doesn´t depend on physical reality to be built, but the approach to how to make movies has also changed through all its phases, from production to post-production and exhibition.

In its first century of existence, cinema was a photo-mechanical medium, its images arising from chemistry, darkroom, and processing lab, fixed in analog form on a celluloid surface, and trucked around the country for exhibition. This paradigm is changing because of the influx of digital tools in all phases of film production: set design, cinematography, editing, sound, postproduction, distribution and exhibition (Prince 2004: 25)

Inside digital techniques, the main approach to manipulating colors in films are softwares specialized in the process of moving pictures coloring. If manipulation through Technicolor was limited by the analogic medium of its production, the emergence of pixel made the altering of each image point possible to control color in the most suitable way to the movie and the narrative. Pixel is a numeric information and is represented, basically, through the three color defining parameters: hue, saturation or chroma and value or brightness.

(1) Main North-American Company responsible for movies coloring in the early XX century.
(2) We can observe these processes on these two videos offered by Technicolor: https://www.youtube.com/watch?v=g9S76vtk4Ro and https://www.youtube.com/watch?v=N-T8MVrw1L0

2. COLOR AS NARRATIVE INFORMATION

The proper use of color is understood as information, since it is part of a communicative process, and this is how we seek cultural diversity, in its organization, storing and transmission. We use the concepts of polarity and opposition, in which a natural code (color parameters) oppose to another one (other parameters), with different values, a negative one and a positive one. An example are traffic lights: red is opposed to green and each one carries a different polarity, red being the negative one in this case. (Guimarães, 2000).

Contrasts which qualify the presence of color in the context of speech (e.g. intense colors for specific sets, and desaturated tinges for other sets), identified as color categories, correspond to one of the expressive traits related to the content field (meaning). The meaning behind color is built through relations established in the speech itself, through its relationship with shapes, atmospheres, state of mind, thymic layouts (euphoria, aphoria, dysphoria), spacial distributions (topology), and the chain of events that characterizes narrative [...] (Barros 2012: 77)

2.1 Color in mise-en-scène

Mise-en-scène refers to framework, objects, people, distance between them, in short to a number of scene elements, it is the movement in scene. Mise-en-scène is conceived and articulated by a number of professionals in charge of filming and production. It is the dramatic space, where the action happens. (Aumont 2004). The objects on the scene, costumes, camera´s position, everything in the producing process influences the mise-en-scène, as well as the color of these elements.

Through color, a great number of directors could convey valuable information. In Blue is the warmest color (directed by Abdellatif Kechiche in 2013), character Adèle (Adèle Exarchopoulos) is constantly surrounded by blue objects. The color blue in the movie is on her clothes, the objects in her room and everywhere she goes. Adèle falls in love with Emma (Léa Seydoux) who dyes her hair blue. The color is therefore associated with Adèle and her crush on Emma. Over time, infatuation wears off, thus the blue elements that surrounded Adèle disappear, making way for ever less saturated shades of blue (greyish). On the final scene there is Adèle in a blue dress, however surrounded by objects in shades of grey, confirming the end of their love.

Color will depend on the context, or sometimes, on a small variation in its chromaticity to acquire proper connotation. Small variables in a set of invariables build a cultural color repertory. (Guimarães 2001: 107)

Building a narrative in which color plays preponderant and proper role to meaning is a challenge. Some filmmakers stand out in this sphere, as is the case of Brazilian Alê Abreu and his animation produced in 2013 - The boy and the world. Throughout the work we are presented to black (greyish shades) versus saturated and impacting ones, showing the director´s sensitivity, who opposed the freedom and joy connotation represented by multicolored scenes, war and depression that follow it, represented by achromatic.

2.2 Color in movies looks

Not only during the filming process authors think about colors and their usage throughout the narrative. During the post-production process, more specifically during color correction, the filmmaker may change his work considerably. Nowadays the color correction process consists in modifying the scenes´ pixel colors. The first movie to use this technique was Brother, where art thou? (2000), shot in two locations with

very different weather conditions (North America´s south and center) Cuts between scenes did not make a good impression because of different colors, very common in places where the weather is dry and hot (to the south) and rainy and moist (center). In order to solve this problem digital techniques were used to transform the images of the country´s center region into images of dry and hot weather, removing the color green and shades of blue from the scenes, and adding shades of red and yellow to create a hot and dry appearance. This technique appeared initially to make all scenes uniform, but some authors began to use it to conduct the narrative, in which the movie´s looks may change according to location, mood or feeling conveyed by the characters, which makes it easier for the viewer to grasp the narrative. (Prince 2004)
Color correction isn't just about making every shot in your program match some objective model of color balance and exposure. Color and contrast, like sound, provide another level of dramatic control over your program when subtly mixed and adjusted.
With imaginative grading, you can control whether the image is rich and saturated, or muted and subdued. You can make shots warmer or cooler, extract detail from shadows or crush it, all with a few turns of a dial or trackball. Such alterations change the audience's perception of a scene, setting the mood. (Hurckman 2011:xi)
Consequently, the color correction process was highlighted not only for allowing control over each image point´s chromaticity, but also for using this control to make sense and produce new interpretations. In this context, Elza Capai´s work Here is so far (2013) is highlighted, for she uses saturation to translate the character´s feelings. The movie sheds light over women´s real life aches and pains in Africa, from north to south, resembling a documentary, and as the character is faced with the diverse social contexts of the continent, shades become less saturated.

3. CASES DISCUSSION

Both cases chosen for analysis – The boy and the world and Here is so far – are highlighted as they bring polarity and opposition among color concepts. There is no need to oppose a shade to another in order to produce na opposition of meanings. Opposing saturation levels on a same shade may contrast two concepts, thus generating a duality that was typical in the beginning of photography and movies, in which colors were opposed to black and white images. Another example of this duality in digital movies is in Pleasantville (1998), the first movie shot in colors, digitally faded. Directed by Gary Ross, the movies is about a boy who can get inside a TV show, where images are black and white, and outside, in the character´s reality, colored.

3.1 Color in The boy and the world

Ale Abreu´s work narrates the story of a boy who lives in the countryside and sees his father leave after opportunities in a big city. Running away from home to go after his father, the boy meets old and young versions of himself.
It is possible to see opposing achromatic values (black and grey) versus colored ones, hue value which are usually intense and saturated, throughout the work. The first ones remind us of militarism, fascism, war, raw force and popular control, whereas the colored ones make we think of carnival celebrations, music and partying. Black is therefore associated to melancholy and depression, whereas multicolored is associated with joy and enthusiasm. On the boy´s young and old versions' clothing, for example, we can observe that while the old man wears a black coat, showing his resignation and weariness in the face of control and raw force, which he endured, his young version, on the other hand, wears colorful clothes, showing and spreading happiness. (Fig. 1)

Figure 1: Frames from The Boy and the World

This animation is an example of how color, taking into consideration the culture in which it is inserted and in analogy to common knowledge values, by being added to scene elements, may create meanings and relevant and fundamental connotations to the movie´s narrative.

3.2 Color is Here is so far

In this movie, the documentarist travels around Africa asking women about their condition and the way they see themselves as members of those societies. Along her journey in Morocco, Mali, Ethiopia and South Africa, the filmmaker is faced with appalling situations, some of them humiliating to the eyes of western civilization: rapes, arranged weddings, the wearing of burkas and female genital mutilation.

The narrative´s saturation follows the character´s path and her view on African women´s situation, and consequently, her reflection concerning the situation of women around the globe. In the beginning of the movie, which coincides with the beginning of the character´s adventure in Africa, we may notice very saturated scenes, mainly the first interviews. As the characters moves forward in her discoveries and reflections, including the mention of an alleged daughter, the work´s saturation gradually fades into a very little saturated level. In the end, getting close to South Africa and noticing women´s struggle for better living conditions, the character´s hope comes up again, and the movie gains saturation, not as intense as in the beginning, which reveals the character´s awakening to what she has seen and the real possibilities of change in the near future. (Figure 2)

4. CONCLUSIONS

As observed in the studied cases, color may play an important role during the narrative of a movie. For this purpose, it is necessary to oppose two or more concepts through color parameters. The cases observed in this article bring ideas opposed by the saturation level: in the first case, scene elements, in the second one, the cinematographic image itself.

Color carries information and may be used creatively to convey concepts, ideas and sensations. Cinema is na art the allows a number of creative usages to color, and observing and analyzing them is a challenge for research on this field.

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(3) As conceptualized by Guimarães (2000)
(4) The movie can be seen for free on this link - https://vimeo.com/70961333

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Colours in Indian Context: the Tangible and Intangible Perspectives of Colours Pigments in Indian Painting

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ABSTRACT

Colour is an integral part of our deep-rooted Indian history, which is immensely strong in its cultures and traditions. This research aims to identify the colour pigments that were used for colorations in the Indian paintings and understand their tangible and intangible aspects, which leads to an understanding of how it has shaped colour associations within India.

The making of colour pigments is a process in itself. In the Vedic tradition the transformation of mineral stones and metals into pigment colour is seen as an inherently alchemical journey and is not only considered as a physical activity; but is also an intangible process of spiritual realization and hence it holds great importance. These colour pigments (tangible element) have been used on paintings, frescoes, crafts and hold symbolic meanings. Based on this, the colour pigments are described according to their use in the tradition of colour application for various purposes. It unveils their occurrence as alchemical materials and pigments derived from plants and other natural sources. There have also been certain influences on the procurement of colours from other countries and that has been looked into as one of the influential parameters for their use. The tradition of alchemical materials were used as ayurvedic medicines and later on passed to the tradition of paintings and frescoes. Performing arts (intangible element) are one of the most valued possessions of the Indian culture and according to the Natyashastra (Indian treatise on performing arts that dates back to 200 BCE and 200 CE) every Rasa (emotional response of the spectator) has a specific colour. This rasa is an emotional response in conjunction to the Bhava (expression conveyed by the artist). Since antiquity, the paintings of India have these influencing parameters, which are tangible and intangible in nature, which have been researched in this paper.

1. INTRODUCTION

Earth pigments have been widely used from ancient times till date and India has an important historical background for the use of ochres and clay pigments in arts.

There are a lot of colour theories that have been evolved with respect to colour pigments. In the Vedic tradition the transformation of mineral stones and metals into pigment colour is seen as an inherently alchemical journey. For the craftsmen the process of journey towards realizations is two-fold. Mineral rocks (base metals) transform into pigment colour and eventually into luminescent light.

"Alchemy is of great practical use; it teaches us to prepare precious metals, dyes and many other useful things in better and richer ways than they are brought forth in the Nature".

2. METHOD

Literature findings have confirmed that the colours used in antiquity were related to Rasas. This is in relation to the aesthetics and visual narratives, which are seen in the

(1) http://www.kfpe.ch/projects/succes-stories/electronic_appendix/cavallo.php
(2) Desomns, Peter Lazaro, Methods and Symbolism in the Picchvai painting tradition of Rajasthan, Mapin publishing, 2005, p.35
(3)ibid, p.32

Indian paintings where the colours have meanings. The research is done by studying the basic available colour pigments used in antiquity and relating them to the intangible aspects of Rasas and analyzed with respect to their occurrence.

3. COLOUR PIGMENTS AND RASAS: TANGIBLE AND INTANGIBLE COLOUR

3.1 Red pigment

The Vishnudharmottara suggests that a colour called Igur was used to delineate the image of fresco paintings in India, as it is one of the visually boldest colours after black. The Abhilasitartha –Cintamani also mentions sona, red from darada, which is an early name of Cinnabar.
In Ayurvedic traditions in the subcontinent, Mercury (red) and Sulphur (yellow) are attributed respectively to Shiva and Kali, the elemental male and female principles of the Hindu pantheon. With reference to painting, sublimated cinnabar crystals were ground into a brilliant red pigment, known in Europe as Vermilion and in Sanskrit as Hingaloo.
Lac was also used in the miniature paintings to outline the images in manuscripts. Geru (red ochre) is one of the most widely used colour in the paintings of Rajasthan.

3.1.1. Red pigment and Rudra Rasa in context:

Red is associated with Rudra Rasa where it means wind or storm, basically related to the storm god Marut. It depicts fury, the mightiest of the mighty, embodiment of wildness and danger.
It is a colour of battle for the Kshatriyas and also signifies purity. The Hindu god Shiva shares several features with the Rudra. Red is a very auspicious colour. Forty days after birth of the child, the mother takes her baby to ceremony known as Suraj Puja, in honor of the sun god.

3.2 Yellow Pigment:

The only surviving pigment in the 19th century, as later painters turned to chemically produced yellows such as chrome and lemon yellow. Ramraj is the most stable yellow pigments in the miniature paintings until the half of the 19th century. Initially used as a fresco pigment but later became a part of paper tradition. Harital (orpiment), Goguli (magnesium), Gamboge (resin from a tree), Peori (lead chromate), Kesar (saffron), Haldi (turmeric), Kussum (safflower) are all derivations of yellow colour pigments. These are the different yellow pigments that were made and used in the Indian paintings, either as pure colour or mixed with other colours to make new ones. 6

3.2.1 Yellow pigment and Adbhut Rasa in context:

Yellow is associated with Adbhut Rasa which depicts wonder and amazement. Yellow is the most vibrant and bright colour. The presiding deity for this particular Rasa is Brahma the god of creation. It is considered as the ultimate formless metaphysical reality and cosmic soul in Hinduism. Yellow is also associated with goddess Kali. It is observed that yellows and reds are the colours used in majority and its mixed hues

(4) ibid

are widely seen in the Indian paintings. Reds and yellows together are considered to be auspicious in the Hindu tradition as Haldi and Kumkum.

3.3 Blue pigment:

Blue is mentioned in the Silpartana as mulranga (primary colour) together with kajal (lamp black), soot and syama (dark blue or black). Vishnudharmottara mentions Neel (indigo) and Rajawarta (lapis lazuli) as colour substances. Popular colour pigment in Rajasthan and its preparation was prevalent in Mewar, Kherwa, Pali and Nagpur. The plant was grown on a large scale in the Mewar region of Akola Sanganer. The colour known as ultramarine blue was extracted from this semiprecious stone. Syama (Azurite) is a deep blue colour used in Ajanta. Azurite initially came to Rajasthan painting from the early Jain manuscript tradition, so craftsmen in India would have been familiar with its method of preparation and general use. Asmani (smalt), alchemical name cobalt oxide is introduced to India from Persia most probably via. The silk route Indian paintings, blues are seen in the frescoes of Rajasthan where blue is used in small amounts as accented colour.

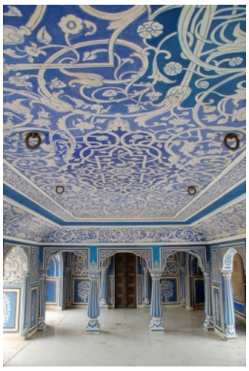

Fig. 2. Chandra Mahal in City Palace Jaipur painted in blue. (Source: https://www.pinterest.com/pin/114771490479863663/)

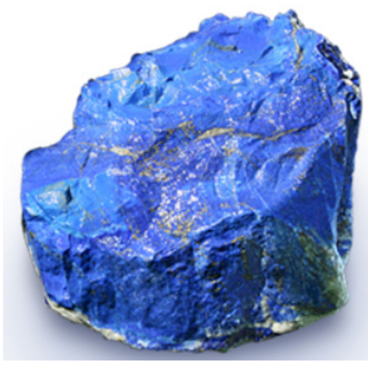

Fig. 3. Raw Lapis Lazuli (Source: http://www.gia.edu/lapis-lazuli#uncut)

3.3.1 Blue pigment and Bibhatsa Rasa in context:

Blue depicts Bibhatsa Rasa, which indicates disgust, and the preceding deity for this rasa is Shiva. Shiva is eternal and also has benevolent, fierce forms and depicted with the colour blue. Blue and grey colours are predominantly associated with fear. However, due to other foreign influences of the blue pigment, in the palaces of Rajasthan it is looked upon as a precious colour used mainly in the core precious interiors, where it is looked upon as iconic.

3.4 Green pigment:

Traditionally green is made by mixing the prime colours yellow and blue for this reason it is listed in the Sanskrit text as anaritas (secondary colour) green- brown a mixture of harital, orpiment, and kajjavala, lamp black.

Danafarang (malachite) seems to be brought to India from Persia along with azurite as the two are often found together in the same earth deposits. Zangal (verdigris) having the mineral copper acetate is an intense green blue colour unstable in damp conditions and tends to breakdown in cuprite and acetic acid. Harabhatta also known as fresco pigment its existence is found in many of the Rajasthan palaces in-

cluding the painted havelis of Shekhawati used alongside other colours.
Many craftsmen still know of this particular color Selu, but it has been rarely used after the turn of the century. Many greens were often made with Neel, harital, goguli and gamboge.

3.4.1 Green pigment and Sringara Rasa in context:

Sringara Rasa depicts beauty and is a metaphor for the relationship between the individual and the divine. Classical dancers refer to Sringara Rasa as the mother of all Rasas. Sringara gives scope for a myriad of other emotions including love, jealousy, fear, anger and compassion. Natyashastra lists Vishnu as the presiding deity of the Sringara rasa. Vishnu is the supreme god and one of the principal denominations of Hinduism.

3.5 White pigment:

The earliest textual reference to white pigments is found in the Abhilasithartha Cintamani, which describes the preparation form seep, mother of pearl and sankh which is conch shell ashes. The 16th century treatise Siplaratna mentions white as a primary colour.
Kharia (chalk white) is an earth mineral calcium carbonate also called as safed mithi, which is widely used in mandana paintings. It is a silent colour that has the ability to lay with many other altering shades. Safida Sisa (Lead white) with basic mineral of lead carbonate is difficult to determine when lead white was first used in India, although it has a long history of use in Persian and Western paintings. Kharia mitthi (gypsum), Chini –mitthi (Koalin), Shikhari (soapstone); Titanium white and flake white are other pigments of White.

Fig. Mandana paintings seen replicated on the City Palace Jaipur, in white and earth colours. (Source: Self-clicked)

3.5.1 White pigment and Hasya Rasa in context:

White is the colour associated with the Hasya rasa, which means laughter, mirth or humor. Hasya is associated with Sita (white) and Pramatha. White colour also depicts peace, purity and has the ability to accentuate all the other hues. It complements and enhances the beauty of the overall narration.

3.6 Black pigment:

Carbon has been used as a source of pigment since early times. The Silpartana actually describes the method of making kajjavala or lampblack. The Abhilasitartha – Cintamani also mentions lamp black for use as a black pigment. Jaina Chitra Kalpadrum describes various recipes for preparing kajjavla into ink for palm leaf and paper. Black has been used in the miniature paintings and symbolizes shoonya, which means nothingness.

3.6.1 Black and Bhayanaka Rasa in context:

Black refers to terror or Bhaya, which means scary or scared. Black is used in the paintings as one of the achromatic colour. Like white, black is another colour, which symbolizes nothingness. Black has been used in many paintings as an outline colour in small proportions for depth and bold features. It was also used in preparing tints, shades and tones of other hues as well.

4. CONCLUSIONS

The narration and depiction of stories is the representation of facts, as well as aesthetic elements. These along with the association to the Rasas (emotions) forms its inherent attributes, in the absence of which the stories would not convey the meanings. Both these factors add meaning and value and are inseparable from each other. Colours have these values and meanings individually as well as in correlation with each other. The Bhayanaka Rasa is negative emotion, which is an attribute of blue as well as black. This combination visually enhances the overall impact of fear. Similarly, white is for Hasya which when combined with subtle shades can create a self-explanatory story emoting joy. The Hasya Rasa is a happy emotion, which is related to bright and cheerful colours, and white has the capability to visually accentuate the other hues along with it. Even if the colour pigments are associated with the rasas, there are iconographic representations as motifs and patterns, which convey meanings along with the same. The research gives another dimension to further research the iconography, motifs and patterns in relation with the colours. It is a study that can be used by designers from various fields in practical applications. In these practical applications, the colour proportions will play a major role in creating the desired impact on the spectators or the users and needs to be dealt with sensitively. These colours can be combined together in combination with each other and for application in the contemporary context as per the desired results.

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An expression of three-color combination preference setting in reasons for preferences as intermediary variables

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ABSTRACT

An experiment was executed in which the subjects asked to judge the preference of the showed color combination samples and to select their reasons from the list prepared. Two analysis were executed using the obtained data: (1)To clarify the accuracy of the prediction using the data of which items recognized the reason can predict the preference, (2) the accuracy of predict formula that shows the condition the subjects recognize the reasons using three attributes of composit colors.
The correration coefficients between the preference values and the prediction values of preferences is very large, 0.97 shows the possibility of the method based on a new concept from analysis (1). The correlation between the preference average value and the prediction value calculated with the formula intend to express the condition more than six subjects recognize the reason using three attributes of the composit colors of samples became 0.74 on analysis (2). it shows the possibility of the method.

1. INTRODUCTION

Experimental studies of color harmony theories for two- or three-color combinations have had two common features. One is that they have used samples consisting of two or three equal areas close to each other. The other is that the estimation of preference or harmony ratings have consisted of two elements: the effects of the component color themselves and the effects of component color differences.
However, it is clear that products consisting of three colored areas rarely have equal areas, but rather, they often consist of a large background area and medium or small areas within it, as per a survey based on more than 700 photos of items around us. Moreover, the results of the ratings of three-color combinations using 40 obtained color combinations in the survey mentioned above showed much larger background color effects.
Three-color combinations of equal area and different area have no differences in the three attributes of the component colors and the differences among them. This suggests the need for a new formula containing new attributes such as area size or area position for estimating the color combination preferences of products and other things in our surroundings.
However, a number of experiments are necessary to clarify the effects of such attributes, as the effects might change depending on attributes such as size and position. Moreover, a new alternation of estimation formula would be needed to adjust new features to explain the preferences. Therefore, a new approach that is available to express the effects to the preference of sample features across various samples is desired to overcome this difficulty.

Figure 1: The items in the environment surrounding us

2. BASIC IDEA

The objective of this study is to assess a new estimation model of color combination preferences containing intermediary variables. Past studies have tried to clarify the relationship between preferences and attributes of color combinations directly; on the other hand, this model addresses three valuable layers: preferences, reasons, and physical attributes of objects.

Employing this evaluation model has two benefits.

The first point is expandability. For example, the sample number limitation for the rating experiment forces experimenters to choose colors from a few dozens of color sets. This results in color combination samples with medium to large color distances. Experiments using samples with few color differences might lead to different relationships between ratings and the attributes of component colors as compared to past studies. In such cases, formulas suggesting a direct relationship between preference and color attributes need to reassess the relationship. On the other hand, the suggested model only needs to add a new relationship by adding new words expressing new features to reasons or simply add a new relationship between reasons and attributes.

The second issue is ability to make a qualitative expression. To create a perfect estimation formula that adapts to a variety of situations remains highly difficult if the suggested model is employed. The preferred expression of reasons and the representative examples that express the features of them are likely an alternative solution that is valid for designers when considering a preferred color combination.

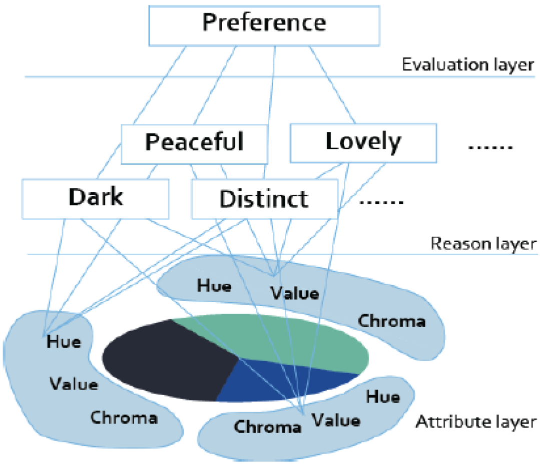

Figure 2: Three layers model

3. EXPERIMENT

Participants were presented with 120 color combination samples composed of small and medium areas in a large area placed on a gray background on an LCD monitor. Participants rated preferences of them using seven-point bipolar scales. Moreover, they selected several reasons for their preference from a prospective reason list consisting of 22 items selected from the reasons that three people mentioned when they rated the samples in a preliminary experiment. Participants indicated whether the reason had a positive or negative effect on evaluation by indicating + or - for the reasons on the form.

The color combinations are selected from each cluster as a result of cluster analysis of 720 items (book cover, writing material, things we use kitchen, furniture, bag, and so on) composed of three colored areas. The experiment included 22 participants who were young female students aged 18–22 years.

Figure 3: Examples of samples showed for the participants

4. RESULT

The average value of all cases indicated as the reason after separating + and - responses was calculated for each reason in the list. The differences between the values and the average of all ratings were set as the effect of reasons for a preference. The average ratings of each sample were estimated using a formula: total of ((number of participants who checked a reason) by (effect of each reason)) divided by the number of checks in each sample. The correlation coefficient between the results of this calculation and the average values of ratings was very large, R = 0.97. This suggests the new model's ability to estimate the preference of three-color combinations better than past studies.

In the next step, we tried to express the conditions for picking the prospective reason for each reason. The conditions by which each reason was picked by more than six participants were described using three attributes of the three colored areas.

Classification to two categories on number of participants who checked had a disadvantage in the accuracy of estimation. However, the correlation was still strong, R = 0.82, in calculating based on the assumption of perfect formula preparation. Following this result, we attempted to express the conditions using L*a*b* values of the three colored areas through trial and error.

Most of described conditions for each reason are plural. For example, the reason "Similar color combinations" has three conditions described as "Brownish," "Similar hue," and "Achromatic colors" using L*, a*, b* and L*, C*, h. The estimation of the expression consisted of 20 reasons and 59 condition descriptions of the reasons for picking reasons showed R = 0.74 with the average ratings. This is relatively higher level of explanatory power as a study by Ou et al. (2011), the most successful study in this field that showes R=0.682.

Table 1: Reason effects for the evaluation

The reason of the evaluation	1 Distinct	2 Dim	3 Containing remakable colors	4 Beautiful	5 Reflseshing	6 Tender	7 Composed	8 Colorific	9 Cheerless	10 Subdued	11 Lurid
Effect for the evaluation (+)	1.07	1.44	0.96	1.80	1.18	1.52	1.19	0.99	0.80	1.69	0.98
Effect for the evaluation (-)	-0.90	-0.59	-0.70	-1.31	-1.25		-0.38	-1.23	-0.31	-0.56	-1.22
Prediction formula (+)	○		○	○	○		○				
Prediction formula (-)	○	○	○							○	○
Selected frequency (+)	218	80	276	124	249	155	479	100	9	47	7
Selected frequency (-)	240	337	650	7	16	0	29	121	305	613	403

The reason of the evaluation	12 Similar color combination	13 united	14 Good color combination	15 Bad color composition	16 Disliking to the base color	17 Lovely color combination	18 Containing lovely colors	19 Bright	20 Dark	21 Hard	22 Approaching
Effect for the evaluation (+)	0.88	1.18	1.75	1.19		1.87	1.15	1.03	1.54	1.36	1.44
Effect for the evaluation (-)	-0.96	-0.66	-0.86	-0.96	-1.08	-1.35	-1.14	-1.03	-0.63	-0.78	-1.13
Prediction formula (+)	○	○	○			○	○				
Prediction formula (-)				○	△				○		○
Selected frequency (+)	214	539	436	4	0	213	357	184	27	6	4
Selected frequency (-)	49	45	9	1039	528	27	6	74	419	198	217

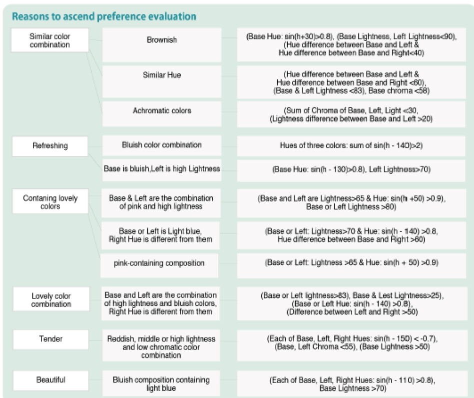

Figure 4: Examples of Preference estimation formula (Part of + marked reasons)

5. DISCUSSION

The ability to assess three-color combination preferences and simultaneously investigate the reasons as intermediary variables was verified. However, the correlation coefficient is still similar size as the past studies. To increase this correlation is an important subject for future work. Another area is the expansion of sample variety and number to clarify valid color composition areas.

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Colour, City and Visual Narrative

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ABSTRACT

During spontaneous courses and using the photographic image as an instrument of representation, the visual perception of a city can reveal itself gradually. Specific interests are then unfolded: the colour's atmosphere and its transitory nature in space, the movements and rhythms created by variations of light. How is this chromatic image formed? What are the meanings and symbologies behind it? How can they contribute to thinking the architecture and the city? Having these questions in mind, this paper aims to discuss a city's image based on four visual narratives, all of them guided by the colour aspect and built on the everyday life of four different places: Tokyo, Singapore, Morocco and Chicago. The main principles that guide this analysis are the theories of environmental perception, the concept of 'geography of colour' and the situationists writings on the 'dérive' and the 'psychogeography'. In a first stage, the free and spontaneous walks through various sites break the everyday visual perception. Photographic images are then taken and in a second stage organized according to their chromatic nuances. This allows us to identify certain recurrences and local singularities that defy the global and homogeneous image of the contemporary metropolis. It is the association between sensorial and spatial qualities, as well as aspects of environmental communication, that guide the creation of these four visual narratives. In the end, each of them is materialized in a small picture book that represents a chromatic synthesis of the analyzed sites.

1. INTRODUCTION

This topic has been accompanying me since the 1990's, when I developed my master thesis, Chromatic identity of the urban landscape (Mazzilli, 2001). At the time, aiming to trace a guideline for the "colour design", I was investigating how a city's chromatic image could be formed based on a set of perceptive indicators. My motivation was the will to overcome the overall difficulty in using colour in architectural design. Since the schools of architecture generally adopted modernist principles, the "rule" at the time was using white or raw materials. By choosing a central area of São Paulo (Bixiga's quartier), though, my research revealed a place full of colours and textures, where each individual used its own cultural an urban experience to create a unique image of the site. The basis for this research included theories of the environmental perception and the city's image (Cullen 1983, Lynch 1987, Rapoport 1978), the

(1) The psychologists Mirilia Bonnes Dobrowolny and Anna Paola Ercolani (Università Degli Studi La Sapienza) define the concept of "urban place" based on the group of stimulus that fall upon the inhabitants, whether they are of a physical or representative order, or refer to the activities developed in a certain environment (Mazzilli, in Del Rio, 2001: 169).
(2) Jean Philippe Lenclos (1992) has made a chromatic study of various areas in France in order to develop the concept of "geography of colour". According to this principle, the chromatic characteristics of a specific architecture depend on the environment in which it has been established, which include, for example, local materials, local climate conditions and local traditions.
(3)The researcher's perception has been registered with drawings and photographs, which were then chromatically organised in palettes according to the functional use of the site (residential, leisure, commercial or industrial areas) and the colour's components (hue, brightness and saturation). This originated a colour catalogue that was subsequently applied to the user research. The user's perception was registered through interviews and visual questionnaires based on levels of perception – quarters, streets, architecture and details – and its associated meanings. In the end, all the information was gathered in a "dictionary of colours".

concepts of “urban place ”, “geography of colour ” (Lenclos, 1982), considering both the researcher’s and the user’s perception .
The results showed that each area was identified as a unique image, with its own, specific colour. After all, this is what makes us distinguish (in terms of a mental image) a quartier from another, a residential area from a commercial area. The dominant characteristics of a microenvironment are what define it and guide the inhabitants to move both physically and mentally.
At the same time, this “general” view is not the only one responsible for the identification of an environment. There are also the references and relations established by the inhabitants: as they pass by streets and squares, getting close and away from various urban objects, they can visually feel textures and experiment sensations such as shrinkages and expansions. Some elements, when seen from a certain distance, can be instantly recognized mostly because of their colour, be it in terms of “volume” or in terms of saturation. As the colour is always associated with the light, it is only natural we perceive it this way.
The city’s chromatic image is also the main object of this paper, this time taking four study-trips as the basis for our analysis: Tokyo (December 2013), Singapore (December 2013), Morocco (January 2014) and Chicago (April 2014). Here, colour and form syntaxes combine theirselves with the complexity of different urban contexts, each with its particular set of cultural aspects. Skyscrapers, houses, market places, leisure and religious spaces, tradition and modern technologies all can live together in these cities.

2. READING AND ANALYSIS PROCESS

After mapping the referred areas, each one was experienced according to the dérive technique, which is based on free and spontaneous walks (Debord 1997, Jacques 2003, Careri 2009). An attentive and observant eye is essential here, as it unveils uncommon situations and promotes unexpected associations. The chosen media to register this experience was the photographic image, since “To photograph is to confer importance.” (Sontag 2004: 41). From the moment of the click to the choice of which image to use, many stages of the visual thought occur: the attentive eye looking for answers, the search for a specific point of view, the decision to crop a scene (imposing an order to it), the instant when the focus is set and the shutter is finally released (Shore 2014: 37).
Then, in a second moment, the produced images were selected and organized based on groups of recurrent aspects: space, colour and light; structure; unexpected sights; people and their everyday life; graphic signs. At this point, the identities and singularities emerged naturally, defining sequences both of chromatic analogies and of contrasting meanings. In Morocco, for example, the colours have a very strong bond with the natural local environment, as well as with the local culture and tradition. In Chicago, the first impression we have is of a strong contrast between the deep blue sky and the materiality imposed by the steel and the netted glass. Nevertheless, there are also many surprises awaiting the pedestrians, who eventually discover artistic interventions and unusual panoramas and points of view. As for Tokyo and Singapore, both of them have multiple identities; the colour is displayed almost everywhere: on people’s clothes, buildings, advertisements and urban furniture.

3. VISUAL NARRRATIVES

If the colour played an important role in the images’ composition (as a structural element), it was also a key element in the way the narratives were conceived afterwards. Thus, it was possible to associate environmental communication with sensorial, spa-

tial and meaning aspects, which were all materialized into four different series of images, each one edited as a small picture book.
The books have all the same size, but not the same bindings, as the intention was to individually integrate the narratives with the physical object. The covers synthesize each chromatic group in the form of a palette.

3.1 Morocco

Figure 1. Part of the Morocco series.

The colour of the Nature materials defines the essence of the visual space in Morocco, creating a unique atmosphere (Figure 2). We can see this in earth tones, blues, greens and grays that apply in textures and details of buildings, rich geometric patterns, clothes and fabrics dyed with natural pigments. The same goes for the relation between the Moroccans and their environment: be it in the desert or in the medinas, people share a strong bond with their surroundings. So, in order to build this narrative, a series of elements has been explored: the ryads' atmosphere, the everyday life in the marketplaces, streets, squares and in the desert, the burkas wore by women, their way of getting dressed, the arts and crafts, the graphic signs etc. It all comes together in an accordion bound book, where the narrative can be seen as a continuous sequence or page by page.

3.2 Chicago

Figure 2. Part of the Chicago series.

The first and general impression of Chicago is of a city built on neutral shades, rhythmic reflections and shiny surfaces (Figure 3). But when we go deeper inside it, navigating through its dense nets, we may surprise ourselves with green parks or with uncommon perspectives that put together the blue sky and the grey buildings. The public art makes its appearance as well, helping the pedestrians to create reference points and locate themselves in the city (Calder's red sculpture is a good example). We might even find ways to experiment a more ludic and oneiric universe.

3.3 Singapore

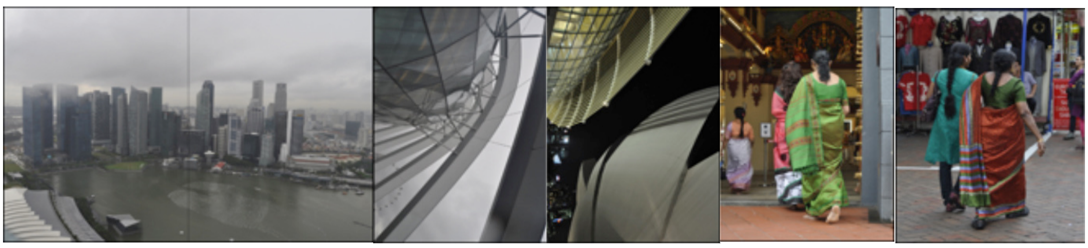

Figure 3. Part of the Singapore series.

At a first glance, we see Singapore surrounded by a fog that suggests a cold atmosphere. Beneath this fog, though, the city hides its cultural diversity. In this spectacle city, we can see Malay, Chinese, Indian and Arabic cultures all coexisting together, each manifesting itself in people's clothes, religious symbols and in the saturated colours of the urban signs. All our senses are instantly activated at these microenvironments. The cycle day-night is also a surprising element, as it reveals the colour both as emitted and reflected light, putting in evidence the architecture patterns.

3.4 Tokyo

Figure 4. Part of the Tokyo series.

Tokyo's narrative is built on a predominant yellow atmosphere, as it is frequently seen in mirror buildings, urban furniture, vehicles and flowers. At the same time, the various corporative identities inundate the urban landscape with colours and graphic signs; at night, when they are all illuminated, a new set of visual information appears in front of us. Combined with different layers of sounds and noises and the intense people traffic, the city's image is then complete. In this environment, the Japanese tradition and the modern space live side by side.

4. CONCLUSIONS

The photographic language has proven to be an efficient way to read the four locations. The process of selecting and (re)arranging the images in sequences also helped to refine the analysis and establish connections between the colour and the visual discourses. In each of these narratives, we can see a synthesis of each place's atmosphere based both on its material chromatic dominances and on its unique set of cultural and geographic singularities. In the Moroccan cities, the influence of natural elements on the country's identity is a particularly interesting topic, as it confirms Lenclos' (1982) theory on the "geography of colour". In a contrasting comparison, the three metropolises have a very modern chromatic appeal, showing off their huge metallic structures, shining surfaces, reflections and glass facades that create a scenographic environment. At the same time, due to their cultural differences, each one of them has its own singularities that define them as they are. This only states the importance of a quotidian experience in order to gauge the local colours and define the primary requisites for design.

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Computational Comparison of Urban Scenes and Realistic Paintings

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ABSTRACT

In our study we have compared statistical parameters obtained form the a set of images corresponding to urban scenes and compared it with images of paintings by Antonio Lopez and Edward Hopper, representing urban scenes. Antonio Lopez is a well-known Spanish painter classified as hyper-realistic style painter. We tried to determine whether the general characteristics of the paintings accurately respond or not to the scenes to reproduce. The statistical parameters studied were the moments of the first order, the color gamut , the patchiness an the signature of the power spectra of the images (FFT) (Oliva). Realistic painting reproduces most of the statistical characteristics of natural scenes, but it can be found small differences, such as the average chromaticity, which can be conditioned by the ambient light in which the paintings were made. It can be also seen some differences between Antonio Lopez and Edward Hopper in terms of lightness, color gamut and patchiness. We found that a realistic painter, such as Hopper, can be closer to real scenes than hyperrealistic painter, such as López, in terms of the computational analysis of the color paintings.

1. INTRODUCTION

In the last few years the interest in the computational analysis of artworks, especially paintings, has grown (Graham and Redies 2010, Montanger et al. 2016). Some attempts have been done in order to establish similarities between the real scenes and pictorial reproduction by calculating and comparing certain statistical parameters, such as power spectrum. It has also tried to establish whether the determination of a set of statistical parameters can be enough to make stylistic classifications or detect possible counterfeits of art. In this field the results are not conclusive. (Walraven et al 2009).

In our study we have chosen a set of images corresponding to urban scenes and compared it with images of paintings by Antonio Lopez and Edward Hopper, representing urban scenes. We have chosen Antonio Lopez for being a well-known painter classified as hyper-realistic style painter, to determine whether the general characteristics of his paintings accurately respond or not to the scenes to reproduce. Hopper was an author also dedicated to urban and indoor scenes, with realistic features but not listed as hyper-realistic. We tried to see if his paintings are similar to the scenes from the point of view of a computational analysis. For our study we used 13 digital images of urban scenes, a set of 8 images corresponding to pictures of Antonio Lopez and another set of 9 Hopper's paintings.

2. METHOD

The statistical parameters studied in the three sets of images were the moments of the first order (mean, contrast, skewness and kurtosis), the color gamut (number of colors, volume and area in color representation systems, Linhares et al. 2008), the patchiness (Yoonessi et al. 2008) and the signature of the power spectra of the images (FFT) (Torralba and Oliva 2003). All images were s RGB and analysis of these parameters was performed in the color representation systems CIELAB (L *, a *, b *) and CIE1931(x,y) chromaticity diagram. In figure 1 we show some examples of the images.

Figure 1: Examples of the images of paintings: Antonio López (left), Eduard Hopper (middle) and real urban scene (right).

3. RESULTS AND DISCUSSION

Table 1 shows some of the numerical results of our analysis referred to the CIE1931(x,y) and CIELAB color coordinates. All of them are average values of the different statistical parameters. Parameter Real scenes López paint. Hopper paint.

Parameter	Real scenes	López paint.	Hopper paint.
xmean	0.314	0.320	0.324
ymean	0.331	0.336	0.339
L*mean	74.6	81.7	73.4
a*mean	-0.5	0.1	0.3
b*mean	0.0	3.5	4.8
xcont	0.001	0.015	0.023
ycont	0.001	0.010	0.024
L*cont	0.028	0.033	0.046
a*cont	-1.117	0.462	-0.119
b*cont	0.479	1.526	1.474
xskewn.	1.100	1.025	-0.079
yskewn.	0.096	0.168	-0.250
L*skewn.	-0.135	-0.406	0.291
a*skewn.	-0.056	-0.078	0.568
b*skewn.	0.371	0.013	0.160
xkurtosis	27.7	22.1	15.1
ykurtosis	80.4	28.0	5.7
L*kurtosis	4.2	10.2	12.3

Table 1. Statistical parameters for real scenes and Lopez and Hopper paintings

Regarding the mean value of chromaticity coordinates, all fall in the achromatic region with a high similarity between the two sets of paints and slightly biased towards yellow zone values corresponding to the set of images of real scenes. In the case of L *, clearly, the values of the paintings of Antonio Lopez are higher than those of Hopper and the real scenes, which gives us an idea of the taste of this author for reproduction of scenes with high lightness.
The contrast of the images showed no differences between the three sets of images,

also theskewness. The values of this parameter are very close to zero, which gives us an idea of the
symmetry around the mean of the distribution of color in images. Kurtosis values are very high for all three data sets, which is consistent with findings by other authors recommend a logarithmic transformation to find next to the Gaussian distributions in these images (Grahahn and Redies 2010)
The color gamuts are similar in natural scenes and paintings by Hopper. In the case of paintings by Antonio López, despite his hyper-realistic technique, the total number of colors, according to the algorithm of Linhares et al. 2008, is smaller and the volume occupied by the color gamut in the color space or area on the chromaticity diagram. Figure 2 shows some examples of the color gamuts in paintings.

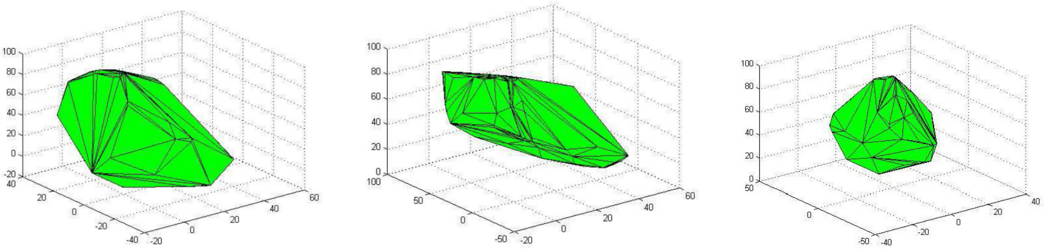

Figure 2: Color gamuts in CIELAB for the images of figure, same order.

Patchiness values, which indicate the uniformity of surfaces on images, is superior in the case of a* coordinate for Hopper's paintings. This implies some greater uniformity in the red-green variation.
Regarding the signature of the FFT images, there seems be small differences between the three data sets, but a deeper analysis should be needed to extract conclusions. Figure 3 shows some an example of the FFT signature for an image. In general, the signatures follow the characteristics shown by Torralba and Oliva 2003, for real scenes.

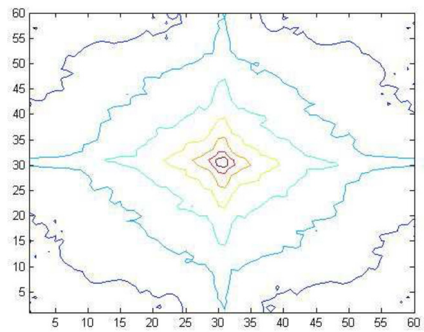

Figure 3: Example of FFT signature. B channel Hopper's image of figure 1.

4. CONCLUSIONS

We can conclude that realistic painting reproduces most of the statistical characteristics of natural scenes, but it can be found small differences, such as the average chromaticity, which can be conditioned by the ambient light in which the paintings were made or the features of the sky, especially in the scenes when there is much clear sky. It can be also seen some differences between Antonio Lopez and Edward Hopper in terms of lightness, color gamut and patchiness. We can conclude that the statistical parameters of the paintings for a hyperrealist painter, such as Antonio López, do not exactly match the parameters for the scenes to be reproduced. Other realistic painters, such as Eduard Hopper, with a greater freedom in the stroke, show statistical parameters even closer to real scenes than those hyperrealistic paintings.

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The Value of Colour Design Applications on Urban Campuses

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ABSTRACT

The intention of this research was to assess the social benefits of adding colourful environmental design elements to urban places, by asking the question: Do spatial and/or architectural applications of colour play a role in creating a vibrant urban space? The study concentrated on the influence of certain design elements— colour and coloured light (installations)— on the experiential quality of an urban environment. More specifically, it examined colour's involvement in shaping how citizens use, and ideally enjoy, a public place for social purposes.

This study took an in-depth look at the role of colour played in the experiences of those who visited the Image Arts Building on the campus of Ryerson University, located in the downtown core of Toronto, Ontario, Canada. Primary data was collected from 25 randomly-selected individuals on campus via intercept surveys, inspired by Hutchings and Luo's (2009) five types of design expectations. The findings showed that the majority of the participants enjoyed or regularly enjoy their time in or around the Image Arts Building —with a large percentage of those individuals citing the colour found in and around the space as a major reason.

1. INTRODUCTION

Colour affects us both physiologically and psychologically. "At every era of his existence and of his history, the human being has associated colour with his joys, his actions and his pleasures." (Léger, 1943: 94) The use of colour can make built environments appear to be more visually attractive, comfortable, or even meaningful. It can also do the contrary and, thus, shapes how we occupy (or don't occupy) space. Urban designers critically consider design, human behavior, and the interface of the two. Colour should be a larger component of the scrutiny. "The evidence-based knowledge, however, for making informed decisions regarding color application has been fragmented, sporadic, conflicting, anecdotal, and loosely tested." (Tofle, et al., 2004: 47) Exploring the advancement of colour use in urban landscapes is important to the field by helping designers identify and fully comprehend the different possible correlations between structure, space, and colour — and how these, in turn, affect their design expectations. Specifically, this research study investigated if the (strategic) use of colour can maximize a space's appeal, how often that space is frequented, and the number of social exchanges occurring within it. This was explored by looking at colourful design applications of Ryerson University's Image Arts Building (Figure 1), located in Toronto, Ontario, Canada.

2. METHOD

There are five types of design expectations for any space, scene, or object, according to Hutchings and Luo (2009): visually-assessed safety, visually-assessed identification, visually-assessed usefulness, visually-assessed pleasantness, and visually-assessed satisfaction. Their five types of expectations had a direct influence on the questions asked during the intercept surveys, which were carried out by stopping or approaching willing individuals in or outside of the Image Arts Building at Ryerson University, screening them for suitability (i.e., colour-sightedness), and conducting a brief interview in situ. These members of the Ryerson community — students, staff, faculty, stakeholders, etc. — were selected through random sampling. Although the participants were not representative of, say, Toronto's overall population, the opinions of those who are in proximity of the Image Arts Building is the vital characteristic to this study.

Figure 1: Image Arts Building, Ryerson University, Toronto

Interviews took place during daylight and nighttime hours. This was to allow for comparative analysis of the findings between the participants' experiences with the Image Arts Building when the coloured LED-light installation is off and when it is on, respectively.

3. RESULTS AND DISCUSSION

3.1. Data Collection

The intercept surveys were conducted four times over three days in February 2015: twice during daylight hours and twice during the night. Twenty-five individuals, 14 females and 11 males, of the Ryerson University community participated. Their ages were estimated and they were then sorted into two groups: those assumed to be under the age of 35 and those to be older than 35 years of age (Table 1). None of these participants reported to having X-linked colour-blindness.

Table 1: Summary of Statistical Information

Participants	*Gender* Female	*Gender* Male	*Age* < 35 years old*	*Age* > 35 years old*	TOTAL
Daytime (a.m.)	8	7	10	5	15
Nighttime (p.m.)	6	4	10	0	10
TOTAL	14	11	20	5	25

* Ages of participants are approximations assessed at time of interviewing

3.2.a. Findings: The Five Expectations

"The physical attributes of an [environmental] design directly contribute to our expectations of the space ... If spaces can be analyzed it will become possible to identify specific design elements critical to the achievement of optimal [user] expectations." (Hutchings and Luo, 2009: 2) I, along with others, feel that design professionals can be steered towards incorporating those particular design features that cause, or support the creation of, sought-after characteristics in public places.

Identification

All participants knew what this building is called with slight variations of its name:

“Image Arts (Building),” “School of Image Arts Building,” “Ryerson Image Centre (Building).” Again, 100% of them were also cognizant of what activities — academic and non-academic — goes on in and around the Image Arts Building. The participants also were able to specifically identify the space’s (design and/or visual) features and functions.

Safety

Majority of the participants felt safe in the spaces surrounding, just outside of, and within the Image Arts Building. There wasn’t much variation in the responses, including those between male and female participants. One female interviewed during the day, however, did state that her feelings about her perceived safety were time-dependent and that she took precautions when using this space (and all spaces on campus) at night. Two participants mentioned that the campus’ security office was located across the street, which added an increased sense of security, but stressed that their rankings of 5 (out of 5) would be the same even if the office was not nearby.

Usefulness

Most participants gave the Image Arts Building an average grade (of 2.5 or 3 out of 5), although many mentioned using this space often. Thus, there is a little discrepancy between how effective they find the space and the frequency with which they utilize it.

Pleasantness

Overall, most participants felt their involvement with the Image Arts Building and its surrounding space is generally pleasant. Five out of 5 was the most popular grade assigned. One participant expressed that his experiences were pleasant exclusively because of the social factor. The one ‘opposing’ individual that had gave this expectation the lowest score of a 3 shared their frustration that arises when the space is overcrowded, which, according to him, is quite regularly.

Satisfaction

This was perhaps the expectation that cause the most confusion (as I had anticipated). A few participants had difficulty differentiating between Usefulness and Satisfaction, without further clarification. As with Pleasantness, the majority of participants expressed being satisfied post-involvement with the Image Arts Building and its surrounding space.

3.2.b. Findings: Descriptions of the Image Arts Building

Attractiveness

Participants were asked about which aspects they find visually appealing about the Image Arts Building. The features that came up the most were “coloured lights (installation),” “colour scheme,” “glass/windows,” “(architectural) shape,” and “natural light.” While one participant detests the coloured lights that illuminate the campus, it was the feature mentioned most often by interviewees — regardless of whether they were asked at night or during the day (when the light installation is off).

Descriptors Other Than Attractiveness

When asked to describe the space, the most common adjectives or terms given by participants were “clean,” “open/uncluttered,” “minimalist,” “pedestrian,” and “artistic.” Time after time, participants gave descriptors of the physical space and structure of the Image Arts Building and its surrounding space. The few who discussed the unobstructed flow of pedestrians highlighted the width of the sidewalk (or the building’s setback) that allowed for easy movement in and around the space.

3.3. Discussion

The external colour found on — and even the internal colour found in (i.e., the furniture and planar surfaces that can be seen when indoors or outdoors via the large windows) — the Image Arts Building appears to influence how individuals use and characterize this space. The findings showed that the majority of the participants enjoyed or regularly enjoy being in or around the Image Arts Building. The average scores of all five design expectations were above the median value (of 2.5). The small number of participants who felt that their experiences were unpleasant or unsatisfactory gave reasons that did not pertain to the colour, appearance, or design of the Image Arts Building and its surrounding space. There were three major trends that emerged:

1. Regardless of time of day, participants felt safe in and around the Image Arts Building.
Colour has a bearing on the perceptions that visitors and citizens have towards the places they visit and reside in. "Colour and light in built spaces influence our experiences and feelings, our comfort and physiological well-being ... and can promote visual clarity, functionality, orientation and sense of security." (Klarén, et al., 2012: 40) This feeling of safety can be woven into our collective image and identity of colourful spaces. This could be partly due to the instinctive connection humans make between colourfulness and childlike characteristics (i.e., brightly-coloured places incite thoughts of harmlessness, not danger).

2. The display of colour added to the space's level of attractiveness.
When asked to describe the elements of the space that they found attractive, the words/terms mentioned most often include: "coloured lights," colour scheme," and "modern design." All (but one participant) said they found the colourful light installation on the Image Arts Building's façade to be attractive. This particular individual describes the building's exterior as "looking better before [the reconstruction]" and being "overdesigned." However, since only one participant had this opinion, this may suggest that similar applications throughout Toronto's urban landscape would be welcomed by many.

3. The Image Arts Building (and its surrounding space) is an inspiring place on campus.
"Deliberately designed experiences should be positive ... A better term for positive, [instead], may be 'worthwhile' or 'valuable.'" (Hassenzahl, 2010: 31) Colour can contribute greatly to this. Eight (just under 33% of) participants found visual inspiration in both the physical space and the people who occupy it. Since almost a third of them appreciate the Image Arts Building for its 'eye candy,' this could represent an important attribute of a communal, collaborative space. There is a certain degree of visual interest, creativity, and novelty that all humans crave and, according to some theorists, require.

3.4. Limitations of the Study

This study was undertaken with the awareness that it is difficult or impossible to isolate and exclude the other environmental elements (i.e., sound, smell, or temperature) from the way we construe — and, thus, experience — a space. Also, language (specifically adjectives or other descriptors) can be ambiguous in everyday conversations or in research studies and, as a result, can be limiting.

"Language expression, however, is very complex and may be influenced by the age and sex of the subjects, as well as their national and cultural background. Furthermore, it is very hard to assemble all possible adjectives expressing color emotion and it is difficult to consider new words with existing research results." (Wang and Ding, 2012: 469)

4. CONCLUSIONS

This research study sought to identify and raise awareness about any potential social rewards that colour can provide to a public place, so that city officials can successfully introduce more colour to more urban landscapes. Colour can and should be leveraged to animate, not just decorate, urban surfaces. "[A] space of enjoyment cannot consist of a building, an assembly of rooms ... Rather, it will be ... a genuine space, one of moments, encounters, friendships." (Hassenzahl, 2010: 152) A sizeable number of the study's participants chose to work/study/play in or outside of the Image Arts Building over other spaces on Ryerson's campus because they found it to be attractive, comfortable, and inspiring. While more research is necessary to develop associated design guidelines or planning policies, experimenting with additional uses of colour would still be beneficial in Toronto (and other cities) along various urban dimensions.

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Effects of Watercolor Illusion on Perceived Whiteness

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ABSTRACT

Watercolor illusion graphics were presented to observers by using a liquid-crystal color display, and the observers were to compare the perceived whiteness in the white region enclosed by the double contour line using the paired comparison method. Two colors (any two from red, yellow, green, and purplish blue) were combined for the double contour line of watercolor illusion graphics. When the relationship between the evaluation results of the perceived whiteness and col-orimetric characteristics of the contour lines of watercolor illusion graphics was analyzed, most ob-servers tended to evaluate the region enclosed by lighter contour lines to be whiter.

1. INTRODUCTION

The luminous reflectance improves if pulp or raw materials are bleached, whereas the reflectance in the short wavelength region relatively decreases, causing the materials to look yellowish. For this reason, a bluish dye or a fluorescent brightening agent is added to most types of printing paper and white clothing to enhance the perceived whiteness. The goal of the additives is not only to can-cel out the yellowishness but also to use the brightness enhancement effect of the bluish component in the additives (Katayama and Fairchild 2010). For example, when comparing the perceived whiteness of two whitish objects with the same level of luminous reflectance, where one has chro-maticity slightly biased toward the yellow hue compared to the chromaticity of the illuminant and the other has chromaticity slightly biased toward the blue hue compared to the chromaticity of the illuminant, the bluish white object is perceived to be whiter.

When drawing a wavy double contour line using two different colors on a piece of white paper, the color of the inner contour line appears to bleed through the region enclosed by the double contour line. For instance, a white region enclosed by a double contour line composed of an orange-colored inner line and a purple-colored outer line looks slightly orange-colored. This phenomenon is called watercolor illusion (Pinna, Brelstaff, and Spillmann 2001). The application of this phenomenon en-ables the perceived whiteness in the white region to be changed without chemical treatment — without adding a dye (Isawa, Iga, Katayama, and Suzuki 2015). This study evaluated how the col-orimetric characteristics of the double contour line composing watercolor illusion graphics influ-ence the perceived whiteness.

2. EXPERIMENTAL SET-UP AND METHOD

Watercolor illusion graphics were presented to observers by using a liquid-crystal color display (Eizo CG223W) adjusted to match the white points with the chromaticity of the standard illuminant D65, and the observers were to compare the perceived whiteness in the white region enclosed by the double contour line using the paired comparison method. The experiment was performed in a semi-dark room. The contour lines were composed of the following colors: red, yellow, green, and purplish blue. A total of 13 types of watercolor illusion graphics were presented, including 12 types where two of these colors were used for the inner and outer contour lines, respectively, and one type enclosed by a black contour line. Figure 1 shows an example of watercolor illusion graphics presented for the paired comparison. Figu-

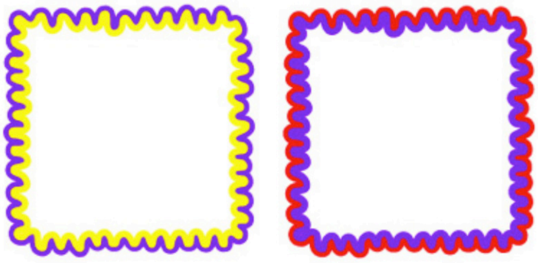

Figure 1 Example of watercolor illusion graphics presented for the paired comparison

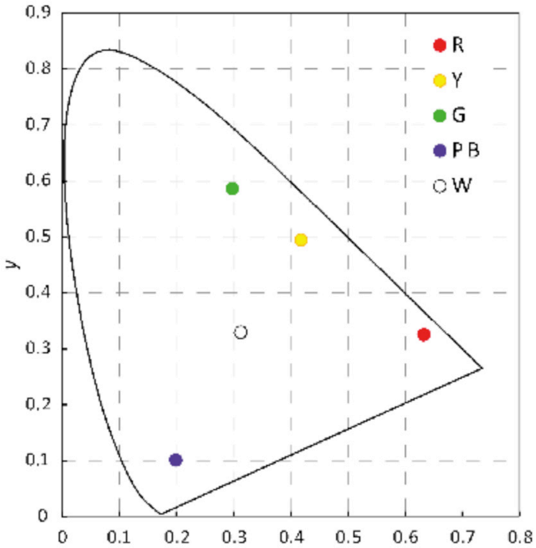

Figure 2 Distribution of the xy chromaticity of four colors composing the contour lines as well as of the white background

re 2 indicates the distribution of the xy chromaticity of four colors composing the contour lines as well as of the white background. Table 1 shows the xy chromaticity coordinates, luminance, and values in the Munsell system for each color composing the contour line. Chromaticity and luminance were measured using a luminance colorimeter (Kon-ica Minolta CS-100). The illusion graphic was a square of 50 mm on a side and the associated wavy contour line was drawn by hand. The width of the outer contour line was 1 mm and that of the inner contour line was 1.5 mm, with the illusion graphic apposed with a 6 mm interval, to be observed by an observer from 60 cm away by natural binocular vision. The visual angle of the illu-sion graphic was 4.8°×4.8° and that of the white background was 18.2°×24.3°. The luminance of the white background was 75 cd/m2.

After the observers have adapted to an achromatic background equivalent to N7 for 1 min, they selected the whiter illusion graphic out of all the 78 pairs of 13 types of watercolor illusion graphics. The above procedure was considered as one session, which was repeated twice. The presentation order of the stimuli was randomized. Although 56 observers with normal color vision participated in the experiment, the results from only 45 (mean age = 23 years; SD = 9.2 years; 16 males and 29 females) of them were analyzed; they were those whose evaluations in both sessions showed significant consistency and significant rank correlation between the two sessions. The remaining 11 observers were excluded from the analysis because the internal criterion upon evaluating the perceived whiteness was not considered as one-dimensional or the evaluation ability was considered insufficient.

Table 1 Chromaticity coordinates, luminance, and values in the Munsell system for each color composing the contour line

				Munsell notation		
	x	y	Y	H	V	C
R	0.633	0.325	13.8	7.5 R	5.0	19.4
Y	0.418	0.495	65.8	0.4 GY	9.5	5.7
G	0.299	0.586	46.1	9.9 GY	8.2	17.4
PB	0.199	0.101	8.5	9.7 PB	4.0	24.3

3. RESULTS AND DISCUSSION

The evaluation results of the perceived whiteness significantly varied among observers; therefore, the observers were categorized into four groups (A–D) with cluster analysis. The proportion of the observers in each of Groups A to D to the 47 observers was 38%, 42%, 11%, and 9%, respectively. The interval scale of the perceived whiteness was configured from the results of the paired compar-ison for each observer group. Figure 3 shows the results of arranging the graphics by the order of the perceived whiteness.

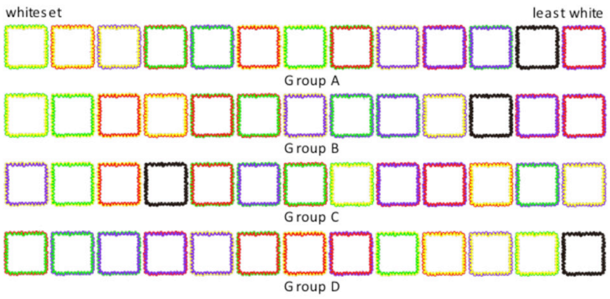

Figure 3 Results of arranging the graphics by the order of the perceived whiteness

The focus is on the lightness of the contour lines as well as on the brightness enhancement effect as the colorimetric characteristics of watercolor illusion graphics. Chromatic colors are perceived brighter than achromatic colors of the same lightness and have a higher level of equivalent light-ness. In this study, the difference between the equivalent lightness and the nominal lightness is de-fined as the brightness enhancement effect. The brightness enhancement effect changes depending on the chroma and hue of chromatic colors, while the quantitative estimation method has been clar-ified (Nayatani 2004). The brightness enhancement effect of the color composing the contour line is estimated using Formula (1):

<BEE> = Veq - V = -0.8660q(H)C + 0.0872KBrC, (1)

where <BEE> represents the estimated value of the brightness enhancement effect of a chromatic color; Veq represents the equivalent Munsell Value of the chromatic color; V and C represent the Munsell Value and Chroma of the color, respectively; q(H) is a function of hue H to represent the degree of contribution to the brightness enhancement effect; and KBr represents the adaptation coef-ficient. The adaptation coefficient KBr can be obtained using Formula (2) (Nayatani 1997):

KBr = 0.2717 (6.469 + 6.362La0.4495) / (6.469 + La0.4495), (2)

where La represents the adaptation luminance.

The estimated value of the brightness enhancement effect of a chromatic color obtained from For-mula (1) is expressed with the unit of the Munsell Value. Table 2 indicates the estimated values of the brightness enhancement effect for the colors composing the contour lines as well as the Munsell

Table 2 Estimated values of the brightness enhancement effect for the colors composing the contour lines as well as the Munsell Value and equivalent Munsell Value for the colors

	R	Y	G	PB
V	5.0	9.5	8.2	4.0
Veq	8.6	9.1	8.1	8.7
<BEE>	3.6	−0.4	−0.1	4.7

Value and equivalent Munsell Value for the colors composing the contour lines, obtained from Formulas (1) and (2), respectively. Purplish blue has the highest brightness enhancement effect in the four colors composing the contour lines and yellow has the lowest brightness enhancement ef-fect. Yellow has the highest Munsell Value in the four colors and purplish blue has the lowest Munsell Value, whereas all four colors have similar values for the equivalent Munsell Value (equivalent lightness) in consideration of the brightness enhancement effect.

The following results were obtained when the relationship between the colorimetric characteristics of watercolor illusion graphics and the perceived whiteness was analyzed with regard to each ob-server group. The evaluation results of Group A revealed a strong correlation ($r = 0.855$, $p < 0.01$) with the Munsell Value of the inner contour line. It means that the observers in Group A tended to highly evaluate the perceived whiteness in the enclosed region when the lightness of the inner con-tour line was higher. The evaluation results of Group B revealed a strong correlation ($r = 0.728$, $p < 0.01$) with the average of the respective Munsell Values of the inner and outer contour lines. Thus, the observers in Group B tended to highly evaluate the perceived whiteness in the enclosed region when the lightness of the contour line is higher regardless of whether it is inner or outer. The eval-uation results of Group C revealed a strong correlation ($r = 0.790$, $p < 0.01$) with the difference in the brightness enhancement effect between the inner and outer contour lines. For example, the ob-servers in Group C tended to highly evaluate the perceived whiteness in the enclosed region in the case that the color of the inner contour line has a high brightness enhancement effect (e.g., purplish blue) and the color of the outer contour line has a low brightness enhancement effect (e.g., yellow). Regarding the evaluation results for the observers in Group D, no definite relationship was ob-served for any colorimetric value.

Judging from the fact that the brightness enhancement effect of the blue component has been used as a method to improve the perceived whiteness of a white object, most observers were expected to fall under Group C; however, the relevant observers only comprised 11% of all observers as ex-plained in the above. Most observers tended to evaluate the region enclosed by lighter contour lines to be whiter.

4. CONCLUSIONS

Watercolor illusion graphics were presented to observers by using a liquid-crystal color display to compare the perceived whiteness in the white region enclosed by the double contour line using the paired comparison method. As a result, it was clarified that most ob-servers tended to evaluate the region enclosed by lighter contour lines to be whiter.

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Colour, Appearance of Landscape

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ABSTRACT

Colour is a vital element for human vision and affects life every moment. Colour research is a multidisciplinary work that combines physics, chemistry, physiology, psychology, art, etc. In the same way, landscape research consists of geography, biosphere, social culture, environment, architecture, ecology, aesthetics and philosophy, etc. For the research of landscape assessment, colour plays important role in evaluation of landscape aesthetic. Moreover, the theories of colour harmony, colour meaning, colour association, colour emotion are closely linked with landscape visual assessment.

1. Definition of Colour

The word of "colour" appeared in the West in AD 1225, which is recorded in Ancient French Dictionary and Ancient Latin dictionary1. In Chinese language context, these abundant expressions imply different emotions. In Chinese ancient times, the meaning of "/colour" is different from todays' significant. Preliminarily, it only denoted complexion. For example, Yufu, The Songs of Chu recorded which means complexion is haggard. Shuo Wen Jie Zi recorded that which means "complexion refers to between eyebrows and colour refers to complexion tinct".
In the field of colour science, one perspective held that colour is another factor of physical world. Another perspective held that colour is a perspective factor, but not independent existing physical quantity. Although British philosopher John Locke (1632-1704) is not the first person combined the two perspectives, he still distinctly analyzes the definition of colour. That is to say, the first layer of implications refers to the physical quantity of independent existing themselves. The second layer of implications denotes that colour is the perceptive results of the physical quantity of watchers2.
According to the definition of optics perspective, colour or hue means the visual effect through eyes, brain and living experience on light. In terms of the perspective of visual arts, the presentation of colour has three important properties, colour tone (colour hues), chroma (saturation, purity) and lightness. The description way of colour was created by American art educator, Albert H. Munsell (1858-1918) in 1898. It was the official colour describing system adopted as earth research by USDA (United States Department of Agriculture) and still remains the standard of colourimetric method. It can also be found in the exclusive words made by CIE (International Commission on Illumination)3. Hues refer to the external phases of colour, which means different colours sensed by eyes like red, yellow and blue, etc., shone under light of different wavelengths. Saturation refers to the purity and saturation degree of colour. Brightness refers to the lightness of colour. Different colours have different brightness. For example, yellow is higher than the brightness of blue. The colours at a same scene under different brightness can arouse different psychological feelings. If the sky has lower brightness than the ground, it would stimulate the feelings of depression.
Seeing from the definition of colour, a landscape scene can be considered as the same stimulation that from sensation to cognition of landscape to perception of it.

2. Colour Psychology

Psychologists found that colours not only have physical features, but also arouse human's emotional reflection, change acting behaviors and stimulate the features of special emotions4. The researchers found that, red will trigger down feelings easily than blue; red makes people feel stimulation and quickening of pulse jumping while blue makes people feel calmness5,6. Lawrence pointed out, colour can arouse different temperature feelings in humans. For example, red is hot; blue is cold, focusing on weighing sense. Dark colours stimulate heavy feelings. Bright colours show light sense, feelings of sound, as well as odor feelings, for example, freshness and decay7.
Different landscape elements form different colour presentation, such as the soil, sky, vegetation, flowers, water system, rock, buildings, marks and device in human landscape, etc. All these colour can arouse different psychological response in the human's recognition and emotional touch. It can be said that, the blue sky resembling peace and quietness and green vegetation implying health and environmental protection is the common sense of human beings. The landscape colours in different terrains formed by long-term development will necessarily produce different psychological feelings.

3. Colour Harmony

In the definition, researchers utilized attributives like "complete8", "supplementary/opposite9", "orderly10", "balanced11" and "explicit12". So far, the current colour academic circle defined colour harmony as "the satisfactory reflection acted by two or more colours13".
In fact, no matter what school of researches, it can be found that there is no indivisible relationship between the "harmony of colour" and "delightful psychology". Therefore, "people-orientation" is particularly important in landscape colouring and harmony research. Meanwhile, the harmony of colour is also affected by variant factors, such as shape, size, surface texture as well as the quantity of colours14. Therefore, the fixed features of all kinds of elements composed of landscape are also the basis of measuring "harmony".

4. Embodiment of Colour Psychology and Colour Harmony in Landscape

The word "landscape" appears in the Old Testament of Bible of Hebrew Text, which is used to describe the magnificent colour of imperial city of Solomon (Jerusalem)15. No matter seeing from the explanation of "landscape" word in AD 1600 "embodying natural scene portraying", or the explanation in 1886 on "landscape" as "the land possessing unique features"16. Its preliminary meaning is on the basis of the visual embodiment of aesthetic layer.
The first international convention focusing on landscape in the world, ELC, The European Landscape Convention, defined landscape as "an area sensed by the people, distinguishable from the features of other areas, the results of activities and interactions between human and nature". It can be seen that the humans' feelings are especially stressed in the Convention.
Explored from the perspective and landscape of Chinese culture, it is the landscapes, views and sceneries in traditional sense. In the poem of Drinking At Eastern Pavilion at Night by Song Zhiwen, it described that "Marvelous landscape in high gully and scenery and comforting my touring mind ". It embodies the landscape shows the human's psychological reaction and human philosophy notion. It has become the important basis of Chinese landscape notions. Through more deeply exploration, it

reflects the abundant "Interaction of Heaven and Man " sense of philosophy in the red notion. It can trace back to "Theory of Five Elements" of Chinese Colours in The Law of Yao, amazingly connecting colour, geographical locations with geographical elements17. The correspondence of colours and locations seemed to be common sense as early as the Confucius times (the 6th century BC)18. In the "Theory of Five Elements", red, white, black, yellow, green (black/green) correlate to each other, which respectively corresponds to four directions, four seasons, five elements, deities, stars, biological creatures and imperial activities. From this perspective, the environment, colour in Chinese culture and human philosophy are integrated together and correlate each other. It also reflects the unique features in Chinese culture.
East-Light green South-Red Center-Yellow West-White North-Black
The modern colour science classifies colours as warm hues (red, orange and yellow) according to humans' psychological feelings to colours, cold hues (light green and blue) and neutral hues (purple, green, black, white and grey). Japanese colour research expert, Shigenobu Kobayashi makes contributions by forming coordinate from cold, warm, soft and hard colours19 . Different colours can arouse different psychological response of watchers.

Cold colour	Warm colour
Indistinctive	Distinctive
Quiet	Joyful
Retreating sense	Forwarding sense
Sense of distance	Stimulating
Low dimension	High dimension

However, tracing back to the explanation of Oxford English Dictionary on cold colour and warm colour. It closely correlated to light in landscape. Warm colours correlate with light and sun-setting. The light ray of cold colour correlates with the grey sky. That is to say, the cold and warm of colour is illustrated as per Figure 1 against the rays of light of landscape.
Generally, cold colours are associated with waters, blue sky and forests, thus arising the feelings of quietness, coolness and relaxing. Warm colours are the representation of sunrays, flames and fruits, usually as individuals of visual stimulation. Thus it can make persons feel excitement, fervency and energy. While the cold and warm colours and feelings of advancing and retreating can be embodied in Fujiyama made by Katsushika Hokusai (Figure 2). The red Fujiyama looks moving forwardly in the figure, while blue Fujiyama looks moving backwardly.

Figure 1: Katsushika Hokusai (1760-1849), Thirty-six Sceneries in Fujiyama
The landscape produces different psychological feelings to human's colour image entirely

Japanese Colour Research Institute (NCD) experiences 40 times of ecological colour investigation during the two years period from 1944 to 1996. It implements four-seasonal colour research on Koishikawa Botanical Garden, University of Tokyo20. It also made analysis of investigating results of four-seasonal colour change of botanical garden in the colour-image coordinates of WARM COLD/SOFT HARD. The investigation also finds that, as for a same landscape, different seasons demonstrates different colours, producing different psychological association.

Figure 2: Implement four-seasonal colour research on Koishikawa Botanical Garden, University of Tokyo

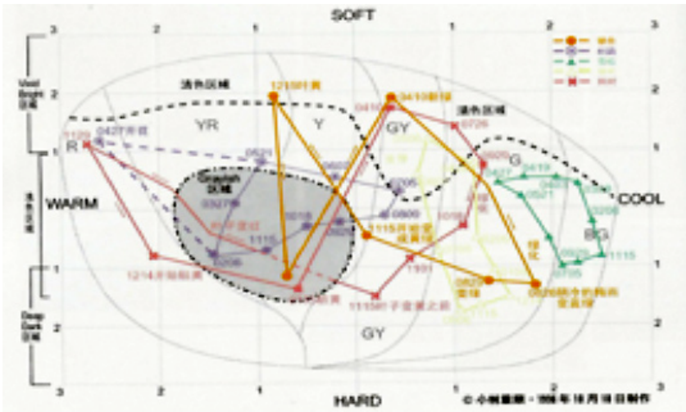

Figure 3: Four-seasonal colour change of botanical garden in the colour-image coordinates of WARM COLD/SOFT HARDNESS

As for a same landscape, different seasons demonstrates different colours, producing different psychological association. January 5, Tranquility, seriousness, strictness, April 5, Tranquility, peace, April 19, Pure calmness, rich spring atmosphere, May 21, Freedom, lightheartedness and freshness, June 21, Freedom and actively, August 12, Energetic, robustness, October 18, Clamness, elegance, November 29, Gorgeous, abundant, luxury.
Psychologically, from the colours presented in landscape of different seasons, it can be seen that green means freshness and spring atmosphere. The warm colour in autumn arouses gorgeous and abundant feelings.

5. Colour value in landscape visual quality evaluation
As for the comment on visual aesthetic value of landscape, it has been debated among philosophers, artists, designers, the environment management personnel and the policy makers. According to the subjective and objective methods on landscape visual aesthetic value comment, Lothian21 proposed an overall visual aesthetic value outlooks with the background of philosophy. Objectively speaking, the visual

quality of landscape is the reflection of its features. Subjectively speaking, it is the comment made by viewers. Experienced controversy over several centuries, subjective comment method holds the advantages of comment methods against the modern philosophy. Therefore, the visual comment of landscape denotes the psychological reaction, recognitive reaction and emotional reaction on the basis of different features22. Thus, there are still all kinds of conclusions on what landscape features can cause what kind of psychological perception. But undoubtedly, the viewers in the visual quality comment of landscape is a vital important factor.
For example, Britain issued a set of system called as LCA landscape features evaluation23. The subjective factors difficult to quantify of human perception and somatosensory shall be researched in the way of issuing questionnaires. They were completed in the way of relying on "Field Survey". The subjective description replaces the cold quantifying mode. For example, as for the colours of landscape, the questionnaire provides 4 kinds of choices, respectively as "monochrome", "muted" ,"colorful" and "garish". The personnel filling questionnaires ticks the corresponding items through their own subjective feelings.

6. CONCLUSIONS

Although colour is only a concerning point in landscape visual factors, both colour and landscape are the interdisciplinary research category. Meanwhile, both aspects possess abundant features by themselves and accept the perception and psychological judgment of viewers. Colour is the common language of humans, but passes different feelings in individual nationality group due to the difference of cultures. The colour feeling to landscape exist great difference upon combining complex emotion. As the appearance of landscape, colour transmits signals of all features of all landscapes, even indirectly expressing the internal information of historical progress, ecological transfer and environmental quality. Thus, exploring landscape colour and what psychological reaction it arouses in humans' mind as well as the manifestation of colour in landscape visual assessment is a long-term subject with social significance and humanistic value.

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Colorlight Compositions. Temporary Artwork for Wind Power Plants at Night

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ABSTRACT

The design of wind power plants is determined by the requirements for technic and energy. These buildings are placed in landscapes, often like ‘windparks’. Their aesthetic is fascinating – but only in daylight. But what’s about it at night? What does it mean for our perception, when only small red flashlights are blinking, seeming to soar into the dark sky? And when the rotor blades cut the air with an ominous sound. Our senses cannot feel these signs and register them with fear. We cannot find the reason for it, because we cannot identify the dimension of that new architecture sculptures with its moving and turning elements in various speeds. This observation has found my interest and I have created a temporary art-project, to react to this observation. I developed Colorlight Compositions, who are based on plenty different parameters. I developed a method to create them with the focus on our perception relating to influences of the weather, temperature and visibility from near and far. I realized this temporary project in several landscapes with 3 and more windmills in Northern Germany 2014/5.

1. INTRODUCTION

While watching buildings of the everyday architecture I am often concerned with phenomena meeting our senses unexpectedly. Sometimes I am very astonished, that there arose many new buildings, which give our senses no chance to react with all their possible sensibilities. I notice that, and sometimes I have the chance, to create a composition for color and light - and to realize it. My background to do this is my knowledge and experience from other art-projects about color and its effect on physis and psyche. That has been in hospitals, schools, art-projects in urban space, my own color-light-concerts etc. So I concentrated on windparks and single wind turbines, day and night. Especially these objects at night had found my interest and I started and realized an artwork for them. I created 8 different Colorlight Compositions, to allow individual units shining in changing light. The idea behind it, colors have a positive effect on people (and animals) at night. The dangerous feeling of dark towers, red-blinking lights and that very noisy situation can be better accepted, when a small ensemble of the power plants has another visual appearance.

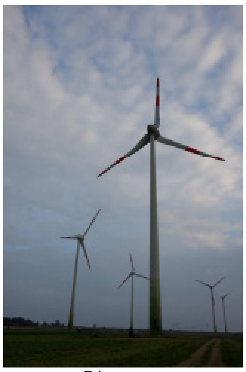

Photo 1
windpark at daylight

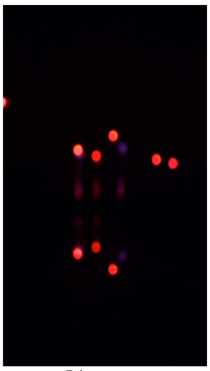

Photo 2
windpark at night

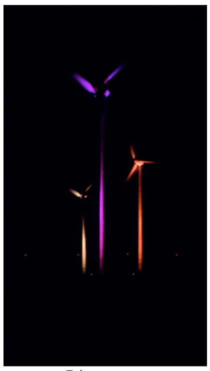

Photo 3
windpark in colornight

The statement of my compositions takes into consideration the influences of weather (which has an impact on our physical conditions), surfaces and design of the towers, distances of viewing, our perception of remaining color-periods (how long needs the pupil to adapt) and kind of color-change (hard step or fading). All these considerations are found on one tower or an ensemble of towers. These facts are the basis for the choice of the used colors and all their parameters and the possible light-quality.
The power plants are up to 150m high. The pale steel towers have a diameter of approximately 5m, the rotor blades a length as far as 50m. They are positioned in a sparsely populated region in Northern Germany, close to the North Sea.
The light of the highly efficient lamps reaches the altitude of 150m and was visible within a distance of 6-7 km (about 5 miles). Thus the towers are fully surrounded by light. In contrast, the rotor blades are only illuminated when they cut through the light beam.

2. METHOD

In the following I differentiate the method of creating Colorlight Compositions and how to use it in the windpark.

2.1 The content of Colorlight Composition

To create a Light-Composition I select 18 different hues of the same saturation. They form the basis of all instances of this project. Out of these hues many nuances and different intensities are defined. From the material of these ‚notes' I compose the contents, determined by ordered sequences of colors and intensities, tempi and color transitions (fading or hard changes).

Colorsystem- basics for Colorlight Compositions

100%	Brillux 'Scala'	NCS S-	RAL	Exel	Led Red %	Led Green %	Led Blue %
1. neutral							
1.1 gelb	9.24.126	0469 G95Y		gold	255	220	-
2.1 rotorange	12.21.15	0583 Y23R		orange	255	90	-
3.1 rot	30.24.24	2267 Y99R		rot	255	-	-
4.1 violett	45.18.27	4148 R55B		violett	255	-	130
5.1 blau	57.21.27	3651 R79B		blau	-	-	255
6.1 grün	78.18.24	3356 B91G		grün	-	255	-
2. + gelb							
1.2 gelb	03.21.14	0573 Y03R		hell-or	255	200	-
2.2 rotorange	15.21.15	0874 Y27R		braun	255	70	-
3.2 rot	27.24.24	1381 Y69R	3020	d'rot	255	25	-
4.2 violett	51.18.27	4344 R66B		indigo	255	-	80
5.2 blau	66.18.24	2862 R98B		d'blgrü	55	-	255
6.2 grün	75.21.24	3953 B67G		meergr	50	255	-
3. + grün							
1.3 gelb	90.18.12	0767 G69Y		gelb	170	255	-
2.3 rotorange	09.24.15	0781 Y15R		gebrau	255	120	-
3.3 rot	36.15.24	1768 R23B		rosa	255	-	25
4.3 violett	42.21.27	3750 R43B		lavend	255	-	190
5.3 blau	54.15.27	3753 R73B		d'blau	-	80	255
6.3 grün	81.18.21	2068 G06Y		grellgrü	-	255	50

Table 1. my chosen basic colors and examples for their definition

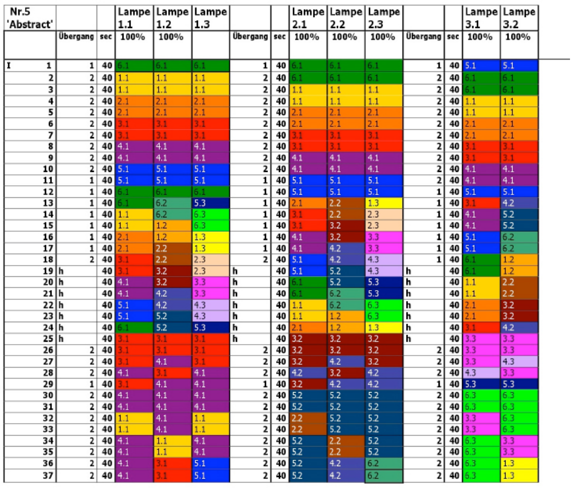

figure 1.
part of composition 'abstract' for 8 lamps

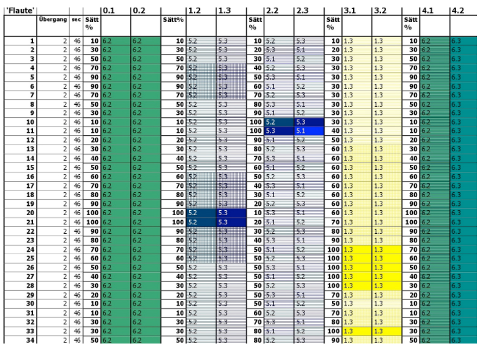

figure 2.
part of composition 'lull' for 10 lamps

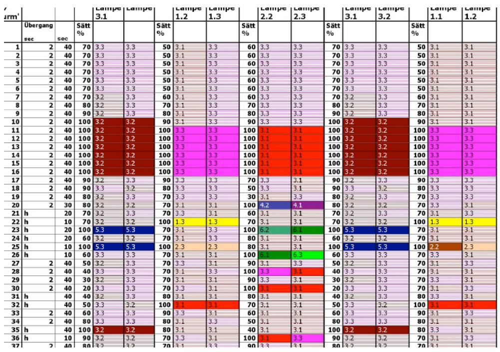

figure 3.
part of composition 'storm' for 10 lamps

There are 8 different compositions. Some of them have the same character as a stormy and rainy night, some others take care about the behavior of some kinds of birds, and others are related to a warm summer evening or to a moonlight-night. Another one is composed for insiders, observing it out of a protected place.
Each composition is based schematically in 3-4 parts. Each part has up to 48 steps with a uniquely defined time. Each of the 8 to 10 lamps has its own color-part, like a musical instrument in an orchestra - all are playing together.

Photo 4-7: example of an ensemble of illuminated wind power plants, watched from afar
here: moments of Colorlight Composition 'abstract'

There are many options to combine/differentiate the colors: Brightness, intensity, and various kinds of contrasts. The colors for a tower range from only one to plenty.

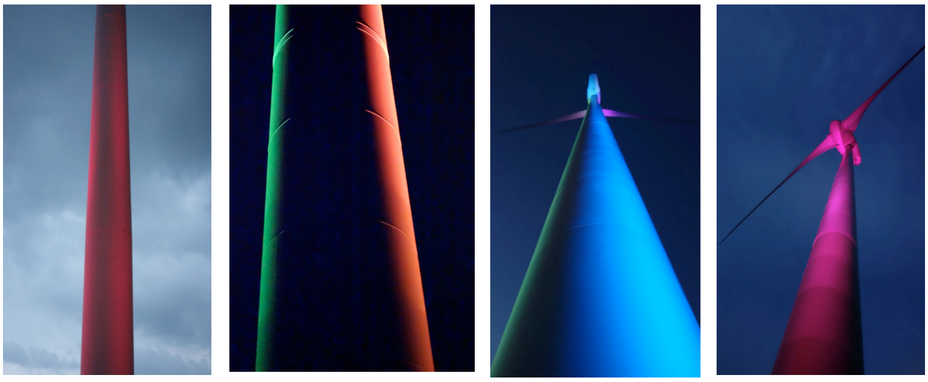

Photo 8-11: example of one illuminated tower of a wind power plant, watched from nearby

2.2 Colorlight Compositions, realized in windpark/landscape

The design of the composition is made ready for production by programming it digitally so that it is reproducible at any time. To realize that, I used a special electronic control system and qualified low energy lamps. Each tower gets its light from 2 or 3 lamps, placed around the ground. Sometimes the colors have to be adjusted depending on the surfaces of the towers, because they are made of different materials causing variable reflections. It was necessary for the whole project and my observation about the reactions, that these requirements had been met best and equal for all towers.

In some regions the illumination has been realized unexpected, without advertisement. It has been accepted very well from the public as a lovely part in their everyday life.

Observation from afar: The colors seem to breathe and wrap around the towers like a coat. Their interaction makes the ensemble to coalesce into a whole. The continually changing blaze of colors flowing into each other in swelling and subsiding colour intensities and blends cause associations to arise. The eye cannot escape from the rotational movement and the color changes. In this dynamic perception process time seems to dissolve.

Observation from near: Color is reflected by the tower and as a result of its proximity has a direct effect on the vegetative system. It tolerates all colors.

During sunset there had been only some special colors visible, which are possible to produce with that special high-efficient led-lamps.

Photo 12, 13: during sunset on a mild summer evening: Colorlight Composition 'abstract'

RESULT AND CONCLUSION

The idea for the basic-color concept has been confirmed in the realized project. From near and far all the colors itself and all the phases of their composition had been seen very well.
The varying contents of the Colorlight Compositions were relating to the climate. The realization has shown, that the attendee reacts to this phenomenon naturally. F.e. the composition ‘storm’: Red colors, hard steps, yellow/violet flashlights while it was rainy and stormy. People were minded adequately for that weather, to watch the illumination. The atmosphere, which the light spreaded, has been in harmony with their senses. If in such a moment bluegreen colors and fadings like in ‘lull’ would have appeared, people would have turned away soon. Because compositions like ‘lull’ being created for watching while relaxing outside on warm evenings need another condition of the senses to empathize than those like in ‘storm’.
The perception of the colors does also influence the perception of the sound of the rotor blades. While ‘storm’ has been illuminated, people properly expect the sharp sound of it - while at ‘lull’ the sound was accepted, sometimes unconscious. During the darkness of a night without illumination the sound always makes angry, because the eye can not recognize the source of the sound. This confirms the direct connection between our senses hearing and seeing in general.
This impressing light project at the profane architecture of the wind power plants in the midst of the region was well accepted by the residents and guests and enjoyed great popularity. At the same time it contributed to the further acceptance of the wind turbine technique.
Inspired of that light-art-project with its ‘breathing colors’ and all those details like described, the architecture of the wind power plants became something like colorful dreams at night for me. It turned out, that such dominating buildings in landscape and urban space need much more attention about their appearance, to be accepted. Our senses need a chance to value the dimension and locate the source during daytime and at night.
My project was an independent art-action, but it has illustrated, how directly color and light effect on our perception, physis and psyche.
°As a widening of my artwork I translate some of these visible Colorlight Compositions into sound. Each color corresponds to a tone, so that each composition reflects its own acoustic color.

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Creative Game

Bernardita LAGRÈZE, Cecilia VALENZUELA.

ABSTRACT

Children are always discovering and exploring whatever surrounds them, and when they play, they are also learning and expressing themselves. In their play they are experimenting freely.
¿So why not do it forever?
Art is vital in education and especially visual art for designers. Everybody knows that today we need good design in so many fields.
Our Creative Game seeks to increase creativity with a simple method in which we use some of the principles of visual language, color being its major element.
Playing is always fun and this game will challenge you not only to reach a goal, but to search in new ways for different solutions , improve your imagination, broaden your mind and enjoy the wonder of the process itself.

1. INTRODUCTION

Nowadays everybody wants to be creative and be able to innovate, be willing to accept new technologies and information, with flexible minds that allow us to react without fear, to be positive and proactive in solving problems and to achieve a happier life.
To be creative means you have to investigate and experiment, it means that you can "see" what others don't see and somehow, that you can feel all the freedom that is required to activate your own sources of inspiration.
It means that you have to use not only your whole brain, but also sometimes your whole body.
It is quite important to considerer that our brain has two styles of thinking. The right side is: nonverbal, perceptual, global, simultaneous, synthetic, intuitive, concrete, non-temporal and spatial. The left side is: verbal, syntactical, linear, sequential, analytic, logical, symbolic, temporal and digital.
Increasing the functions of the right side of the brain can make a difference in how you "see" and combined with the left side this can have an important and positive effect on creative endeavors.
Our experience studying the works of Josef Albers, Betty Edwards and Johannes Itten and coaching workshops in creativity, made us understand the importance today of visual literacy. We realized that we could design a series of color exercises in different and attractive ways, with the structure of a game, so as to increase the work of the right side of the brain, leading the participants into a special state of mind where the "flow" is essential to creativity. Even though Creative Game has certain rules to follow, the experience allows for the possibility of serendipity as a happy accident.

2. METHOD

We have already mentioned the importance of working today in art and how this applies generally to creativity. We must also mention that visual art requires a different pace and this is very important in the way we are living today. Computers and even electronic games pressure you to do things very fast.
"Kairos" is a Greek word for the opportune point of time at which something should be done; it is a concept of time based on the quality of an experience, not on the clock.
"Kairos" encourages us to activate the right side of the brain, giving us the chance to perceive, understand, observe, discover, examine, read and see among other charac-

teristics of vision. This enables us to experiment carefully and slowly, with no rush, in silence and avoiding verbal language introducing us in our inner world, where creativity is born.
The method is basically simple: each game includes a task, a route to follow and a goal to reach, plus some examples for inspiration. It can be played in solitaire or in group. The preference of using paper provides a comfortable way of working, with no hurry, seeking options, anticipating results, increasing the awareness of color and form and using glue when you are absolutely sure of the result. Some basic knowledge is needed especially in color and will be explained whenever required.
Our method has a variety of games that permit a lot of experimentation, where color is expected to enhance the composition, encouraging you to create original and attractive works. The same challenge played with different materials, including recycled ones, give way to a completely and different final result, where it will express our character, our feelings and our artistic sensibility in the best possible way.

2.1 Game with texture: in Sudoku style.

Working with textures has the benefit to be quite simple, and especially for young kids to experiment.
Task: color and texture.
Route: use Sudoku as a framework; with paper, crayons and a kitchen grater for texture, to obtain 4 different examples of color and texture to play in a grid of 16 squares.
Goal: color in attractive relations.

2.2 Game with organic shapes: inspired in Matisse.

Matisse was a great artist and a wonderful colorist. When he was old and sick he could not stop creating and started "painting with scissors".
Task: use Matisse's technique in a composition.
Route: draw organic shapes in different colored papers, cut them and arrange them in a special chosen background.
Goal: balance figure versus ground in color with different values.

2.3 Game with geometric shapes: in warm and cold colors.

Triangles are interesting to work and even more with color contrast.
Task: warm and cold colors interacting.
Route: In a grid of 16 squares, work with triangles in cold and warm color so as to achieve new shapes.
Goal: color balance.

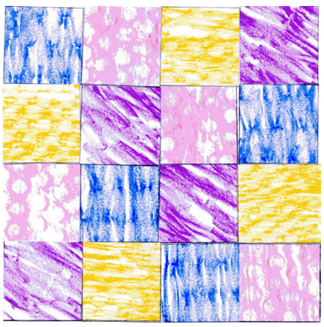
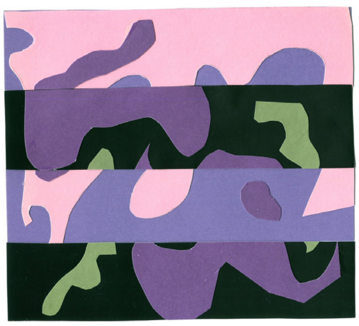
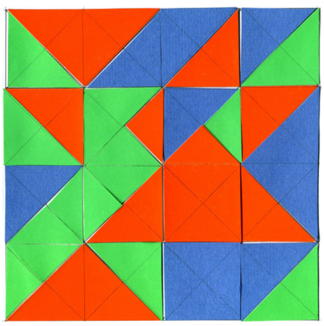

Figure 1: Games with texture. Figure 2: Games with organic shapes. Figure 3: Games with geometric shapes.

3. RESULTS AND DISCUSSION

3.1 Workshop in Casa de Acogida Emaús . Valparaíso, Chile.

Boys (age 10-13) with family problems, attended with Bernardita Lagrèze, once a week for one year in a 45- minute session. Each one received a set of prepared materials and where guided mainly in color and abstract compositions. Feeling safe, comfortable and motivated, once each task was finished, an evaluation took place in a very respectful way, teaching the boys to visualize and verbalize the concepts and characteristics of color and composition.
Mauricio Villegas, the psychologist in charge states:
"The group had the opportunity to experience color in an adequate form, where they had the chance to feel that they could be themselves and freely express creativity. This led to start expressing in a better way their inner world conflicts and emotions, discovering that they were capable to do many things in their lives, which led to improving self-esteem".

3.2 Workshop with Grandma in country house, Rapel Lake, Chile.

Children (age 10, 11 and 14) love to stay with their grandparents and have fun, especially in summer and long-weekends. This is also a chance to experience color and creativity with grandma.
As a first experience children are motivated to go outdoors to seek for textures in stones, gravel, leaves and tree trunks and transfer these materials with crayons onto paper. This ends in a composition as a task. Next step is indoors using geometric shapes, such as triangles, working with balance in positive and negative spaces.
Cecilia Valenzuela, author of Creative Game states:
"The younger girl and boy felt more comfortable in figurative compositions, though the elder boy created wonderful abstracts. It is important to point out that this family interaction, without school evaluation gives them the freedom and joy in creative activities".

3.3 Workshop in Fundación Trabajo para un hermano . Santiago. Chile.

Adults with small business attend with Bernardita Lagrèze, 2 weeks, 40 hours, learning how visual literacy can make a difference in how they work the design process, discover skills and achieve a new product.
Isabel Del Campo, general manager states:
"It has now been now 5 years since we realized the need for a method that would improve creativity. This has been a wonderful experience, where improving design led to a much better self-esteem, forgetting fears and inducing to a more proactive attitude for a new approach for business"

We are still designing and testing games that will ultimately end in a book. Considering that using color makes a great difference in exercises, some games are more attractive than others perhaps depending on the conditions of the task and age of the participants.

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(1) Casa de Acogida Emaús is a house where children stay in transition when social and psychological support is needed.
(2) Fundación Trabajo para un Hermano is a catholic foundation, working for more than 30 years in giving vulnerable people the chance to develop a worthy and sustainable work.

4. CONCLUSIONS

Creative Game gives us the chance to play, to develop visual literacy, creativity and intelligence, learning to appreciate the work of others and most of all stimulates us to “see” the world in a different way.

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The Appearance of Paintings under White LEDs with High Colour Rendering. Differences among occupations, age groups and paintings

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ABSTRACT

Recently white LEDs have been introduced in many museums and galleries. The spectral distribution of general white LEDs is within a visible region and does not emit UV, which will damage paintings. However, their effects on the appearance of paintings are yet to be fully known. In this paper we will report the effects of new White LEDs, whose long-wavelength red region is strengthened, on the appearance of oil and pastel paintings. Differences in the evaluation among occupations, such as curators, lighting designers and students, and age groups from 20s to 70s were also examined in this experiment. Results show that halogen lamps could be replaced with the high colour rendering white LEDs and there are some differences in evaluation among occupations and age groups

1. BACKGROUNDS AND PURPOSES

Recently white LEDs have been introduced in many museums and art galleries. One of the advantages of white LEDs is that its spectral distribution is within the visible range, and it does not emit UV rays and heat, which are harmful for paintings. The spectral distribution of white LEDs is completely different from conventional museum lightings such as halogen lamps, hence the effect on the appearance of artworks is yet to be fully known, and some museums are still hesitating to introduce LEDs. The results of our previous research2) indicated that halogen lamps had the tendency to get the higher evaluation than the white LEDs with lower colour rendering in oil painting evaluations, therefore the effects of white LEDs with high colour rendering were examined in this paper.
In that research the subjects were only university students aged around 20, whereas people of various ages and occupations participate in museum activities and it should be considered that there is a possibility that painting evaluation under some lighting conditions could not be exactly the same among them. The another purpose of this research is to examine the differences in evaluation among occupations, age groups and paintings.

2. WHITE LEDs IN MUSEUMS

The most prevailing type of white LEDs is stimulated by a blue LED chip, coated with yellow phosphor layers (expressed in this paper as Blue-Y-White LEDs). These LEDs have a strong sharp peak in the blue part of the spectrum and generally exhibit poor rendering of deep red colours, and general colour rendering index (Ra) is usually less than 90.
There are two types of White LEDs that have been developed to overcome the weakness of Blue-Y-White LEDs. One is white LEDs stimulated by a blue LED chip, coated with red and green phosphor layers, and the other is white LEDs stimulated by a purple LED chip coated with red, green, and blue phosphor layers. All of them exhibit smooth curves of spectral distribution and have high CRI Ra value more than 95.

3. EXPERIMENTAL METHODS

Four kinds of white LEDs were used in this experiment. [Blue-White LED] is phosphor-based white LEDs stimulated by blue LED chip, coated with red and green phosphor layers. Its correlated colour temperature (CCT) was 2950K and general colour rendering index (CRI: Ra) was 97. [Purple-White LEDs] is phosphor-based white LEDs stimulated by purple LED chip. Its correlated colour temperature was 2911K, Ra was more than 97, and the purple-peak was cut with a peak-cut filter for conservation of paintings. Another two types of Purple-White LEDs, red components of which were strengthened in order to get closer to spectral distribution of halogen lamps, were used in this study. [Purple-White LED + Red component - No.1] is phosphor-based white LEDs stimulated by purple LED, of which long-wavelength region was strengthened by adding the red LED chips (around 660nm). Its colour temperature was 2989K and Ra was 95. [Purple-White LED + Red component - No.2] is also phosphor-based white LEDs stimulated by purple LED, of which long-wavelength region was more strengthened. Its correlated colour temperature was 2900K and Ra was 97. The spectral distribution of [Blue-White LED] was very similar to [Purple-White LEDs]. [Halogen lamp] was used for comparison and its correlated colour temperature was 2998K and Ra was more than 99. Table 1 shows the test illuminant information, such as CRI and CQS, and almost all the special colour rendering indexes are high. Figure 1 shows the spectral distribution of each illuminant.

Table 1. Test illuminant information

	Tset illuminant				
	Blue-White LED	Purple-White LEDs	Purple-White LED + Red component - No.1	Purple-White LED + Red component - No.2	Halogen lamp
correlated colour temperature (K)	2950	2991	2989	2900	2998
Ra / Qa	97 / 98	97 / 97	95 / 95	97 / 97	99 / 99
R1 / Q1	97 / 99	96 / 97	97 / 98	98 / 98	98 / 99
R2 / Q2	100 / 97	98 / 100	96 / 96	99 / 99	99 / 99
R3 / Q3	96 / 96	96 / 99	88 / 98	97 / 97	100 / 100
R4 / Q4	96 / 98	96 / 97	96 / 96	98 / 97	99 / 99
R5 / Q5	98 / 98	97 / 98	94 / 93	98 / 98	98 / 100
R6 / Q6	98 / 98	96 / 98	90 / 98	97 / 97	99 / 100
R7 / Q7	99 / 99	99 / 95	97 / 92	98 / 96	99 / 100
R8 / Q8	97 / 98	99 / 98	97 / 96	97 / 97	97 / 99
R9 / Q9	96 / 99	98 / 99	99 / 96	92 / 96	92 / 99
R10 / Q10	99 / 98	99 / 95	85 / 91	95 / 94	98 / 99
R11 / Q11	92 / 97	95 / 94	92 / 90	97 / 93	100 / 100
R12 / Q12	87 / 99	92 / 98	76 / 95	89 / 98	97 / 100
R13 / Q13	98 / 96	96 / 98	97 / 95	99 / 98	98 / 98
R14 / Q14	97 / 98	96 / 100	92 / 98	98 / 99	100 / 99

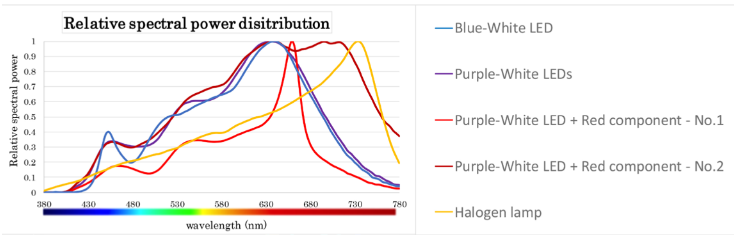

Figure 1: S.P.D of test illuminants.

The experiment was done at Museum of Fine Arts, Gifu, and an original oil painting and a pastel painting with different characteristics were used for this experiment. The names of these paintings are as follows; the left side of Oil Painting shown in Figure 2 is “Paravent d’Olivier Sainsère” and the right side of Oil Painting shown in Figure 2 is “Fleurs dans un vase blue” drawn by Odilon Redon. The subject’s viewpoint location of the oil painting was 1500mm distant from the painting and 1470mm height on the floor. The viewpoint of the pastel painting is 1150mm distant from the painting and 1470mm height. Surface illuminance of the oil painting was 150lx and 50lx for the pastel painting. The number of subjects was 40, aged between 21 and 71, and they were divided into 3 age groups; 21-29, 31-49, 51-71. Table 2 shows the number of subjects in each occupation and age group. Subjects evaluated the appearance of entire paintings and its details using 9-point bipolar scales, such as "colourfulness", "easy detail discrimination" and "preference" etc. There were three or more points for the evaluation of details, such as "Texture of flower", in each oil and pastel painting.

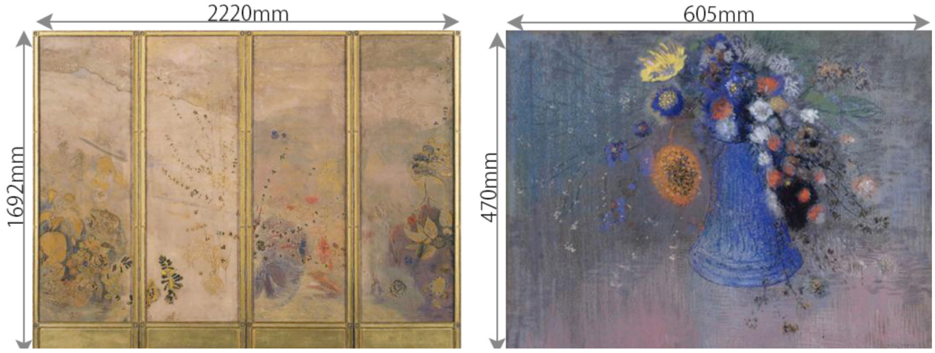

Figure 2: Oil Painting (left), Pastel Painting(right)

Table 2. The number of subject's occupations and age group

		Occupations						
		Curator	Lighting designer	Engineer in a lighting manufacturer	Museum staff	Volunteer staff in the museum	University student	Total
Age group	21-29				4		13	17
	31-49	1	1	1	5	1		9
	51-71					14		14

4. RESULTS

As to the oil painting, all the white LEDs, [Purple-White LEDs], [Purple-White LED + Red component - No.1], [Purple-White LED + Red component - No.2] and [Blue-White LED], got almost the same evaluation as [Halogen lamp]. The age group of 21-29 tended to evaluate [Halogen lamp] low compared with white LEDs. However, this tendency was not observed in other age groups. Figure 3 shows the results of oil painting in each age groups. A curator preferred [Purple-White LED + Red component - No.2], and an lighting designer preferred [Purple-White LEDs].

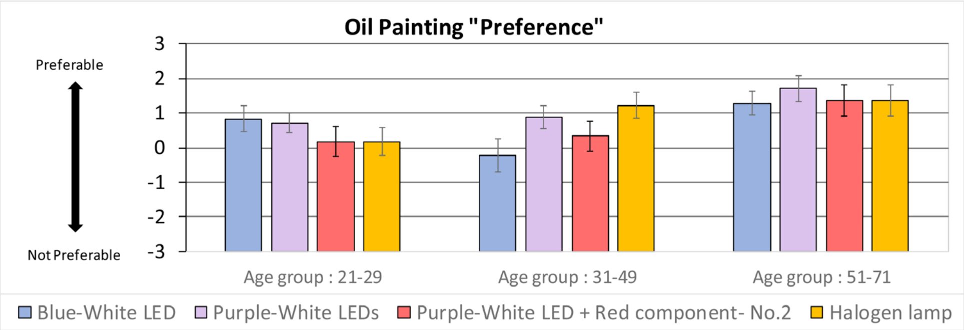

Figure 3: "Preference" of oil painting in 21-29(left), 31-49 (center), and 51-71(right)

As to the pastel painting, [Halogen lamp] got generally the higher evaluation than white LEDs, and there was a significant difference in "preferable" between [Purple-White LED + Red component - No.2] and [Halogen lamp]. In the age group of 21-29, there was the tendency that White LEDs got almost the same evaluation as [Halogen lamp], whereas the age group of 31-49 tends to evaluate [Halogen lamp] higher. Figure 4 shows the results of oil painting in each age groups. A curator preferred [Halogen lamp], and an lighting designer preferred [Blue-White LED].

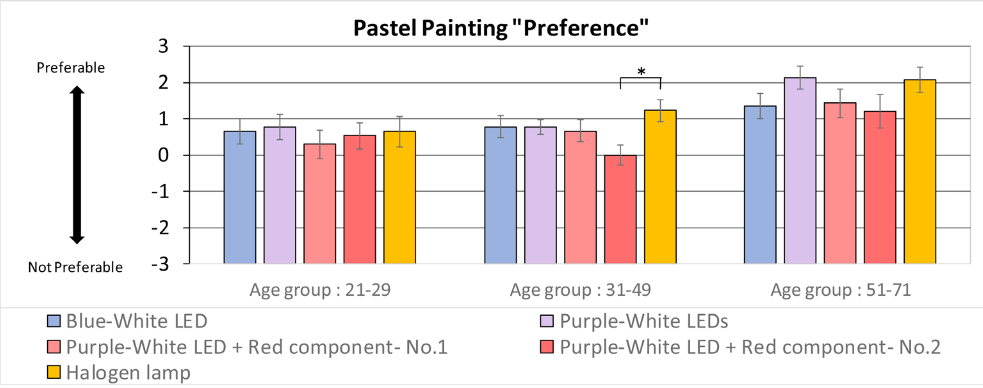

Figure 4: "Preference" of pastel painting in 21-29(left), 31-49 (center), and 51-71(right)

5. CONCLUSIONS

The results are as follows; 1. The halogen lamp can be replaced basically by white LEDs with high colour renderings. However, the white LEDs strengthened in long-wavelength region showed no specific effect on the painting appearances. 2. There were no identical tendency among museum lighting specialists, such as curators and lighting designers. 3. There were some differences in evaluation among age groups, however, the cause is not clear because subject's occupations and age groups factors are not mutually independent from each other. Further experiments will be necessary as to the difference between white LEDs stimulated by purple LED and blue LED with higher colour temperature.

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Spectral and Polarized Environment Imaging

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ABSTRACT

Realistic 3D image synthesis of urban materials, such as glass, metal, stone, concrete, wood, and so on, are at the core of numerous fields of research and development, notably for the correct predictive rendering of architectural spaces and building simulations. The main focus of this paper is to investigate the use of spectral data and light polarization states for the purposes of photorealistic predictive image calculations of both natural and artificial environments. More than merely rendering photorealistic 3D scenes, predictive rendering makes it possible to accurately compute the radiative (heat) and illumination properties of a future building, or of any digitally created object. After a short overview of analytical skylight models, we outline a polarization calculation process based on scientific data and models, and then present the device we developed to measure spectral and polarized environments, the SPLIS (Spectral Polarized Light Image Sensor). A complementary device, developed concurrently, is also presented. Though the SpectroSun takes fewer samples of the skydome, it takes more samples from the visible spectrum and can therefore be used for the calibration of the SPLIS. Attending the AIC conference in Chile will allow us to use these devices to take measurements in both urban atmospheres (polluted) and atmospheres at different altitudes (very pure conditions).

1. INTRODUCTION

Real-world light probes using reflection mapping were introduced to computer graphics in the early 1980's. This can be seen as the origin of Image Based Lighting (IBL). Subsequently, numerous devices were designed to capture real-world light, from reflective domes and spheres to panoramic cameras. As panoramic images produced by such devices and tools are usually rendered in RGB mode, the lighting input data used in the rendering process inevitably implies trichromatic results. These digital pictures, generally based on image acquisition with a fish-eye digital camera, can achieve extremely high spatial resolutions due to the capabilities of modern cameras; the resulting hemispheric digital images are called "environment maps." In many situations the combined images of a pure 3D object and an environment map is sufficient (movies, TV ads, packaging, etc.). However, when the calculations are done in spectral mode for scientific applications or industrial projects requiring physical and scientific accuracy, the acquisition devices for producing RGB environment maps are not reliable enough. Our research covers the entire calculation and computation process of physically based rendering. Several software (as PBRT, Ocean, etc.) make use of physically based spectral rendering to produce images based on "true physical properties". But, software that only support RGB environment maps have to manage input in trichromatic mode while producing spectral output. This implies converting RGB values to spectral values based on empirical assumptions.

(1) http://www.pauldebevec.com/ReflectionMapping/

2. LIGHTING ENVIRONMENT MODELS

By using non-spectral or incomplete spectral input, the rendering process arbitrarily converts environment map RGB values to spectral values, a mathematically consistent if not physically accurate solution causing typical problems of metamerism. To render accurate physical images, spectral environment maps are an absolute necessity. Preetham's and other such sky models (Kider et al. 2014) are all non-spectral, excepting the Hosek model (Hosek et al. 2012), which includes turbidity for a homogeneous distribution of particles. Disort software (Discrete Ordinate Radiative Transfer Solver) (Stamnes et al. 2000) used in our research (Figure 1) is a spectral-based software validated by the climatology researcher community. Though it does not take into account polarization state, this latter produces radiometrically-correct results and it can be enhanced to include theoretical polarization states of natural lighting environments. This makes it possible to obtain a new image that can be compared to highly-accurate MYSTIC simulations of sky light distribution, including light polarization states, though the calculation time of such simulations, even with a recent PC, is relatively slow (several days for 380-780 nm by 20 nm steps for a full skydome of a given date and place).

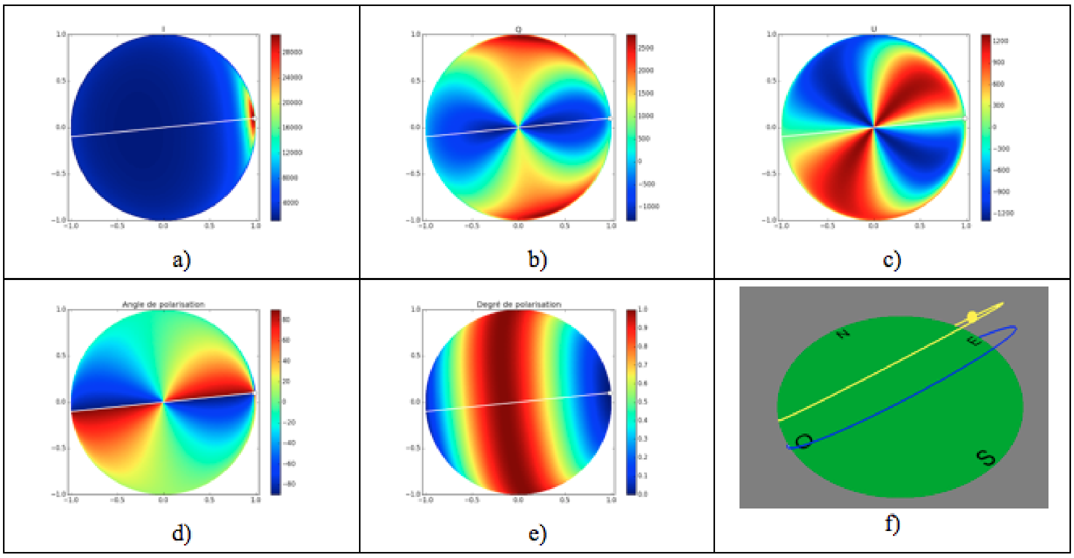


Figure 1. A theoretical representation of scattering parameters for Rayleigh and Mie scattering theories obtained with Disort sotfware, for a given date (25th August 2015 08:00) and place (Paris), for a single wavelength of 540 nm. a) Radiance map b) Stokes Q component c) Stokes U component d) Linear Polarization angle e) Degree of Polarization

Using computable sky models requires comparing theoretical data to real sky physical measurements taken in several locations and in different conditions. To guarantee accurate predictive rendering, we chose to focus solely on spectral and polarized environment simulation.

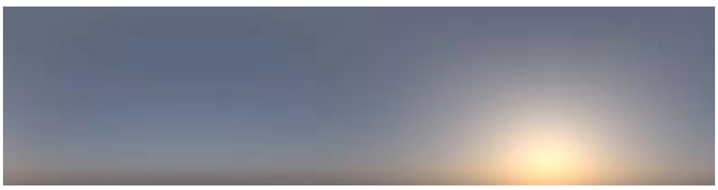
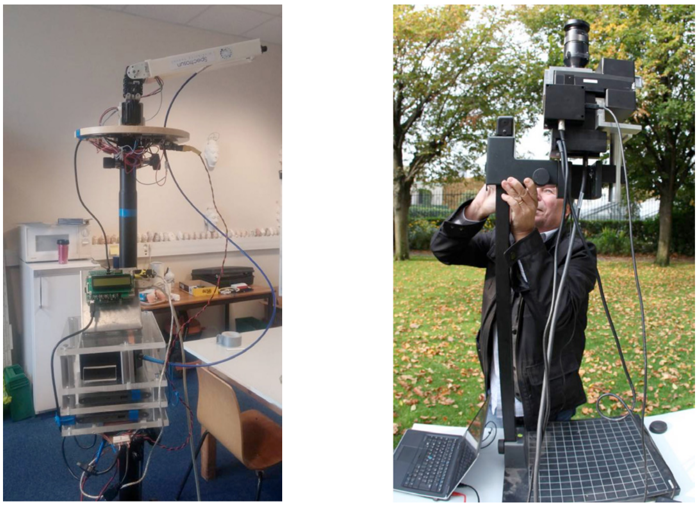


Figure 2. A Disort simulation of the sky according to Rayleigh and Mie scattering theories. Clouds are not taken into consideration in this model. Image of the theoretical sky for the same date and place as in Figure 1, converted from 21 spectral bands to sRGB.

3. A NEW SPECTRAL DEVICE

Producing synthetic images that are physically and perceptually accurate when compared to a digitally calibrated photography of a real scene or object is not a mere scientific challenge; a wide range of practical applications exists in fields such as the automotive, building, cultural heritage, paint, and glass industries, among others. Natural skylight produces a polarized distribution of light that illuminates the environment according to solar position. In urban environments, a number of different materials impact lighting conditions through direct or indirect object illumination, multiple reflections (large vitreous surfaces), metallic materials, car paints, etc. The polarization of light is not neutral in these interactions. Due to the lack of spectral and polarized input available for purposes of predictive rendering, we decided to design a new device to measure spectral and polarized skylight, the Spectral Polarized Light Image Sensor (SPLIS) (Figure 3).
As it captures the spectral and polarization properties of all incident light at the place of acquisition, this new device is also useful for controlling air quality. The acquisition time for producing an environment map, in both spectral and polarized modes, is approximately 2 minutes. The SPLIS records images sampled using a set of16 spectral filters and 4 polarization filters. It can also be activated in HDR mode, which entails a longer acquisition time. At the same time, we designed another device, the Spectro Sun, useful for the calibration process.



a) b)

Figure 3. a) The SpectroSun complementary device used for the calibration of the SPLIS. b) The SPLIS (Spectral and Polarized Light imaging Sensor) device.

This second device consists of a motorized optical fiber equipped with a tiny lens (2° field of view). The optical signal is transmitted to a spectrophotometer whose spectral band is [200; 1100] nm, with a resolution of less than 1 nm. Motorization allows us to scan the skydome with a relatively sparse sampling density: 81 directions. It is such targeted spectral data sampling that makes it possible to keep the measuring time under 2 minutes. In very calm environments, or static scenes, the two devices can match their data to obtain both high spectral and high spatial resolutions. Together the SPLIS and the SpectroSun can generate environment maps of 2000 x 2000 px2 with a high level of spectral acquisition accuracy. Such data provide physically accurate input for truly predictive rendering. These devices can also be combined to study atmospheric air evolution.

4. RESULTS AND DISCUSSION

Though still in the development phase, the SPLIS and its auxiliary calibration device, the SpectroSun can produce full spectral and polarized images of natural environments that are useful for integrating virtual objects in perceptually and physically accurate renderings. A spectral rendering engine using polarized light was specifically developed to be able to utilize spectral and polarized lighting environments. The possible use of spectral and polarized skylight measurement data for the detection of atmospheric pollutants is another promising direction of research (Emde et al. 2010).

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Study on Japanese Skin Color Chart of Injured or Sick Persons According to Age and Gender

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ABSTRACT

This paper indicated artificial procedure of the injured or sick skin color, which was the most prominent symptom in shock with the distal ischemia portion of healthy subjects. By using collected spectral reflectance of skin color, the Three Skin States' Color Charts (healthy, ischemia-shocked, and reperfusion-congested skin states) for four kinds of Japanese groups (young male, young female, elderly male and elderly female) were proposed.

1. INTRODUCTION

We have many disasters occur in Japan every year. It is widely known that response time for saving injured persons alive is within 72 hours, so rescue and medical teams operate whole day through midnight. Limited light source makes rescuers observe situations significantly more difficult, especially nighttime and confined space.
Recent LED technology can support rescue works, but some medical relief workers warn LED lights make it difficult to observe injured person's skin color, as LED has distinct spectral distribution from incandescent or florescent lamps. Our research aims to extract problems of lighting and visual environment for relief works and to create more effective equipment and tools at the disaster areas.
In preceding research projects, we carried out the questionnaire survey on visual problems experienced by disaster relief workers. Many rescuers and medical staffs answered that major problems of personal lighting equipment were the lack of luminous flux, narrow range of irradiation, and bad color rendering (Akizuki 2011). These results revealed that the relief workers were well aware of those serious visual/lighting problems as they were on the front line of disaster relief efforts. At the relief efforts in confined spaces after earthquake disaster, it is important to diagnose injured persons as a case of crush syndrome or not, based on their skin color. In order to develop suitable lighting equipment for disaster relief works, we should determine the color information of skin under various health conditions such as shocked or congested state.
This paper reports the skin color information such as spectral reflectance of artificially produced shocked/congested state of healthy young/elderly subjects. Moreover, by using this skin color data, four kinds of skin color charts of differing age and gender are shown in this paper.

2. EXPERIMENT

The skin color of the critical patient in shock changes over time widely. Therefore, we artificially produced the injured skin color, which was the most prominent symptom in shock with the distal ischemia portion of healthy subjects.

2.1 Subject

Subjects were selected from Japanese students in University of Toyama: 22 young female with an average age of 22.0±4.4 years old (y/o), and 15 young male (20.7±2.7 y/o). Moreover, the members who were registered in the Toyama Silver Human Resources Center were recruited as these experimental subjects: 15 elderly female (69.3±2.8 y/o) and 15 elderly male (71.7±2.6 y/o). They were measured their blood pressure (by M-7080IT, Omron), heart race and the percentage saturation of oxygen (by N-560, Nellcor) to check for their health conditions before experiments. All subjects wore a thin shirt with long sleeves in the experiments.

2.2 Experimental Method

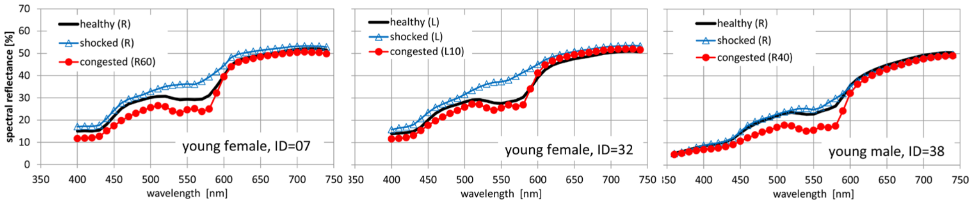
We artificially produced the injured or sick skin color, which was the most prominent symptom in shock with the distal ischemia portion of healthy subjects.
Before an experiment, a subject sits a chair quietly for 60 seconds. Then the subject put one's hand on a table and the skin color of the back of one's hand was measured as "healthy skin state (H-state)" by a spectrophotometric colorimeter (CM-2600d, Konica Minolta). The measurement site of the back of one's hand was the base between first metacarpal and second metacarpal.
After the experiment started (t=0), the subject raised one's upper arm, kept the pose for 90 seconds in order not to flow the blood in peripheral part such as hand. The upper arm was wrapped a sphygmomanometer cuff (UM-101, AND). After 90 seconds with keeping the pose (t=90), the upper arm was brought to 200 mmHg pressure by the sphygmomanometer cuff, and kept the pressure for 60 seconds. The internal bleeding was not appeared. After that (t=150), the subject slowly pulled his arm down on the table, and kept the pose for 60 seconds. And then (t=210), the skin color of the back of one's hand was measured as "ischemia-shocked skin state (S-state)" by the spectrophotometric colorimeter.
The experimental time marked the 240 seconds since its beginning (t=240), the pressure of the sphygmomanometer cuff was reduced to 0 mmHg, and the skin color of same part was measured as "the reperfusion-congested skin state (C-state)" at 10 seconds intervals for 240 seconds.
In this experiment, we set three skin states: healthy skin, ischemia-shocked skin, and reperfusion-congested skin. Both hands of a subject were measured once. At first, the right hand was measured about three skin states, and then the left hand was measured.
We measured spectral reflectance of three skin states; the healthy skin state (H-state), the ischemia-shocked skin state (S-state), and the reperfusion-congested skin state (C-state). By using these spectral reflectance data, we calculated XYZ tristimulus values under the standard light source D65. We defined the spectral reflectance data which got the lowest Y value between t=240 to t=480 as "the reperfusion-congested skin state" spectral reflectance. The time, which became "the reperfusion-congested skin state", varied according to individuals.

3. RESULTS

3.1 Spectral Reflectance of Three Skin States

Fundamental principle in the selection process for the skin color database of this research was that the order of Y values was S-state>H-state>C-state. If the order of Y values was not S-state>H-state>C-state, the result was discarded. Under this fundamental principle, we found three patterns of skin spectral reflectance distribution (Figure 1).
(1) The spectral reflectance distributions of three skin states were different, and the differences of Y among them were large (pattern S-H-C).
(2) The spectral reflectance distributions of H-state and C-state were similar, and the

difference of Y value between H-state and C-state was less than 2.0 (pattern S-HC).
(3) The spectral reflectance distributions of S-state and H-state were similar, and the difference of Y -value between S-state and C-state was less than 2.0 (pattern SH-C).



(Left) pattern S-H-C, (Center) pattern S-HC, (Right) pattern SH-C
Figure 1. Typical Patterns of spectral reflectance distributions at three skin states.

A typical result of the spectral reflectance pattern S-H-C at three skin states was shown in Figure 1 (left). The spectral reflectance of the ischemia-shocked skin was whitened and higher as compared with healthy skin, especially within a range of 450-600nm. On the other hand, the spectral reflectance of the reperfusion-congested skin was wholly lower than other skin states. This tendency was applicable to many subjects.

Some results of spectral reflectance distribution showed strange characteristics. One of the strange pattern was that the partial spectral reflectance data of C-state was slightly higher than the one of H-state beyond 600nm especially (pattern *). Another pattern was that the partial spectral reflectance data of S-state was lower than the spectral reflectance data of H-state beyond 600nm especially (pattern **). There were some unusable spectral reflectance data in these two patterns.

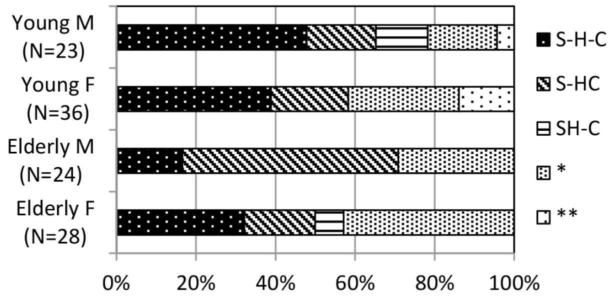


Figure 2. Appearance ratio of spectral reflectance patterns.

Figure 2 showed the ratio of spectral reflectance patterns for each group. In any group, the cumulative ratio of "pattern S-H-C" and "pattern S-HC" accounted for more than a half of results.

3.2 Skin Color Chart of Injured or Sick Persons according to Age and Gender

As values attained by the spectrophotometric colorimeter of Munsell Color System under the standard light source D65 came as decimal number, we rounded off them into integer number. As compared with the healthy skin, the ischemia-shocked skin tended to be more yellowish and had higher brightness, and the reperfusion-congested skin tended to be more reddish and had higher saturation. These tendencies were found in all subject groups.

We confirmed the skin states' difference, gender difference and age difference for Munsell value. Thus, we need to set up the Three Skin States' Color Chart (healthy, ischemia-shocked, and reperfusion-congested skin states) for each subject group; young male, young female, elderly male and elderly female. We use the data in order to propose the Color Chart for injured or sick persons.

We comprehend the characteristics of the commercially available color charts, and then we explored how to set up the three attributes of Munsell Color System for "the

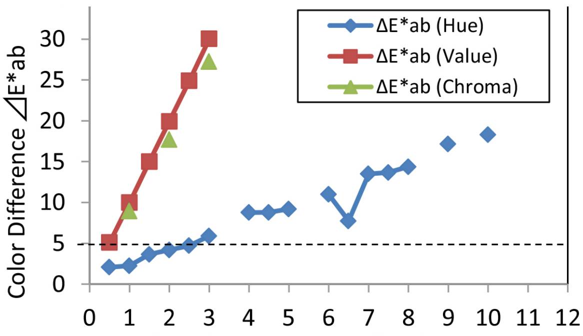


*Figure 3.Munsell Color Number and ΔE*ab*

Skin Color Chart of Injured or Sick Persons”. The commercially available color charts we used were all made by Japan Color Enterprise Co., Ltd, such as “the series of Skin Color 75”. Total of 129 skin color charts were within the Munsell Hue of 10R-10YR (interval of 2-2.5), Munsell Value of 5.0-8.0 (interval of 0.5), and Munsell Chroma of 2.0-5.0 (interval of 1.0) for each series. By using the spectrophotometric colorimeter, we measured the tristimulus values (Yxy) and calculated the color difference caused by value change in Munsell Color System (Figure 3). For Munsell Hue, the color difference was less than 5.0 with 2.5 intervals. For Munsell Value, the color difference was slightly more than 5.0 with 0.5 interval, and the difference of the spectral reflectance is found, but average color difference for all the combinations was 5.09. For Munsell Chroma, the color difference was more than 8.0 with 1.0 interval. Out of consideration for all the results and parameters of commercially available color charts, we set up the Munsell Hue 2.5 interval, Munsell Value 1.0 interval, and Munsell Chroma 1.0 interval for “the Skin Color Chart of Injured or Sick Persons”.

We categorized the results by three skin states (healthy, shocked, and congested skin) and subject groups. The results were showed in Table 1.

Yellow hatched results in Table 1 were extracted with appearance ratio higher than 10%. We can make a portable “Japanese Skin Color Chart of Injured or Sick Persons”. With the colorimetric mask, it is easy to compare the actual skin to this Color Chart, and helpful to diagnose the survivor’s condition.

Table 1. Japanese Skin Color Chart of Injured or Sick Persons according to Age and Gender

(1) Young Female

Healthy Skin (N=36)

Healthy	N	rate
2.5YR6/3	1	2.8%
5YR6/3	2	5.6%
5YR6/4	2	5.6%
7.5YR6/2	2	5.6%
7.5YR6/3	17	47.2%
7.5YR6/4	4	11.1%
7.5YR7/3	4	11.1%
10YR6/3	2	5.6%
10YR7/3	2	5.6%

Shocked Skin (N=36)

Shocked	N	rate
10YR6/3	5	13.9%
10YR6/4	2	5.6%
10YR7/2	1	2.8%
10YR7/3	19	52.8%
2.5Y6/2	1	2.8%
2.5Y7/2	2	5.6%
2.5Y7/3	5	13.9%
5Y7/2	1	2.8%

Congested Skin (N=32)

Congeste	N	rate
10R5/5	1	3.1%
2.5YR6/4	4	12.5%
5YR5/3	1	3.1%
5YR6/3	4	12.5%
5YR6/4	14	43.8%
7.5YR5/2	1	3.1%
7.5YR6/3	5	15.6%
7.5YR6/4	1	3.1%
10YR5/4	1	3.1%

(2) Young Male

Healthy Skin (N=23)

Healthy	N	rate
5YR5/3	1	4.3%
5YR5/4	6	26.1%
5YR6/3	1	4.3%
5YR6/4	3	13.0%
7.5YR5/4	3	13.0%
7.5YR6/3	6	26.1%
7.5YR6/4	3	13.0%

Shocked Skin (N=23)

Shocked	N	rate
7.5YR6/3	1	4.3%
7.5YR6/4	1	4.3%
10YR5/4	1	4.3%
10YR6/3	5	21.7%
10YR6/4	12	52.2%
10YR7/3	3	13.0%

Congested Skin (N=22)

Congeste	N	rate
2.5YR5/4	5	22.7%
2.5YR5/5	6	27.3%
5YR5/5	2	9.1%
5YR6/4	9	40.9%

(3) Elderly Female

Healthy Skin (N=27)

Healthy	N	rate
5YR5/3	1	3.7%
5YR5/4	1	3.7%
5YR6/3	2	7.4%
5YR6/4	2	7.4%
7.5YR5/3	1	3.7%
7.5YR5/4	2	7.4%
7.5YR6/3	17	63.0%
10YR6/3	1	3.7%

Shocked Skin (N=28)

Shocked	N	rate
7.5YR6/3	1	3.6%
10YR6/3	16	57.1%
10YR6/4	1	3.6%
10YR7/3	4	14.3%
10YR7/4	1	3.6%
2.5Y6/3	3	10.7%
2.5Y7/3	2	7.1%

Congested Skin (N=28)

Congeste	N	rate
2.5YR5/4	5	17.9%
2.5YR6/3	1	3.6%
2.5YR6/4	2	7.1%
5YR5/3	2	7.1%
5YR5/4	2	7.1%
5YR6/3	6	21.4%
5YR6/4	9	32.1%
7.5YR6/3	1	3.6%

(4) Elderly Male

Healthy Skin (N=24)

Healthy	N	rate
2.5YR5/3	2	8.3%
2.5YR5/4	1	4.2%
5YR5/3	2	8.3%
5YR5/4	10	41.7%
5YR6/4	1	4.2%
7.5YR5/3	2	8.3%
7.5YR5/4	2	8.3%
7.5YR6/3	2	8.3%
7.5YR6/4	2	8.3%

Shocked Skin (N=24)

Shocked	N	rate
7.5YR5/3	1	4.2%
7.5YR5/4	5	20.8%
7.5YR6/4	4	16.7%
10YR5/3	1	4.2%
10YR5/4	1	4.2%
10YR6/3	8	33.3%
10YR6/4	4	16.7%

Congested Skin (N=23)

Congeste	N	rate
2.5YR5/3	1	4.3%
2.5YR5/4	8	34.8%
5YR5/3	1	4.3%
5YR5/4	10	43.5%
5YR6/4	3	13.0%

4. CONCLUSIONS

We proposed Japanese Skin Color Chart of Injured or Sick Persons according to Age and Gender in this paper. It will be useful in not only disaster medicine but also regular medicine and surgery. Moreover these data is available for use developing proper light source and educational tools for medical care.

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The Chromatic Expression in the City: Urban Places in Córdoba, 1980-2015

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ABSTRACT

The clear trend towards the global city as a virtual city of flows makes us focus our attention on the Urban Place and its insertion in the present urban condition. The urban exteriors display new expressive and communicative functions of color that facilitate the promotion of pleasant experiences and contribute to the construction of urban places. Light, color and sound are sensory effects with the relevance of new ways of expressions established by present technologies (Bahamon 2010).
The concept of place has changed together with the evolution of societies and the research contributions of many disciplines. Nevertheless, its close relation with the concept of existential space proves that the perceptual expression of the city and its places matches the different ideas of city throughout time. This is true in the city of Córdoba, Argentina, where the leading roles of different components of the urban scene prevail according to the idea of each historical time. Consequently, every place or net of places in the city is the result of their previous history. Besides, the accompanying chromatic expression is an active element of the city.

1. INTRODUCTION

The contemporary world witnesses considerable changes in the production of urban environments and mainly in the possibilities of expression of color and the different signs that go with its perception such as cesias, chromatic contrasts and textures that facilitate a wider variety of environmental experiences.
The new interventions, with the appearance of new architectural and urban components as well as the intervention in existing spaces, have as a main objective to re-value the urban environments for the enjoyment of their inhabitants and to generate experiences where social life, culture and citizenship express themselves to build up the city. This also involves the construction, expression, material nature and meaning of the limits of space.
Within this framework, the role of color shows its potentiality to encourage the urban experience of environments in the city, which have become Urban Places, which appears in interventions in the whole world as a result of globalization. On the other hand, the unique context of Latin America makes us focus on the transformations that have taken place in the Latin American urban space in the last decades, especially in the city of Cordoba, Argentina.

2. CITY AND URBAN PLACES

In the process of reappearance of the city, the place, which is linked to the concept of existential space (Norberg Schulz 1975), is regained as a protagonist in the contemporary scene where there is a debate as regards the private and the public, the social and physical dimension of the urban experience, the identity and sustainability, among others.
In this context, the contribution of different disciplines and their various perceptions help to define the concept of place, understanding that "in our present condition, spaces, anti-spaces, places and non-places are intertwined, complement and interpenetrate each other and live together" (Montaner 1998: 52). Consequently, the

last three decades have seen the development of urban places whose appearance and conception have changed, but at the same time, have preserved the essential idea concerning the sense of the places in the city. That is to say, the social production and construction of public urban spaces, as individual and collective meaningful living environments, must be understood as a dialectic relationship that keeps some continuity and in turn changes throughout time building up new ideas, social structures and meaningful places.
In the city of Cordoba, the pedestrian area of the historical center of the 80's, the Community Participation Centers (CPC) and Güemes neighborhood of the 90's and the most recent interventions such as the Cultural Center "Paseo del Buen Pastor" and "Centro Cultural del Bicentenario" (Cultural Center of the Bicentenary) are examples of the city as scenario of socio-cultural exchanges. In this way, the use and appropriation of the city enables the connection between images and events experienced in urban places that build the image of the city. These representations of experienced journeys or itineraries make the inhabitant communicate and identify himself with the environment he lives in, building sense in his meaningful practice of inhabiting.

Figure 1. Urban places in the city of Córdoba. Pedestrian area of the 80s, the Community Participation Centers of the 90s and Cultural Center "Paseo del Buen Pastor" in the beginnings of the XXI century.

3. THE CHROMATIC EXPRESSION IN THE CITY

The intervention of colour with the capacity to inform, suggest and develop meaning creates atmospheres that go beyond the concrete and intangible material nature. On the other hand, colour has the capacity of fulfilling the needs of man and if these are fulfilled in city environments, they become urban places
Being one of the structural components of the language of the city, the importance of the chromatic expression in the city has been confirmed in the last decades. At present, new spatial configurations reveal that the expression of urban language has changed taking advantage of new materials and the development of new technologies By means of new expressive forms of color, these urban places propose a different way of stimulating the sense of place in the city. This prompted a chromatic survey and the subsequent analysis of uses and behaviors in paradigmatic places of the city of Cordoba, Argentina in the last decades.

3.1 Method of the chromatic survey

Light, color, textures and cesias are main components of urban language, and as a consequence, of the created spatiality. These elements work on the whole configuration of limits having influence on the perception and communication of the urban environment.
By recognizing paradigmatic urban places in the city of Cordoba in the last decades, it is proved that color has accompanied the development of the concept of place in

the city. The aim is to prove how the new materials and architectural trends have changed the chromatic expression creating changes for those who perceive and inhabit those environments.

The steps to conduct the chromatic survey are as follows:
- The paradigmatic environments are chosen according to their chromatic expression and temporal condition of urban place.
- The Natural Color System (NCS) is used to measure color since it is the most appropriate way to reveal the different chromatic modifications produced in urban spaces.
- Simultaneously, the performing cesia degree is measured and textures are surveyed to determine more accurately both the perceived color and the inherent one.
- A synthesis matrix is laid out to present the survey of different variables as well as the perceived color and the inherent one.
- The chromatic survey is conducted at different times of the day and in different seasons.

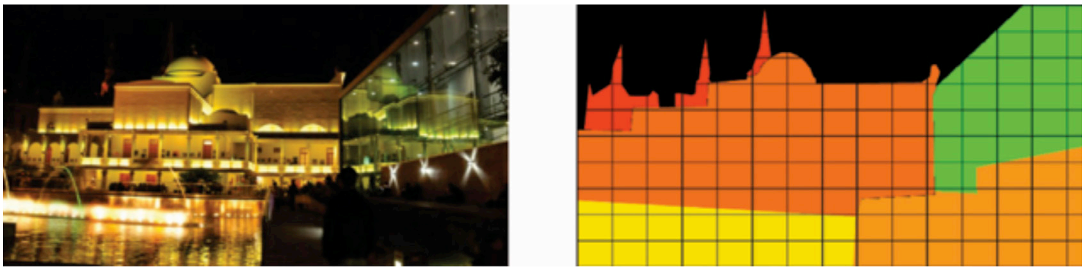

Figure 2. Measuring of urban color.

3.2 Analysis of uses, appropriation and sense of place

The appropriation and use of urban environments are determined by the satisfaction of physical and psychological human needs. When these take place, the sense of place becomes real and is expressed by the emotional behavior and reactions of the inhabitants.
To confirm the new relations between space and sense an analysis of uses and behaviors is carried out to prove the meaning given by inhabitants to the urban experience.
The steps to analyze the uses and behaviors are as follows:
- An interpretative observation is carried out with the aim of determining the behavior and appropriations in the different selected testing environments. This observation takes place at different times of the day, on different weekdays and different seasons.
- With the aim of completing the analysis, questions are made to casual users to verify the association and the meaning the inhabitant relates to the perception of chromatic elements acting on public spaces.
- A synthesis matrix is laid out to present the analysis of recorded uses and behaviors

4. CONCLUSIONS

In accordance with the above mentioned it is stated:

- According to the perception of each period of time, the notion of place proves the main function of color and different components of language and the different role they play.
- In the contemporary city the new urban architectural expressions affect not only

the physical aspect of the city but they also condition the use and appropriation of the public urban space, changing the meaning of the concept of traditional place the inhabitants have.
- At present, the perceptual variation between the applied color and the inherent color is broadened as a consequence of the performance of perceptual signs such as cesias, textures and the synesthetic process shown in the new expressive possibilities of innovative technologies and materials. Besides, an appearance variety is displayed, sometimes short-lived, supported by the new role of sensory effects such as light and sound.
- The chromatic survey and the survey on uses and behaviors show that the perception and meaning the inhabitants confer to color are associated to the different periods of time.
- The role of color in the contemporary city exhibits its potentiality to promote real experiences of city environments, which have become Urban Places, both in new sites or in re-valued spaces. This highlights the need for chromatic design at different performance degrees in the city.

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An Evaluation about the Color-fragrance Associations Differently Appeared Depending on Transparent, Opaque and Glossy Conditions

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ABSTRACT

This study aimed to investigate the responses to the color-fragrance synesthesia differently appeared depending on the factors of gloss, transparency or opaqueness as well as colors being considered at designing fragrance products. For verifying this anticipation, this study produced total 99 pieces of 33-color chips with materials having of gloss, transparent and opaque surface features on the basis of IRI Hue & Tone 120 Color System. After then, the sample chips were directly presented to subjects and ordered to select the fragrance kinds being associated from the samples, and evaluated the intensity of associated fragrance. As the results of the evaluation, it was tended that the kinds of fragrance being associated depending on a material's surface feature and its color were clearly appeared. In the experiment about the fragrance-association intensity depending on a material's surface feature, the fragrance-association intensity scores were higher at using the opaque chips than at using the gloss chips. This result implied that an opaque chip featuring no-glossy and solid surface more strongly associated a fragrance than other glossy-surfaced chips. The results of color-fragrance synesthesia response experiment will apply the color notes in several stages or the fragrance intensity minutely changing to fragrance-emitting products through their surface features.

1. INTRODUCTION

The synesthesia connecting the olfactory sense and visual sense is meaningful as an alternative to effectively express the olfactory sensitivity of varied fragrance-emitting products through the visual sense. Concerning the synesthesia between a fragrance and a color, Gilbert, Martin & Kemp (1996) said that if a kind of fragrance is changed, then the associated color, the color's brightness and chroma are also differently appeared. And Schifferstein, Tanudjaja (2004) mentioned that a color and an fragrance showed the cross-modality relation through their experiment using NCS color chart, and the hue influenced on the intensity of fragrance, and especially the brightness influenced on the intensity of fragrance the most. That implied that if colors are utilized at smelling a fragrance, the fragrance could be felt more effectively resulting from the color-fragrance synesthesia phenomenon. Like that, researches about the cross-modality relation between the color-fragrance synesthesia have been continually developed until now, but existing researches have the limit that they have carried out experiments only targeting the non-glossy, opaque color chips. Hence, this study intended to research about the association intensity of color-fragrance differently seen depending on the gloss degree and the transparency degree as well as a color which would be considered at creating a package design of a fragrance-emitting product. Therefore this study produced different color-chip samples having the surface features of transparency, opaqueness and gloss and conducted a survey about the chips, and forms the results of survey, this study aimed to identify the fragrance kind and fragrance intensity difference being associated depending on each surface's feature (transparency, opaqueness or gloss).

2. METHOD

2.1 Sample Preparation

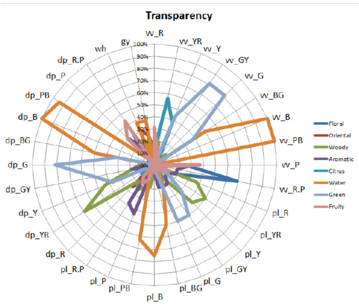
Kim (2010) tried to investigate the association intensity of chancing fragrance depending on a color and a tone through his study utilizing the IRI Hue & Tone 120 colors system. Therefore, this study produced 99 color-simulating chip samples differently applying total 3 factors of color, tone and surface feature. For color, this study selected 10 colors (R, YR, GY, G, BG, B, PB, P and RP) on the basis of IRI Hue & Tone 12 color system and each color of the 10 colors was composed in 3 tones of vivid tone, deep tone and pale tone. The total 33 colors adding 3 achromatic colors, that is, N1 (referring to Black), N5 (referring to Gray) and N9.5 (referring to White) to the 30 colors were applied to the materials having one feature among the 3 surface features of transparency, opaqueness and gloss. For the transparent chip samples, the black color was considered to be meaningless, so the black transparent chips were excluded from the chip samples, so total 99 color-stimulating chip samples including transparent, colorless chip samples and gloss, transparent chip samples were eventually presented to the subjects. For the fragrance kinds, this study used Michael Edwards' Fragrance Classification System Fragrance Wheel (Edwards, 2008). Of the 4 upper fragrance groups in Michael Edwards' Fragrance Classification System (Fragrance Wheel), the 3 groups of floral, oriental and woody had relatively unified fragrance features among their fragrance classes, but for the fresh fragrance group, the features of fragrance belonged to its sub-class classification were relatively differently appeared, so this study selected the upper classes classification for the floral, oriental and woody fragrance groups, and for the fresh fragrance group, this study additionally selected 5 fragrances of aromatic, citrus, water, green and fruity fragrances which were belonged to the sub-classes of fresh fragrance group. Therefore this study classified the fragrances to be used into 8 fragrance classes (Park, 2011). The materials to be used for this study were divided into 3 categories according to the criteria of transparent, opaque and glossy surfaces, and the materials were applied to the above-mentioned color stimulus. The material featuring transparent surface was especially with the colorless, transparent OHP film and produced its samples. And when the transparent samples' transparency degrees were measured under the condition of 10 article visual field of D65 light source on a white-color paper in using the SP62 Portable Spectrophotometer as a brightness-color measuring device on a white-color paper, the transparent-surface samples' transparency degrees was seen between 99.98% and 99.97%. As the opaque material, the color samples of IRI Hue & Tone 120 were used, and for the glossy material, this study manufactured such material by attaching some transparent, glossy OHP film to the IRI Hue & Tone 120 color samples.

2.2 Psychophysical Experiment

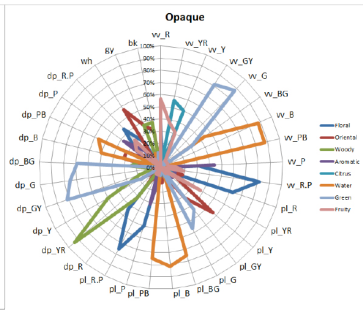
The subjects were instructed to choose one fragrance among 8 fragrances in upper fragrance classes being associated at seeing each sample of 99 samples having different surface features, and also ordered to response the association intensity for each associated fragrance in the 7-point Likert Scale. In the Likert Scale, 1 point was 'no fragrance is felt', and 2 point was 'a fragrance is lightly felt', and 3 point was 'a fragrance is felt', 4 point was 'a fragrance is moderately felt', 5 point was 'a fragrance is somewhat strongly felt', 6 point was 'a fragrance was strongly felt' and 7 point was 'a fragrance was very strongly felt'. As the survey method, one color sample was randomly presented to each subject in the condition of D65 light source and 200-lux light box. Each subject had to observe one sample from 40~50cm distance far away from the sample and to response to the questionnaire.

3. RESULTS AND DISCUSSION

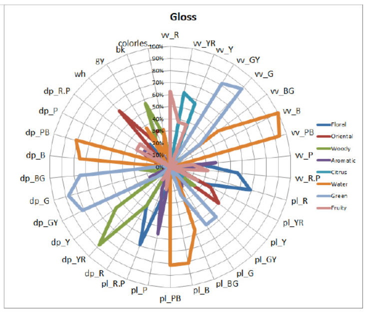
The following <Figure 1>, <Figure 2> and <Figure 3> were graphs classifying the results of associated fragrance kinds at seeing each sample depending on a material's surface feature.



<Figure 1>



<Figure 2>



<Figure 3>

In the following section, the results of survey data about the associated fragrances about each sample and the associated fragrance intensities of each sample were classified according to fragrance kinds and the corresponding data were the contents summarizing the results being selected by over 25% of all respondents

Floral: In the vivid-tone RP material, the floral fragrance was the most frequently associated, and the association intensity was relatively high as its point of 5.8 in Likert Scale. Following the vivid-tone RP material, it was appeared that in the pale-tone RP material, 75% of all respondents' associated floral fragrance, and its association intensity was 4 point. For the glossy material, in the both pale-tone RP and the same-tone R materials, 79% of all respondents said that they associated the floral fragrance at seeing the both kinds of samples, Floral fragrance showed high fragrance association response rate and high fragrance intensity in the all samples excluding the transparent, vivid-tone RP-color material in order of opaque>glossy> transparent materials.

Oriental: For the glossy material, the most respondents said that they associated the oriental fragrance in the white glossy material, and the oriental fragrance association intensity in the material was 4.9 point. For the opaque material, in the white and pale-tone Y-color opaque materials, 56% respondents associated the oriental fragrance, but the corresponding fragrance association intensity was appeared as 4.9 point and 5.3 point in the white opaque material and the pale-tone Y opaque material, respectively.

Woody: Regardless of materials, the rate of respondents reporting that they associated woody fragrance at seeing the deep-tone YR color material was high. The woody fragrance association intensity had high response rate in opaque material as 94%, and followed in the transparent material as 88% response rate and in the glossy material as 69%. The sample that associated the woody fragrance the most strongly was the opaque, deep-tone sample. For the transparent colorless material, the response rate saying that woody fragrance was associated at such material was more than 56%, but the fragrance association intensity was relatively low as 3 point. The woody fragrance association intensity was strongly appeared in material order of transparent>opaque>glossy material.

Aromatic: The respondent rate associating the aromatic fragrance was relatively lower comparing to the respondent rates associating other fragrances. For the glossy, pale P-color material, the aromatic fragrance was associated in the 56% of response rate and its association intensity was appeared as 4.1 points. Besides, in the corresponding color (pale P-color) regardless materials, the fragrance association intensity

was generated as the highest point comparing to other samples. The aromatic fragrance association intensity was higher in order of glossy> opaque > transparent materials.
Citrus: The citrus fragrance was associated only in the vivid-tone YR color and the Y color regardless materials. More than 50% of all respondents said that they associated the citrus fragrance in the vivid-tone R color and the vivid-tone Y color transparent, opaque and glossy materials except the glossy, vivid-tone Y color material, and the citrus fragrance association intensity was higher in order of Opaque> Transparent > Glossy materials.
Water: Most respondents associated water fragrance at seeing the all B-color and PB color materials of all color tones, and for these colors' water fragrance intensity, the highest score was come from the vivid-tone BG color material. The respondent rate about the water fragrance association was higher in order of transparent> glossy> opaque materials, but the results about water fragrance association intensity evaluation were almost same in the both transparent and glossy materials.
Green: Regardless materials, there were a lot of responses that the green fragrance was associated from the vivid-tone G color and the vivid-tone GY color materials, and the fragrance association intensity scores were high in the GY, G and BG colors which were the vivid-tone and deep-tone G color classes. Concerning the green fragrance association, similarly high response rates were appeared in most color materials except the transparent, deep-tone GY color and the BY color materials, and in the opaque deep-tone G color material, the green fragrance association intensity score was the highest.
Fruity: The fruity fragrance drew out the highest response rate generating more than 56% response rate in the transparent and the opaque vivid-tone R color samples, and its fragrance association intensity was also generated as over 6.2 point.

4. CONCLUSIONS

The conclusion of this study is as follows. First, the flora fragrance was associated in the vivid-tone P color, the RP color and the P color regardless of materials, and more respondents associated the floral fragrance in the opaque material than the glossy material. In the deep-tone YR color and the Y-color, the respondents' rate associating the woody fragrance was more than 69%, and the woody fragrance intensity association score was also high in the both colors. The Vivid-tone YR color and the Y color associated the citrus fragrance, and the citrus fragrance association intensity score was appeared as more than 5 point in the both colors. The water fragrance was associated from the deep-tone BG color and the PB color, and the respondent rate associating water fragrance from these colors was higher in order of opaque>glossy>-transparent materials. In the vivid-tone, deep-tone and pale-tone G color classes (GY, G, BG colors), the green fragrance was associated, and the green fragrance association intensity was higher in order of opaque>glossy>transparent materials. Second, as the results investigating the relationships between the response rate about associating fragrance at seeing a color and the fragrance association intensity, it was tended that the fragrance association intensity score was higher in opaque materials than glossy materials. This implied that opaque material having no glossy and solid surface than other surfaces more strongly associated a fragrance. Through the results of this study, the relationships of color and synesthesia could be understood by connecting them with the factors of transparency, opaqueness and gloss, and it is judged that the results of this study will be used as some positive data in planning colors utilizing synesthesia phenomenon at creating a package design for fragrance-emitting product.

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The Comparative Analysis of Building Color on Traditional Commercial Street between Korea and China using NCS Nuance Analysis

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ABSTRACT

This study is a part of the color analysis on the traditional commercial street in Korea and China. This study is aimed at comparing NCS (Natural Color System) Tone analysis of Architecture color for traditional commercial street in Seoul (Korea) and Beijing (China) which have traditional regional cultures, and its research method is as below: 1) In this study, we measured the street of Architecture color, the current study used NCS color Scan 2.0 and NCS Index original-1950 color atlas to measure physiological signals. To avoid the inaccuracies in this study, I must wipe out the Architectural surface by lens paper before color measuring and measure the Architectural surface for many times. Compared with other method, such as photographical analysis method analysis, this method that raise precision and reduce the error is kept below 0.1. 2) To compare and analyze architecture color, the color is classified into three parts: dominant color, assort color, accent color. Also, the NCS(Natural Color System) Tone, which used dominant color values of architecture color on the streets of target area with continuous horizontal spaces, is extracted, analyzed, and compared. As a result of doing comparative analysis of the tonal status of the structures of target areas, it was found that the color of the buildings on traditional commercial streets in Korea created a bright atmosphere on the whole while Chinese counterpart created a dark atmosphere in comparison with Korean traditional commercial streets. In addition, it was found that all of the buildings in target areas were applied by diverse tones, especially in case of Korean traditional commercial streets comparing to Chinese ones, somewhat giving an extraneous feeling, and adding to visual confusion.

1. INTRODUCTION

The importance of commercial buildings has not been properly noticed, although they hold a large majority of commercial buildings, which have caused some problem such as the relationship between color of sign and architecture façade and disharmonious architectural structures owing to poor investment. This study is a part of the color analysis about the commercial street in Korea and China. The research basis is divided into two parts. The first part is aimed at a comparative analysis of Architecture color and sign color for traditional commercial street in Korea and China. The second part is aimed at a comparative analysis of Architecture color and sign color for modern commercial street in Korea and China. This study is aimed at comparing NCS (Natural Color System) Tone analysis of Architecture color for traditional commercial street in Seoul (Korea) and Beijing (China), which have traditional regional cultures, and its research method, is as below:

1) After setting up the researching objectives according to research background & purpose, this study inquired into the direction of research planning through theoretical consideration and analysis of the preceding researches. By selecting the research objects from two most typical cities for example Beijing in China and Seoul in Korea.

2) In this study, we measured the street of Architecture color, the current study used NCS color Scan 2.0 and NCS Index original-1950 color atlas to measure physiological signals. To avoid the inaccuracies in this study, I must wipe out the Architectural surface by lens paper before color measuring and measure the Architectural surface for many times. Compared with other method, such as photographical analysis method analysis, this method can raise precision and reduce the error is kept below 0.1. 3) To compare and analyze architecture color, the color was classified into three parts: dominant color, assort color, accent color. Also, the NCS(Natural Color System) Tone, which used dominant color values of architecture color on the streets of target area with continuous horizontal spaces, were extracted, analyzed, and compared.

2. METHOD

2.1 Sample Preparation

In this paper, four Traditional commercial streets between Korea and China are selected and founded in Beijing and Seoul, which are Nanluoguxiang, Qianmendajie, Samcheongdong-gil, Insadong-gil. This study is aimed at Architecture color in the traditional commercial street between Korea and China(Figure 1).

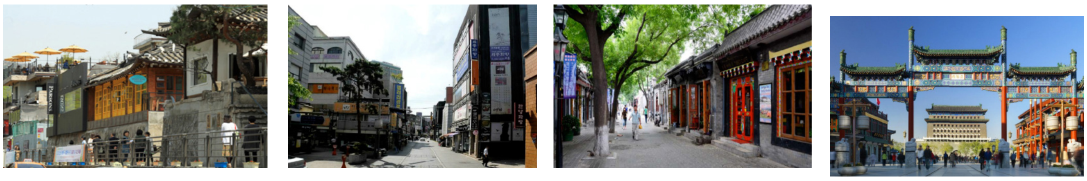

Table 1. Samcheongdong-gil, Insdong-gil, Nanluoguxiang, Qjanmendajie.

2.2 Experiment Procedure

In this study, I measure architecture façade color. The current study uses NCS color Scan 2.0 and NCS Index original-1950 color atlas to measure physiological signals. To avoid the inaccuracies in this study, I must wipe the surface of architecture façade by lens paper before color measuring and measure the surface of architectural façade for many times. Compared with other method, such as photographical analysis method analysis, this method that raise precision and reduce error is kept below 0.1. Due to weather and building high, I also use NCS Index original-1950 color to measure the color of architecture façade.

The measurement method uses as follows. Firstly the subject is seated comfortably in the outside when the day has no strongly sunlight. I use lens paper to wipe the surface of architecture façade. Secondly, NCS color Scan 2.0 is taken for 10 seconds in the surface of architecture façade. In order to reduce the error of result of measurement, I measure different positions in the surface of architecture façade. The other way to reduce the error of result of measurement, I use NCS color Scan 2.0 to measure for many times to find the average value. The research method is as follows (Figure 2).

<table>
<tr><td>Element</td><td colspan="2">Summary</td></tr>
<tr><td>Time</td><td colspan="2">2015.7.26-2015.8.22 sunny</td></tr>
<tr><td>Hour</td><td colspan="2">9am-5pm</td></tr>
<tr><td rowspan="2">Tool</td><td colspan="2">NCS color Scan 2.0, NCS Index original-1950 color atlas</td></tr>
<tr><td>
NCS color Scan 2.0</td><td>
NCS Index original-1950 color atlas</td></tr>
</table>

Figure 2. Research Summary

3. RESULTS AND DISCUSSION

As a result of doing comprehensive arrangement of extracted tone of the traditional commercial street in Korea, light-gray tone was derived the most among the applied general tone; secondary color tone was expressed in dark-gray, deep & strong, dull& dark-gray color gamut while whitish & pale, clear & strong, clean & bright color tone and tone of an uncharacteristic concept were the least expressed. On the other hand, as a result of doing comprehensive arrangement of extracted tone of the traditional commercial street in China, dark-gray tone was derived the most, and secondary tone was expressed in light-gray, deep& strong, deep color gamut while gray, uncharacteristic, clear& strong, clean & bright color tone were the least expressed. The research method is as follows(Figure 3).

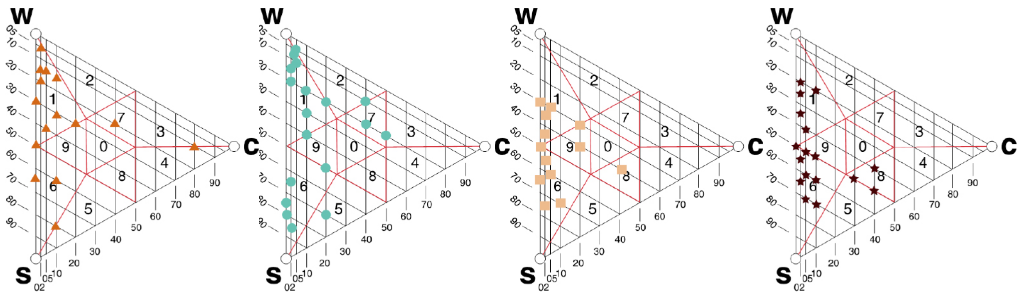

Figure 3: Samcheongdong-gil, Insadong-gil, Nanluoguxiang, Qianmendajie architecture color(dominant color) tone

As a result of doing comprehensive arrangement of extracted tone of the traditional commercial street in Korea, light-gray tone is derived the most among the applied general tone; secondary color tone is expressed in dark-gray, deep & strong, dull& dark-gray color gamut while whitish & pale, clear & strong, clean & bright color tone and tone of an uncharacteristic concept are the least expressed. On the other hand, as a result of doing comprehensive arrangement of extracted tone of the traditional commercial street in China, dark-gray tone was derived the most, and secondary tone was expressed in light-gray, deep& strong, deep color gamut while gray, uncharacteristic, clear& strong, clean & bright color tone were the least expressed. It is found that the color of the buildings on traditional commercial streets in Korea created a bright atmosphere on the whole while Chinese counterpart created a dark atmosphere in comparison with Korean traditional commercial streets. In addition, it is found that all of the buildings in target areas are applied by diverse tones, especially in case of Korean traditional commercial streets comparing to Chinese ones, somewhat giving an extraneous feeling, and adding to visual confusion.

4. CONCLUSIONS

The purpose of the current study is to analyze architecture color by the NCS Color System. As a result of doing comparative analysis of the tonal status of the structures of target areas, it is found that the color of the buildings on traditional commercial streets in Korea created a bright atmosphere on the whole while Chinese counterpart created a dark atmosphere in comparison with Korean traditional commercial streets. In addition, it is found that all of the buildings in target areas were applied by diverse tones, especially in case of Korean traditional commercial streets comparing to Chinese ones, somewhat giving an extraneous feeling, and adding to visual confusion.

This study mainly engaged in comparative analysis of color on the basis of the traditional commercial street. The relationship between architecture façade of the two areas, which environment are different from each other, as a primary research purpose, and it is thought that such a research as this purpose should be regarded as important data for the research related to the traditional commercial streets of Korea and China in the future.

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Chromatic Analysis as a Revaluation Proposal of the Urban Image of Puerto Vallarta: Built Color, Imagined Color

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ABSTRACT

The article presents a review of the literature and background information on the issue to propose through a methodology an analysis of the chromatic elements from the city of Puerto Vallarta, Jalisco, Mexico, due the identification of color relationships with feelings and thoughts around the city, together with key drivers that indicate the relationship between the latter and the inhabitant, establishing a network of significance between color, architecture, context and urban imaginaries.
The proposal or theoretical contribution of the work based on the literature review and the analysis of examples around the world, argues that the presence of color, both in architecture and in each one of the elements that constitute the public space, are fundamental for the effective construction of the meaning of an urban image.
One of the conclusions of the analysis, is that the perception and experience of the architectural landscape, give the user or inhabitant a number of meanings and information that help to create a chromatic mind map, and this constitutes together with the passage of time, configurators elements of an identity.

1. INTRODUCTION

Through a chromatic analysis of the city of Puerto Vallarta, Mexico, seeks to establish the relationship between the built color and the imagined color by the inhabitants of the city, as the motive that allow to study the phenomenon of color as an element of experience and cultural perception of a city.
The importance of this work is to reveal the need for awareness on the role that meets the color in the city, take knowledge of the scope of the same, is the responsibility of all those involved in the construction of the urban environment.

Puerto Vallarta, tourist city and traditional town:
In the city of Puerto Vallarta, there have been a combining series of elements that have shaped together one of the most important tourist towns of Mexico.
Puerto Vallarta, tourist destination recognized worldwide, has happened through different stages that enclose the qualitative scheme by which have passed many cities and towns, areas and natural areas that are part of the picture of the global tourism market. In this process of dynamic and changing conditions that have meaning the place, in a short period of time that goes in the middle of the last century to the present, has caused the foreign occupation of natural space and structure is built, and the accumulation of income which derives from it, has passed through the stages of the rent and use as a hotel, the proliferation of new schemes of business during the last few years.

As mentioned Scartascini (2011) the transformation of the world socio-cultural Vallarta in a very short time produced quantitative changes in terms of demography, in their spatial distribution - with the creation of new colonies popular receiving

workers across the Republic - and the pattern of social relations. The circumstances of the change exceeded the imaginaries of the Vallartenses. On the basis of the large hotels has resulted in the loss of a style of life; have been disappearing, increasingly rapidly, forms of the collective socialization that lived for several generations in Puerto Vallarta.
It needs to take the study of color in the city seeing it as an instrument of re-shaping and re-design of the urban image itself, taking into account the conservation, as well as insertion, more or less consonant of new architectures. The importance of this approach lies in the conception of the city as a fact not only tangible, as an aspect to define the city beyond what you see, immersing himself in the perception of its inhabitants, its longings and desires, concerns, their forms of run in it.

The study of urban color, methodologies and approaches.
The study of urban color comprises the environment such as a transmitter of information chromatic, which has different connotations according to the context in which it is found. Accordingly, investigations in this field consider conditioning variables of the color of the cities, as are the permanent tones (referring to stable elements) and those random or ephemeral, linked to the changing factors of the urban image.
In the same way, the methodology of study contemplates the existence of three contexts: temporary (seasonal situation of the environment), space (physical condition) and cultural (historical-social factors and subjective citizen).

With regard to this second methodological approach Carlos Rodriguez (2014) suggests include a chromatic analysis from the methodology of the study of urban imaginaries “color analysis imagined cities contemplates the methodology of study of the social imaginary, based on research tools as the field diary, observation, interviews and the implementation of surveys to citizenship.”

With this latter approach seeks to identify the relations of the colors with the feelings and thoughts around the city, together with the tones that indicate the relationship between this and the citizen.
Precisely in this field, the French designer Jean Phillipe Lenclos is a pioneer. Its analysis is based on the “geography of color”, theory developed during his work as a colorist around the world and that is synthesized in the publication colors of the World (1999): The investigation of Geography of the color which originated in the 1960s, is based on the methodological and analytical observation of several visual components that contribute to the identification of the habitat. In fact, this is the most practical tool to delimit clearly the tones that constitute a place (Lenclos, 1999, p. 17)

For this work intends to add within these flows analyzed and from the contributions of new urban anthropology, the study of imagined color or perceived by the inhabitants. For this is taken as a point of departure the research developed by Armando Silva (2006)on urban imaginaries, as a clear benchmark of the cognitive relations which were built between the inhabitants of a city and how this is a form of appropriating the place where they live.
In this context is studying the cognitive perception of the inhabitants for the color of the city. Therefore, refers to the theory of the urban imaginaries and the mental constructs developed by persons in the exercise to be citizens. It should be clarified that this linkage between the methodologies of the urban imaginaries and the color element as the protagonist, means a new scenario or point from where from for the

study of color, therefore, from here, it offers a new perspective more attached to the perception of the people and their stories in relation with the colors that the haunt.

2. METHOD

The overall objective of the project is to investigate the relationship between the built color and imagined color in the city of Puerto Vallarta, as axs that allowed to study the chromatic values identified by its inhabitants ,to reveal their knowledge, experience, multiplicity and perception as a result of an urban cultural construction.
This includes setting specific objectives around which there will be a methodology of qualitative approach: to study the contexts of color in the city from the perspectives: temporary (seasonal situation of the environment), space (physical condition) and cultural (historical-social factors and subjective citizen).

To know the nature of the color values of the city and relate them with the values identified by its inhabitants from the construction of the urban imaginary of the color and the chromatic relations that are configured.
• Observe and analyze visual components of color that contribute to the identification of the habitat, to study the tones that constitute a place, and their perception from the urban experience.
• Describe to the city from the chromatic study to know the perception of its inhabitants and to be able to interpret it from the visual image.
• Establish partnerships between the color with urban aspects, sensations and feelings of the inhabitants.
• Identify relationships that set the inhabitant between the color and the places of the city.
• The methodology to be applied will be structured around phases that allow the development of the project in two levels of inductive approach from the physical analysis of color to the perceptive analysis developed by the inhabitant.

For the physical analysis of color of the city raises the approach with techniques of direct observation, as photographic record, notes of drawing, color scanning, registration of dominant palettes.
For the qualitative analysis of the color “imagined” arises the boarding from interviews with key informants, surveys and visual ethnography.
The systematization and analysis of the information obtained in the two aforementioned levels, possible to structure a reading the color of the color in the city of Puerto Vallarta that can give an account of the relations between the inhabitants and the different chromatic properties of the city.

3. RESULTS AND DISCUSSION

The city acquires meaning through its colors that we already know, are not innocent. In the light of the foregoing, the selection of colors must be part of a larger project, where it is understood that this can contribute significantly to assemble comprehensive spaces, enhancing the architecture, history, social organization, aesthetics and, ultimately, to conform better cities.
The article intends to establish a working methodology that question: What is the relationship between the built color and imagined color in the city of Puerto Vallarta that reveal the color values of the city, correlating it with the values identified by its inhabitants, to reveal their knowledge, multiplicity, perception and experience as a result of an urban cultural construction?

We pretend to answer this question by analyzing the debate surrounding the relationship between architecture and the urban landscape, setting the color as a primary agent to study the relations of the colors with the feelings and thoughts around a tourist city, in conjunction with the tones that indicate the relationship between this and the inhabitant.

It seeks here to note as the color becomes an influential factor in the visual perception of a city, but also as part of the construction of the urban imaginaries and the mental constructions of its inhabitants, as well as the cultural dynamics that occurred in the interaction of these with the places of the city.

4. CONCLUSIONS

In the present work, is argued that the study of built color and the imagined color in the city of Puerto Vallarta, can give an account of the nature of the color values of the city and to relate them to the values identified by its inhabitants, reveal their knowledge, experience, multiplicity and perception as a result of an urban cultural construction
It is intended here to note as the color becomes an edifying element in the visual perception of a city, but also as part of the construction of the urban imaginaries and the mental constructions of its inhabitants, as well as the cultural dynamics that occurred in the interaction of these with the places of the city.

Beyond seek to identify color-wise to a city, we performed a reading of the perspectives and insights of the inhabitants that are manifested in their needs, desires, emotions or feelings in their city and that mean a particular cultural construction of the same.

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POSTER SESSION 2

The Relation between Colorimetric Quantities of Two-Color Combinations and the Image Scale of "warm-cool" and "soft-hard"

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ABSTRACT

The purpose of this study is to find the relation between colorimetric quantities of two-color combinations and the axes of warm-cool and soft-hard on the color image scale. The colorimetric quantities were calculated from CIELAB values of three constituents of a combination. These values are the mean of lightness , the mean of chroma , and the mean of hue angle , as well as the differences in lightness , the differences in chroma , and the differences in hue . A multiple regression analysis was performed to find the relation of these quantities with the image scales. The warm-cool image has the strongest relation with the difference in hue. When L^* becomes larger, the image of color combinations becomes warmer, while L^* becomes smaller the image becomes cooler. On the other hand, the soft-hard image has the strongest relation with the mean of lightness. When becomes higher, the image becomes softer, while becomes lower the image becomes more hard.

1. INTRODUCTION

In our daily life, colors are never seen in isolation, but always presented together with other colors. Among many kinds of color combinations, two-color combination is the most basic combination. If an impression of a color combination can be described by colorimetric quantities of the combination, it will be useful both for color design and for color analysis. Previous studies clarified the relationship between the impression and colorimetric quantities of the combinations (Ou et al. 2004, Lee 2010). For the combinations with two or three colors, a practical color image space, with the axes of "warm-cool" and "soft-hard," was proposed by S. Kobayashi (1981). However, a relationship of these axes with colorimetric quantities was not defined, as the scales were obtained from a factor analysis of data. The purpose of this study is to find the relation between colorimetric quantities of two-color combinations and the axes of warm-cool and soft-hard described above.

2. METHOD

2.1 Color Stimuli

One hundred two color pairs were used as stimuli in the psychological experiment, each consisting of two square color patches placed side by side (left being A, right being B). The color pairs were selected to best represent the Munsell color space as referenced by Lee. Each was 3cm×6cm in size. Spectral reflectance of the composed color of the samples was measured by use of a spectrophotometer. The tristimulus value (X, Y, Z) of each sample was calculated from the reflectance of the sample and the CIE1931 standard colorimetric observer. It was then transformed into the CIE1976 L*a*b*metric coordinates with respect to illuminant C.

2.2 Evaluation Scale

The "warm–cool" and "soft-hard" scale consisted of seven steps respectively. For "warm–cool" scale, the score of the subjective evaluation values was decided as follows: “extremely warm” as -3, “warm” as -2, “slightly warm” as -1, “neutral” as 0, “slightly cool” as 1, “cool” as 2, “extremely cool” as 3. For “soft-hard” scale, the score was decided as follows: “extremely hard” as -3, “hard” as -2, “slightly hard” as -1, “neutral” as 0, “slightly soft” as 1, “soft” as 2, “extremely soft” as 3.

2.3 Observer

Thirty six observers of both genders, from 20 to 30 years old. All had normal color vision.

2.4 Lighting Condition

Sixty four fluorescent lamps (40W, Ra:AAA, RLF40S D-EDL-D65M, Toshiba), set in the ceiling of the laboratory (area 58m2, height 3m), were used. The illumination on the surface of the desk was 1000 lx approximately.

2.5 Experimental Procedures

Each observer was presented with color stimuli on a gray background with L*of 50. The experiment was divided into 2 session. 1st session was “warm-cool”, 2nd session was “soft-hard” In each session, observers subjectively evaluated the One hundred two samples at random, each taking about 20 min.

3. RESULTS AND DISCUSSION

The evaluated values of “warm-cool” and “soft-hard” were classified into groups respectively, that is, beyond a score of 2.00, less than -2.00, and between -2.00 and 2.00. As shown in Table 1., the combinations in the “warm” scoring group were composed of vivid tones and deep tones. The main colors were red and yellow. Their difference in hue was large. On the other hand, the combinations in the “cool” scoring group were composed grayish tones and blue colors. The combinations in the “soft” scoring group were composed of pale tones and light tones. Their mean lightness was high. On the other hand, the combinations in the “hard” scoring group were composed dark tones and dark-grayish tones. Their mean lightness was low.

warm		cool		soft		hard	
sample	evaluated value	sample	evaluated value	sample	evaluated value	sample	evaluated value
	-2.92		2.92		2.75		-2.58
	-2.75		2.92		2.67		-2.50
	-2.75		2.75		2.58		-2.50
	-2.75		2.75		2.58		-2.42
	-2.75		2.75		2.58		-2.25
	-2.75		2.67		2.50		-2.08
	-2.50		2.67		2.42		-2.08
	-2.50		2.58		2.33		-2.00
	-2.50		2.58		2.25		-2.00
	-2.33		2.58		2.17		
	-2.25		2.58		2.08		
	-2.25		2.50		2.00		
	-2.17		2.42		2.00		
	-2.08		2.25				
	-2.00		2.25				
			2.25				
			2.17				
			2.17				
			2.08				
			2.08				
			2.00				
			2.00				
			2.00				
			2.00				

Table 1. “warm-cool” and “soft-hard” scoring group.

Necessary and sufficient quantities to determine two-color combination were chosen as predictor variables for the multiple regression analyses. The $L^*a^*b^*$ coordinates were first transformed into the L^*C^*h coordinates, because $L^*a^*b^*$ coordinates are difficult to perceive visually. Finally, six quantities, the mean values $\overline{L^*}$, $\overline{C^*}$, $\overline{h}$ and the color differences ΔL^*, ΔC^*, ΔH^* were calculated from the L^*C^*h coordinates of the sample (L^*_A, C^*_A, h_A and L^*_B, C^*_B, h_B). Hue difference ΔH^* was used instead of Δh because ΔL^*, ΔC^*, and ΔH^* have the same dimension of distance. Note that all these quantities have the dimension of distance in the CIELAB uniform color space. See Figure 1

$$
\begin{aligned}
& L^*_A,\ a^*_A,\ b^*_A \text{ and } L^*_B,\ a^*_B,\ b^*_B \\
\leftrightarrow\ & L^*_A,\ C^*_A,\ h_A \text{ and } L^*_B,\ C^*_B,\ h_B \\
\leftrightarrow\ & \overline{L^*},\ \overline{C^*},\ \overline{h} \text{ and } \Delta L^*,\ \Delta C^*,\ \Delta h \\
\leftrightarrow\ & \overline{L^*},\ \overline{C^*},\ \overline{h} \text{ and } \Delta L^*,\ \Delta C^*,\ \Delta H^*
\end{aligned}
$$

Figure 1. Equivalence of six quantities.

A multiple regression analysis was performed to find the relation of these six quantities with the evaluated values. The objective variables were evaluated values of "warm-cool" and "soft-hard", and the explanatory variables were the above six colorimetric quantities. The result of the multiple regression analysis provided two regression equations. The expression (1) relates to "warm-cool" and the expression (2) relates to "soft-hard", as shown below:

ywc = – 0.81 – 6.11 + 4.19 – 3.95 (R = 0.88) (1)

ysh = – 5.15 + 8.47 + 2.52 – 1.74 (R = 0.92) (2)

The warm-cool image has the strongest relation with the difference in hue. When becomes larger, the image of color combinations becomes warmer, while becomes smaller the image becomes cooler. On the other hand, the soft-hard image has the strongest relation with the mean of lightness. When becomes higher, the image becomes softer, while becomes lower the image becomes more hard. It was explained the results of table 1. One hundred two pieces of the samples were plotted on a two-dimensional plane with the axes defined by the equations (1) and (2). See Figure 2. The distribution of the samples in this plane shows quite good correspondence to the Kobayashi's image scales (Kobayashi 1981).

4. CONCLUSIONS

The conclusions are summarized as follows:

(1) The representative colorimetric quantities for two-color combinations are the mean of lightness $\overline{L^*}$, the mean of chroma $\overline{C^*}$, and the mean of hue angle $\overline{h}$, as well as the differences in lightness ΔL^*, the differences in chroma ΔC^*, and the differences in hue ΔH^*.

(2) The result of the multiple regression analysis provided two regression equations. The expression (1) relates to warm-cool and the expression (2) relates to soft-hard.

(3) The warm-cool image has the strongest relation with the difference in hue ΔH^*, on the other hand, the soft-hard image has the strongest relation with the mean of lightness $\overline{L^*}$.

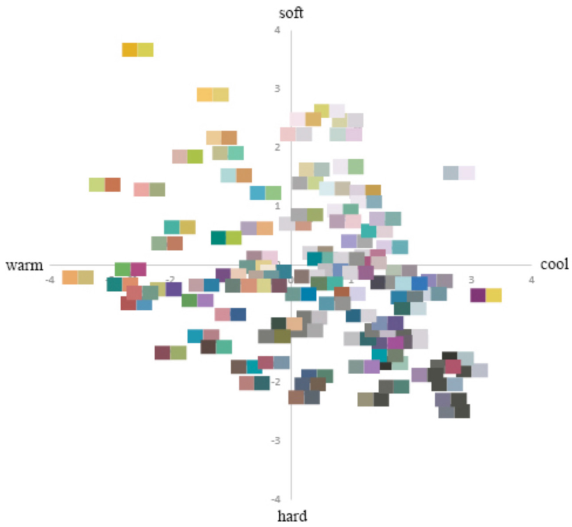

Figure 2. 102 two-color combinations in the Kobayashi's Color Image Scale.

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Research on the Difference of Ambience by Applying Different Background Colors at Stage

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ABSTRACT

With the development of technology and appearance of new media, new aspects started showing in the stage background of theaters. The traditional stage representation techniques through 'picture drawing' with color field are gradually replaced with the direction of lighting or complex technology. Recognizing differences of general ambience in accordance with the color application to the stage background of theaters, this study examined the ambience drawn by each application method.
In the results of the research, when realizing color for the stage background of theaters, depending on the application methods such as lighting or color field, there was specific ambience differently felt by audience. On the other hand, the ambiences noticeably shown in the lighting method were like fantastic, lively, or tense mood, so that it would be suitable for more dynamic performance or scenes. As the ambiences noticeably shown in the color field method were like peaceful, warm, or delicate mood, this type of color application method would be suitable for static mood. In order to more suitably and effectively deliver visual language to audience by differently using the color application method in accordance with the character and ambience of performance, more researches on communications between performance and audience should be continuously conducted.

1. INTRODUCTION

As a main element of more active communication between performers and audience by establishing the performance ambience and delivering language, there is the stage background color deciding the overall ambience of the stage. The appearance of new communication media by the development of modern technology, has accelerated changes in the methods of delivering the ambience of theaters. The picture drawing technique, which is an analog communication expressive method of performance art, has been changed into a converged method using light source, which is the recent trend of stage art expression. However, if the advanced technology cannot reflect the character of a play or it is unclearly abused, a different ambience could be represented.
The objective of this study is to examine differences of ambience in accordance with the color application to stage background of theaters such as color field like picture drawing or lighting as a modern method, and moreover, to understand words of ambience drawn by each color application method for stage background.

2. METHOD

For the research, the evaluation forms were distributed to 13 ordinary women in their 20s-30s, for about a week in November 2015. Due to the limitation of a special space as theater in the empirical research, a miniature theater model was produced. To replace the role of lighting in the actual theater, the screen was projected by using RGB value of a projector. In case of the stage color realization using light source, it was set up as 'lighting group' applying RGB value of projector to white screen. In case of the picture drawing technique, it was set up as 'color field group' illuminating white light source using projector on color paper. The objective of this study is to understand differences of general ambience in accordance with two different color application methods such as color field(picture drawing) and light source(lighting) in the same space of theater. Therefore, it focused more on sensorial similarly adjusting the color values of color field and light source, rather than physically adjusting them like 1:1. After physically adjusting the color values of two groups with a luminance meter of KONICA MINOLTA, the similar value of two groups was adjusted with the naked eyes in the 3D experimental space. Total nine colors of stimuli were given to both groups, and for the assessment of the test, the Likert's five-point scale was used. Regarding words of ambience to be assessed, from test participants, total ten words with the high degree of ambience association or clear connection with color were extracted like 'fantastic', 'peaceful', 'romantic', 'lively', 'warm', 'delicate', 'tense', 'spooky', 'gloomy', and 'scary'. The nine colors selected from the earlier test stimulation were extracted from the color space of light source < KS A 0012 > like <Figure 1>.

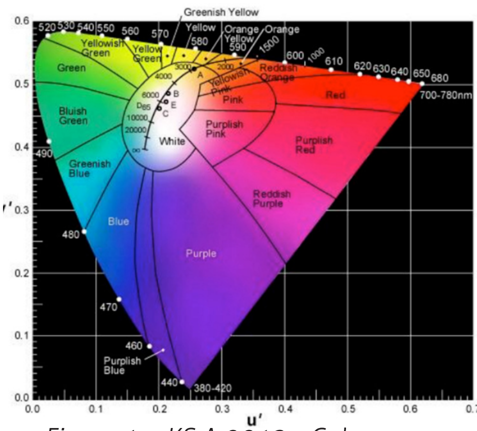

Figure 1. <KS A 0012> Color space of light source

	ambience	Lighting		Color Field	
		Average	Standard Deviation	Average	Standard Deviation
Ambiences showing differences in accordance with the application method	tense	3.054	0.74	2.287	0.524
	scary	2.434	0.962	1.556	0.197
	peaceful	2.574	0.617	3.408	0.205
	delicate	2.287	0.8	3.656	0.205
Ambiences showing no differences in accordance with the application method	fantastic	3.462	0.811	3.102	0.699
	lively	3.166	0.777	2.833	0.767
	warm	2.86	0.782	3.269	0.728
	romantic	2.61	0.592	3.25	0.734

Table 1. Color values of lighting group and color field group shown in each lighting color, measured by optical equipment

As an analysis program, the IBM SPSS Statistics 23 Program was used. In order to comparatively analyze differences of ambience depending on the stage color application methods, it used non-parametric test, Mann-Whitney's U-test, and means analysis while its significance level was set up as 95%, which is universally used, in the social statistics.

3. RESULTS AND DISCUSSION

In the results of the study, first, among <ten ambience words suitable for performance art> initially extracted from participants, there were words showing significant differences of ambience in accordance with the color application method as their 'significance probability p value' was lower than 0.05. It means that there are ambiences showing clear differences depending on the application method while there are ambiences, which are not largely influenced by the application method. As the ambience showing clear differences, 'delicate' was the highest, and then followed by 'peaceful', 'tense', and 'scary'.

	ambience	P-value	Result
1	fantastic	.291¹	No Difference between the ambience
2	peaceful	.004¹	Difference between the ambience
3	Romantic	.050¹	No Difference between the ambience
4	Lively	.387¹	No Difference between the ambience
5	Warm	.340¹	No Difference between the ambience
6	Delicate	.000¹	Difference between the ambience
7	Tense	.004¹	No Difference between the ambience
8	Spooky	.161¹	No Difference between the ambience
9	Gloomy	.436¹	No Difference between the ambience
10	Scary	.008¹	Difference between the ambience

Table 2. Results of ANOVA on ambience words in each application method.

Applying / Ambience	Lighting		Color Field	
	Average	Standard Deviation	Average	Standard Deviation
Fantastic	3.462	.811	3.102	.699
Peaceful	2.574	.617	3.408	.524
Romantic	2.610	.592	3.250	.734
Lively	3.166	.777	2.833	.767
Warm	2.860	.782	3.269	.728
Delicate	2.287	.800	3.656	.226
Tense	3.054	.740	2.287	.205
Spooky	2.537	.850	2.011	.326
Gloomy	2.370	.870	2.011	.504
Scary	2.434	.962	1.556	.197

Table 3. Results of means analysis on ambience words in accordance with the application method

Second, regarding two different application methods like light source and color field, in order to relatively compare mean values of ambience words, the means analysis was used. In the results, regarding the lighting application method, the mean value of 'fantastic', 'lively', and 'tense', was relatively high. In case of the color field application method, the mean value of 'peaceful', 'warm', and 'delicate' was high.

	ambience	Lighting		Color Field	
		Average	Standard Deviation	Average	Standard Deviation
Ambiences showing differences in accordance with the application method	tense	3.054	0.74	2.287	0.524
	scary	2.434	0.962	1.556	0.197
	peaceful	2.574	0.617	3.408	0.205
	delicate	2.287	0.8	3.656	0.205
Ambiences showing no differences in accordance with the application method	fantastic	3.462	0.811	3.102	0.699
	lively	3.166	0.777	2.833	0.767
	warm	2.86	0.782	3.269	0.728
	romantic	2.61	0.592	3.25	0.734

Table 4. Matter of having differences of ambience in accordance with the application method

Summarizing the results earlier, there were two groups like ambiences showing differences in each lighting application method, and ambiences not influenced by the application method. The ambiences largely influenced by the color expression methods like light source or color field, were like tense, scary, peaceful, and delicate. When the tense and scary ambiences were expressed with lighting, relatively, they could be felt more intensely. When peaceful and delicate ambiences were expressed with color field, they could be more effectively felt. Therefore, it would be effective to use lighting when aiming to express tense and scary ambience, and also to use color field when aiming to express peaceful or delicate ambience. On the other hand, the ambiences showing no differences in accordance with the lighting application were like fantastic, lively, warm, and romantic. Even though there were not huge differences of ambience in each application method, they can be classified into a group more influenced than the other. In case of fantastic and lively ambience, the lighting application is relatively more suitable while the application of color field is more suitable for warm and romantic ambience.

4. CONCLUSIONS

As a study to recognize differences of ambience in accordance with the color application method, and also to understand ambiences drawn by each application method regarding the realization of stage background color of theaters, rather than thoughtlessly using the advanced lighting technology by the development of media, conclusions are like following. When realizing colors for the stage background of theaters, there are specific ambiences differently felt by audience in accordance with the application method like lighting or color field. As ambiences remarkably shown in the lighting application method were fantastic, lively, or tense, it would be more suitable for more dynamic performance or scenes. As ambiences remarkably shown in the color field application were peaceful, warm, or delicate, it would be more suitable for static ambience. In order to more suitably and effectively deliver visual language to audience by using the application method suitable for the character, ambience, and directing intention of performance, it is expected to have more researches on visual communications at theaters.

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Legibility Difference of the Lightness Contrast Based on Colors of the Font and Background in the User Interface

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ABSTRACT

Due to rapid supply of mobile devices, researches on legibility of text by font types used in the Web have been conducted actively because the interest is shifting from print media to the web interface environment and the rate to acquire and use information from the tablet PC in the web interface is increasing. This study examined how the legibility assessment of the three basic types of font had changed depending on the lightness contrast based on colors of the font and background in the user interface. The independent variable of the experiment was set to the type of the font, the lightness contrast of background and texts, and the type of the display screen. The lightness contrast based on colors of the font and background, and the types of font and display have been identified as factors that affect the legibility assessment. Also, it was confirmed that the standard of minimum lightness contrast users felt was different according to each font. Thus, this study can propose the proper colors of font and background in order to effectively apply various fonts to consider users when configuring a user interface on the Web. Also, it may be provided as the basis for the interface configuration.

1. INTRODUCTION

Due to rapid supply of mobile devices, researches on the legibility of text by font types used in the Web have been conducted actively because the interest is shifting from print media to the web interface environment and the rate to acquire and use information from the tablet PC in the web interface is increasing. Through these studies, many researchers have been paying attention to providing a comfortable experience for the user interface. If the legibility of the text in the user interface of the web was not considered properly, the problems that could reduce the accuracy and speed in users' tasks were pointed out. Therefore, through experiments, the color scheme of the text and background may affect the accuracy and speed in the process of obtaining information (Ling and Van Schaik 2002).

In the mobile display environment, the type of Hangul (Korean Character) font, the size, and the background colors were discussed as the physical factors that affect the legibility in mobile user experience (Oh 2012). In another study, the type of font, ages and color contrast of texts and background were set to cause the results to vary from guessing experiments in the experiment of testers' answering the Hangul characters. Also, additional research on the legibility by color contrast or the contrast of shading was needed (Song, Lim and Lee et al. 2009). Previous studies were conducted by the experiment for legibility assessment with Gothic and Myungjo the most basically have been used, and the experiment of legibility assessment in the conditions of big difference between white text on a black background and black text on a white background has been processed. Based on these results, the purpose of this study is to investigate the minimum standards of good lightness for users and the difference of legibility when breaking down the lightness contrast phases of the background and text colors on mobile and monitor.

2. METHOD

The experiment was conducted by setting general illumination LED lighting installed in the booth. The types of display used in the experiment were 5.7 inches of Samsung Galaxy Note 3 in the case of Mobile and 27 inches DreamColor Z27x Professional Display made by HP in the case of the monitor. In order to be the word appeared on the mobile and monitor screen in the same field of view, the field of view set the viewing angle of 1.1 degrees and the size of the letters was to evaluate the legibility from a distance of 30cm by 0.6cm when the testers viewed the mobile screen. Also, people evaluate the legibility from a distance of 80cm by 1.6cm when the testers viewed the monitor screen (Figure 1).

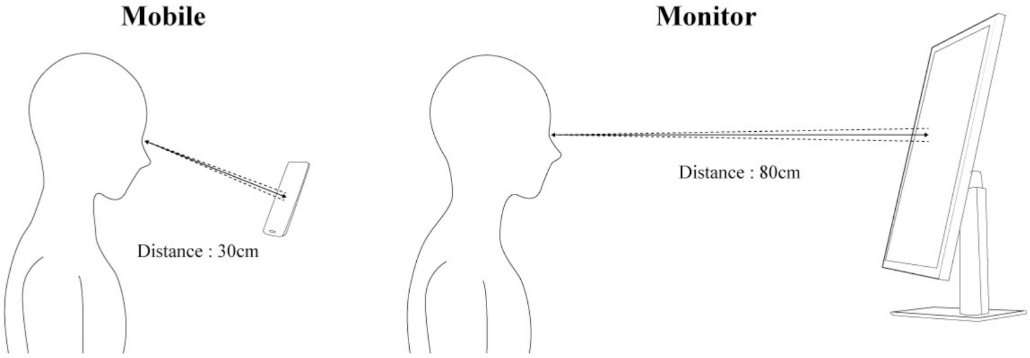

Figure 1. Legibility distance from screen

Words of two syllables are displayed on the screen were randomly extracted from two-syllable words with at least 50 times frequency the National Institute of the Korean Language (2002) configured. The background of 120 sheets of samples were is five types of N1, N3, N5, N7, and N9.5 and the text colors were 8 types of N1, N2, N3, N4, N5, N6, N7, N8 and N9.5 except for the same color as the background (Figure 2).

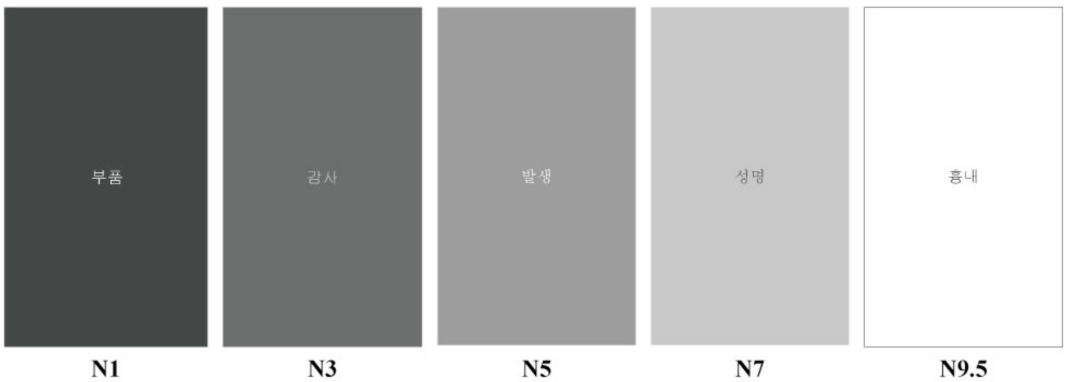

Figure 2. The sample of the legibility tests

Also, the most basic font Gothic, Gulim and Myungjo were divided into three types and presented. The experiment was targeted 15 people out of 20s to 40s, 15 testers were involved in a total of 2 single experiments with different ways of presenting the screen. And, the remaining conditions except for the type 2 experimentation displays were performed in the same manner. Experimental survey was configured using a Likert 5-point scale to evaluate the legibility of the word appearing on each screen.

3. RESULTS AND DISCUSSION

When a screen of color compared to the legibility assessment in environments was N1 in both experiments of the mobile and monitor, Gothic did not show the significant difference between the legibility assessment of mobile and monitors. However, Gulim and Myungjo showed a big difference in the legibility assessment in the section of font color N3 to N7 depending on display types (Figure 3).

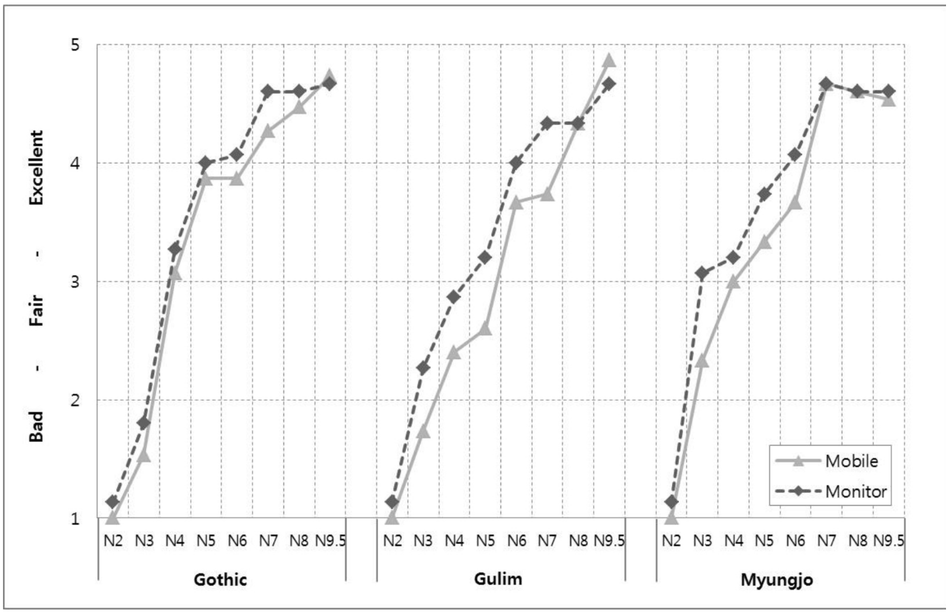

Figure 3. Legibility assessment in the mobile and the monitor based on the font type and color of words appeared on N1 of the background color

When the screen background color was N3, in both Gulim and Myungjo fonts, the lightness differences, which began to improve legibility on another display of the mobile and monitor, equally appeared. On the other hand, Gothic showed legibility improvement in the monitor since the lightness contrast was greater than three and the evaluation of Gothic began to be improved since the lightness contrast was greater than four. It was confirmed that in the case of the Gothic, legibility assessment had improved since lightness difference with the darker text color than the screen background color N5 in mobile was greater than 3. Also, legibility assessment had a good evaluation when lightness difference was greater than 3 in case text colors were brighter than background color N5. These results were also found in the same monitor.

When the screen background color was N7 and all three types of fonts had the darker text colors than N7, lightness contrast, which appeared better legibility on mobile and monitor, resulted in differently. For legibility, the Gothic was rated good in a mobile environment than the monitor. For Gulim, since the lightness difference between the background color and the text color was more than 4, Gulim was rated good in both of the mobile environment and the monitor. However, in case of Myungjo, the legibility assessment in the monitor had been rated above average 3 points since the lightness difference between the background color and the text color was 4. In a mobile environment, the legibility assessment had been rated good since the lightness difference was 5. It was able to confirm that in N9.5, the background color of the screen, Gothic and Gulim showed the lightness difference, which began to be rated good equally in both of the mobile environment and the monitor, but Myungjo did larger difference in the mobile environment than the monitor.

4. CONCLUSIONS

This study examined how the legibility assessment of three types of fonts used by default had changed depending on the lightness contrast between text colors and background colors in the user interface environment. The purpose of this study was to investigate the minimum standards of good lightness for users by breaking down the lightness contrast phases of the background and text colors on a mobile and a monitor based on the experiments results of the previous studies. In accordance with conclusions are as follows:

The lightness contrast of the text and background colors, the type of font and the type of display have been identified as factors that affect the legibility assessment and the legibility of each font had a different minimum standard of lightness contrast to be rated good. Also, in spite of the same background color with the mid lightness, the results of the legibility assessment may be changed depending on the lightness of the text color compared to the background color. Thus, based on these results, different user interface should be considered. Thus, this study can propose the proper colors of font and background in order to effectively apply various fonts to consider users when configuring a user interface on the Web. Also, it may be provided as the basis for the interface configuration.

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Comparison of Sensibility in Light Source Color, and Object Color of Red and Green

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ABSTRACT

This study is intending to do comparative analysis of a human's emotional reaction consequent on brightness of Red, Green color light, and object color in Mock-up space.
To this end, this study conducted an experiment on 20 subjects in their 20s~30s, and analyzed the emotional evaluation results when illuminance was 10 lx and 100 lx in the space created by Red, Green color light and object color.
As a result of this research, the experimental space, in which the Green color light was used, was highly evaluated for its [Stable] image while the experimental space, in which Green object color was used, was highly evaluated for its [Energetic] image. In addition, as for the experimental space, in which Red and Green object color were used, its [Unusual] image was highly evaluated, through which, this study was able to learn that there existed the difference in sensibility according to color light and object color. Such a difference in sensibility can be interpreted as the actual influence of color light and an object color on feelings.

1. INTRODUCTION

1.1 Research Background and objective

According to the change of society, we come to spend longer daily life in closed space, and thus become accustomed to the life in indoor space. Due to such a living environment, we are much influenced by indoor space composition factors.
Especially, color and lighting environment are having a lot of influence on us from the cognitive, mental, physical aspects. From the past, there have been many researches on light therapy and color therapy using lighting and color, but insufficient are the researches, which have inquired into influential factors in color and lighting environment, and their consequent result quantitatively, or compared a human's sensibility response to color light, and the object color painted on the wall. Hereupon, this study did a comparative analysis of a human's sensibility response consequent on the color light, and brightness of an object color of Red and Green in a Mock-up space.

1.2 Research Method and Scope

This study, targeting adults in their 20s~30s, conducted and analyzed the emotional evaluation in space of Red, Green color light, and object color, and this study progress is as follows:

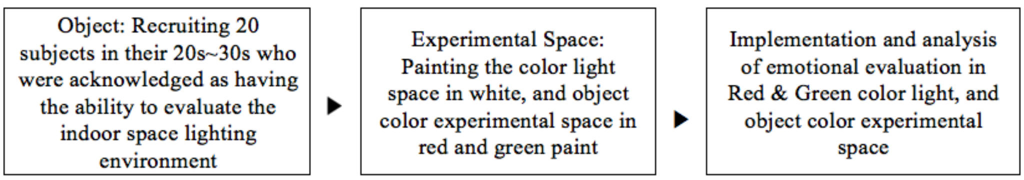


Figure 1. Research Progress Method.

2. SPECIFICS OF THE STUDY

2.1 Experimental Environment

This study partitioned off the experimental space into the dimension of 1500mm×1500mm×2400mm. In order to reduce visual errors from the joint, or texture of each experimental space when it is finished with paper, etc., this study painted the color light experimental space in White (N9.5, S0500-N), and painted the object color experimental space in Red (5R 4/14, S2070-R) and Green (7.5G 5/8, S2555-G). In time of doing experiments, this study avoided the influential factors, such as daylight, artificial light and furniture, etc., and created an environment to make it possible to proceed with the experiment stably by cutting off external environmental factors.

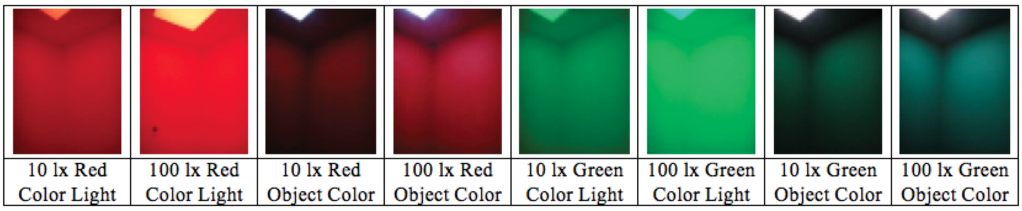


Figure 2. Experimental Environment

2.2 Experimental Light Source and Experimental Variables

The color light source used in this experiment was color light LED and D65 Standard Light Source, which are available for Red, Green, Blue Dimming, and this study composed the experimental space with 600mm×600mm size lighting fixtures as ceiling mounted direct lighting. Also, as for
Red, Green color light variables, this study controlled Red, Green color and illumination using the user interface program.

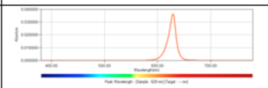
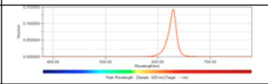
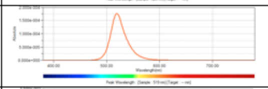
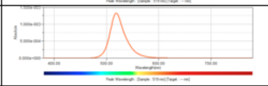
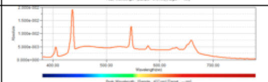
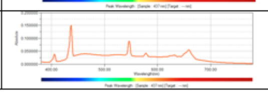
Light	Spectral Distribution	Color Coordinate	
		x	y
Red (10 lx Standard)		0.6921	0.3076
Red (100 lx Standard)		0.6928	0.3070
Green (10 lx Standard)		0.1636	0.7370
Green (100 lx Standard)		0.1590	0.7344
D65 Standard Light (10 lx Standard)		0.3066	0.3205
D65 Standard Light (100 lx Standard)		0.3051	0.3149

Table 1. Spectral Distribution of Experimental Light Source

2.3 Subject Composition

This study organized the subjects participating in the experiments with 20 architecture-related majors who were free of anxiety about closed space, and physically healthy as well as acknowledged as having the ability to evaluate the indoor space lighting environment. This study conducted the experiment after giving a prior explanation about the research method and objective, etc., delivering experiment-related precautions adequately, and getting a consent to participation in the experiment from the subjects.
2.4 Evaluation Item and Evaluation Method
This study divided the evaluation items into a feeling of emotional image consequent on color light, and conducted the experiment using the 5-phase value scale method.

This study extracted the final evaluation vocabulary after collecting related words through the preceding researches and literature research.

Evaluation Vocabulary	Comfortable Warm Delicate Pleasant	Fervent Restrained Stable Cheerful	Tender Exotic Up-to-date refined	Refreshing Unique Open Colorful	Lively Luxurious Cozy
Evaluation Scale	Not very so		So so	Very so	

Table 2. Evaluation Vocabulary and Evaluation Scale of Emotion

3. Experiment Result and Analysis

3.1 Emotional Evaluation Result Consequent on Color Light

3.1.1 Factor Analysis Result

As a result of conducting factor analysis, a total of 19 evaluation words were classified as 4 factor axes while showing 73.418% explanation power. The detailed view of factor analysis results is as follows : Factor I is the most influential one in evaluation while showing the 22.503% contribution rate 22.503%, and it is comprised of evaluation items, such as 'refreshing', 'pleasant', 'stable', 'comfortable', 'open', 'up-to-date', 'restrained, which were designated as a [Stable] axis. Factor I is comprised of evaluation items like 'energetic', 'colorful', 'fervent', 'unique', 'cheerful', 'warm', while showing the 21.510% contribution rate, being designated as an [Energetic] axis. Factor is comprised of evaluation items like 'cozy', 'tender', 'subdued' with the 17.602% contribution rate, being designated as a [Tender] axis. Factor IV is comprised of evaluation items like 'refined', 'luxurious', 'unusual' with the 11.802% contribution rate, being designated as an [Unusual] axis.

3.1.2 Float Chart Analysis Result

As a result of Float Chart Analysis, the [Stable] image shown in Axis 1 was highly evaluated in Green color light experimental space in 10 lx, and 100 lx, and Red color light experimental space in 10 lx, and 100 lx, especially in Green color light experimental space.
The [Energetic] image shown in Axis II was highly evaluated in Green object color experimental space in 10 lx, and 100 lx, and Green color light experimental space in 100 lx, and Red object color experimental space in 100 lx, especially in Green object color experimental space.
The [Tender] image shown in Axis III was highly evaluated in Red, Green color light experimental space in 10 lx, and 100 lx, and Red object color experimental space in 10 lx, and 100 lx.
The [Unusual] image shown in Axis IV was highly evaluated in Green object color experimental space in 10 lx, and 100 lx, and Green object color experimental space in 10 lx, and 100 lx, especially in Green object color experimental space.

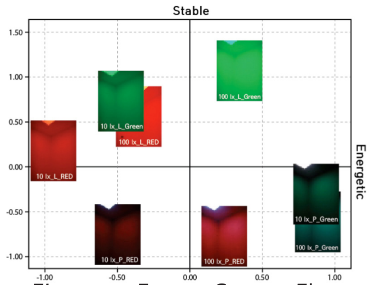


Figure 3. Factor Scores Float Chart I · II Factor

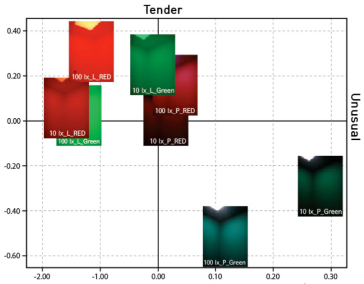


Figure 4. Factor Scores Float Chart III · IV Factor

4. CONCLUSIONS

1) As a result of comparing the preference for Red, Green color light experimental space in 10 lx and 100 lx with the preference for Red, Green object color experimental space in 10 lx, and 100 lx, this study could learn that Red color light experimental space was the least preferred while Green color light, and Green object color experimental space in 100 lx were the most preferred.
2) As a result of factor analysis, it was classified as 4 [Stable], [Energetic], [Tender], [Unusual] factor axes while showing the 73.418% explanation power.
3) As a result of Float Chart analysis, Green color light experimental space was highly evaluated in the [Stable]axis. Also, Green object color experimental space was highly evaluated in the [Energetic]axis, and Red, Green object color experimental space was highly evaluated in the [Unusual]axis.
This study result revealed that there is the difference in emotion depending on color light and object color. Such an aspect is interpreted as the fact that brightness of lighting, color light and object color have an influence on feelings. This study is going to conduct the experiment by organizing the color and age group diversely hereafter.

ACKNOWLEDGEMENTS

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Analysis of the Influence of Color Temperature on HRV (Heart Rate Variability) in Time of Luminaire Ceiling Projection

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ABSTRACT

This study is targeting large area lighting, i.e. a luminous ceiling. This study classified variables into 3000K and 6000K in color temperature with the average lumination of 100lx. Hereupon, this study confirmed HRV influence before/after stimulation. The study results are as follows: The cardiovascular system variables based on large area lighting (luminous ceiling) were all included in standard range, and in the significance probability before/after stimulation, there appeared no significant difference with more than 0.05 in both variables. It was found that 3000K showed a stable response in SDNN, VLF and HF while 3000K showed a negative response in LF. Accordingly, mental stress got higher in 3000K, but regulation of body temperature, vasomotion, and adaptability to external environment, and HRV showed a positive response.

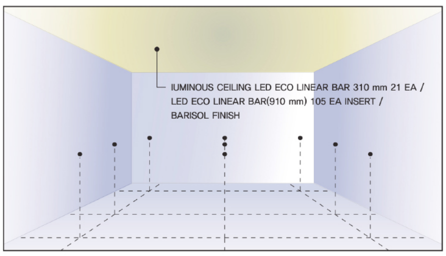
1. INTRODUCTION

Lighting limitations, which were not surmounted from the aspect of physical reproducibility, or technology in the past, have been rapidly overcome by LED development, especially in the sector of area, form and installation method, etc. At present, in case of LED-embedded large area lighting, the trend is towards appearing even in indoor lighting together with lighting for advertisements. Such a lighting environment is based on multi-dimensional base psychological quantity like emotion & preference, etc., and actually, the physiological quantity by a human body signal has not been concretely examined as yet. Hereupon, it's the point of time of data construction based on the physiological quantity in time of creating a lighting environment, and there is the necessity of having to analyze the autonomic nervous system response of lighting variables.

2. EXPERIMENTAL METHOD

2.1 Experimental Environment

The experimental space is a darkroom of 4210 mm (W) x 5180 mm (D) x 2500 mm (H). This study composed LED-embedded large area lighting (luminous ceiling) of 4310 mm (W) x 5180 mm (D).



(a) Multiple Point Method of KS(9 Point)(lx)

Variable	Color Temperature (K)	Illumination (lx)	Color temperature Dimming Level		Multiple Point Method of KS(9 Point) Average Illuminatin (lx)									
			Worm	Cool	1	2	3	4	5	6	7	8	9	A
1	3000	100	18	3	89	103	92	115	125	105	92	106	97	103
2	6000	100	1	16	68	79	71	90	97	80	71	83	76	79

(b) Multiple Point Method of KS(9 Point)(lx)

Figure 1. Evaluated physical quantity

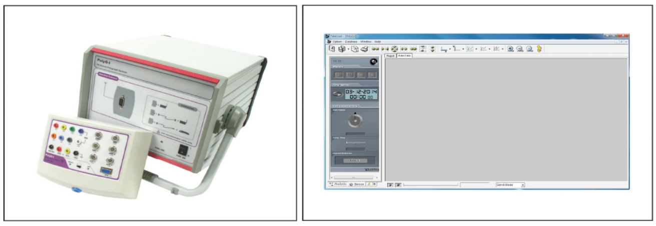
This study composed the whole ceiling side of a light source, and the finishing work was done on the diffuser plate with Bari-Sol. Also, this study calculated the average illumination by means of KS Multi-point (9-point measurement) procedure, and classified the light-caused variables (stimulus quantity) into 3000K and 6000K in color temperature with the average illumination of 100 lx.

2.2 Constitution of Volunteers

Volunteers are constituted with the total of 12 persons of junior class and above of architectural engineering department and graduate students in their twenties and thirties who do not have any abnormality of color vision and whose perceptual capabilities for architectural illumination environment are recognized.

2.3 Evaluation Method

The change of HRV (heart rate variability) is measured with test equipment in accordance with Poly G-I, and through TeleScan 3.1, the time area (SDNN) and frequency area (VLF, LF, HF), i.e., the cardiovascular variables, are extracted.



(a) Poly G–I

(b) TeleScan 3.1

Time area analysis

Variable(unit)	Explanation	Trend
SDNN(ms)	Standard deviation of all N–N interval	If it becomes higher, it will be more stable

Frequency area analysis

Variable(unit)	Explanation	Range	Trend
VLF(ms^2)	Very Low Frequency	≤ 0.04 Hz	If it becomes higher, it will be more stable
LF(ms^2)	Low Frequency	0.04–0.15 Hz	If it becomes lower, it will be more stable
HF(ms^2)	High Frequency	0.15–0.4 Hz	If it becomes higher, it will be more stable

(c) Cardiovascular variables

Figure 2. Evaluation equipment and cardiovascular variables

Volunteers took rest for 5 minutes after sitting down on chairs before the evaluation. When the evaluation was started, they stared at the front from the center of space as shown in the following figure. During the evaluation, the fatigues of volunteers were minimized by creating the darkroom before and after the stimulation. At the time of the stimulation, the factor 1 (3000 K) and factor 2 (6000 K) were projected. Hereupon, the amount of change of autonomous nervous system at pre-stimulation and post-stimulation was compared.

(a) 3000 K, 100 lx

(b) 6000 K, 100 lx

(c) Appraisal procedure

Figure 3. Image of volunteer evaluation and the evaluation procedure

3. EXPERIMENTAL RESULT AND ANALYSIS

Variation of cardiovascular system before and after the large area light (luminous ceiling) stimulation was compared and analyzed. Through SPSS21 statistics program, Shapiro-wilk (parametric and non-parametric examination) was conducted. Hereupon, significance probability was obtained with corresponding 2-sample examination in accordance with parametric/non-parametric result.

Lighting Company	Sorts of Light Source		Control		Function Convergence										Remarks
	LED	OLED	Lumination (light amount)	Color Temperature (Light color)	Security (Crime prevention)	Weather & location information	Facilities, such as heating, ventilation and fire, etc.	Alarm	Sensor	Creation by time slot	Dimming control	Creation of activity type	Control Mode	Product connection	
Zumtobel	○	○	○	○					○						• Sensor : Provision of feedback on lumination and light
Fegerhult	○		○	○					○	○					• Through the installation of lighting trail in the whole space, mounting of diverse lighting on the trail, such as LED Module, and down light, etc. • Provision of customized optics design index by space function to Web공 • Sensor: Motion, Indoor space brightness
Sharp	○		○	○					○						• Lighting color/brightness vary automatically according to daily life pattern • Sensor : Outdoor daylight, or brightness of other lighting apparatuses
Phillips	○	○ (product)	○	○	○	○	○	○	○	○		○		○	• Control function of lighting color/sense of brightness, etc. through exclusive application • Sensor : Temperature(℃), daylight, etc.
Panasonic	○	○ (history)	○	○		○			○					○ (sound	• Launch of lighting products in the light of bio-rhythm in time of the sunrise and getting up through the research on Circadian rhythm • Sensor : Number of persons to be admitted for infrared light
Toshiba	○	○	○	○	○		○							○	• Control function through the remote control(mobile phone)-based connection between the network and the Internet
GE Lighting	○		○		○						○			○	• Control function of lighting on/off, lighting color and sense of brightness from the inside and outside • Function of sleep & rising mode
Cloud	○		○		○		○							○	• Application of lighting embedded with a fire alarm, and function of checking a fire alarm and brightness control through the smart phone
Mipow	○		○	○				○						○ (sound)	• Function of music playback/lighting on/off & brightness, color control through Bluetooth using smart phone App • IOS & Android Support
LG Electronics	○		○	○	○			○	○					○	• Function of lighting on/off & color temperature./brightness control through the application of IOT technology • Function of brightness control to music sound (Only Android products are available) • Function of lighting control of a vacant house • Sensing of a person/thing & brightness control through the street lamp sensor
Samsung Electronics	○		○	○					○					○	• Function of use environment information through communication module & automatic control of lighting environment, and provision of diverse information

3.1 SDNN(Standard Deviation of N-N Interval)

Standard Deviation of N-N Interval(SDNN) means 'being stable' in case it appears higher than a comparison variable. In case of a luminous ceiling in 3000K, SDNN increased more after stimulation(37.34 ms) than before stimulation(33.38 ms). In case of a luminous ceiling in 6000K, SDNN decreased more after stimulation(33.8m) than before stimulation(36.16m). Therefore, 3000K is judged to be much stable in the direct light projection method related to the resistance to stress. To find the significant difference based on statistical inference, this study conducted parametric test of the two variables, and the two variables were found to be commonly more than 0.05, showing no significant difference between the two variables.

3.2 VLF(Very Low Frequency)

Very Low Frequency(VLF) means 'being stable' in case it appears higher than a comparison variable. In case of a luminous ceiling in 3000K, VLF increased more after stimulation(883.62 ms^2) than before stimulation(616.43ms^2). In case of a luminous ceiling in 6000K, VLF increased after stimulation(558.32 ms^2) than before stimulation(521.41 ms^2), but variations by comparison & contrast were slight. Therefore, 3000K is much stable in the direct light projection method related to regulation of body temperature, vasomotion and hormone. To find the significant difference based on statistical inference, this study conducted non-parametric test in case of 3000K, and conducted parametric test in case of 6000K, showing that there was no significant difference between the two variables with more than 0.05 in common.

3.3 LF(Low Frequency)

LF(Low Frequency) means 'being stable' in case LF appears lower than a comparison variable. In case of a luminous ceiling in 3000K, LF increased more after stimulation(401.3 ms^2) than before stimulation(288.69 ms^2). In case of a luminous ceiling in 6000K, LF decreased more after stimulation (320.49 ms^2) than before stimulation(320.75 ms^2), but variations by comparison & contrast was slight. Therefore, 6000K is much stable in the direct light projection method related to stress, and bio-energy supply. To find the significant difference based on statistical inference, this study conducted parametric test in case of 3000K, and also conducted no-parametric test in case of 6000K, showing that there was no significant difference between the two variables with more than 0.05 in common.

3.4 HF(High Frequency)

HF(High Frequency) means 'being stable' in case HF appears higher than a comparison variable. In case of a luminous ceiling in 3000K, HF increased more after stimulation(273.25 ms^2) than before stimulation(255.7 ms^2). In case of a luminous ceiling in 6000K, HF decreased more after stimulation(300.59 ms^2) than before stimulation(493.54 ms^2). Therefore, 3000K is much stable in the direct light projection method related to respiration cycle and HRV. To find the significant difference based on statistical inference, this study parametric test in case of 3000K, and also conducted non-parametric test in case of 6000K, showing that there was no significant difference between the two variables with more than 0.05 in common.

4. CONCLUSIONS

This study is targeting large area lighting, i.e. a luminous ceiling. This study classified variables into 3000K and 6000K in color temperature with the average lumination of 100lx. Hereupon, this study confirmed HRV influence before/after stimulation.
The study results are as follows:
1) The cardiovascular system variables based on large area lighting(luminous ceiling) were all included in standard range, and in the significance probability before/after stimulation, there appeared no significant difference with more than 0.05 in both variables.
2) It was found that 3000K showed a stable response in SDNN, VLF and HF while 3000K showed a negative response in LF.
Accordingly, mental stress got higher in 3000K, but regulation of body temperature, vasomotion, adaptability to external environment, and HRV showed a positive response.
Conclusively, large area lighting stimulation by the lighting installation method(luminous ceiling) functions also as a stress factor, but according to its use, regulation is required, and there is the need to draw stress variables with LF as a starting point.

ACKNOWLEDGEMENTS

† This work was supported by the System Lighting 2.0 R&D of MOTIE/KEIT. [10053785, (3) Development of Guidelines for Light Environment Evaluation Technique and the Technology Standards for the LED System Illumination]

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A Study on Lighting and Technical Developments in the Domestic and International Lighting Company

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ABSTRACT

Each country is introducing an eco-friendly policy according as an environmental problem is coming to the fore worldwide. Due to the depletion of fossil fuel, the necessity of reduction in energy is ever emphasized, and among others, the lighting area is consuming 25% of the world electricity. Accordingly, this study did the comprehensive analysis of the status of light emitting diode (hereinafter, referred to as 'LED') and organic light emitting diode (hereinafter, referred to as "OLED") and technical development by manufacturer, and the analysis results showed that most of the companies are in possession of the ability to control the color temperature of lighting, and brightness. In addition, they were analyzed to achieve the development of lighting control function through the equipment of security, ventilation and fire, etc., an alarm, and a sensor.

1. INTRODUCTION

1.1 Research Background & Objective

Each country is introducing an eco-friendly policy according as an environmental problem is coming to the fore worldwide. Due to the depletion of fossil fuel, the necessity of reduction in energy is ever emphasized, and among others, the lighting area is consuming 25% of the world electricity. Accordingly, restrictions on the light bulb, which was used as main lighting in the past, is in progress, and from 2020, the fluorescent light will be under regulation.

LED and OLED lighting are raised as the next generation lighting which can replace the light bulb, and the fluorescent light, and create a new lighting market.

In case of LED lighting, a separate space must be secured to install LED lighting due to an exothermic problem. On the contrary, OLED lighting incurs relatively smaller installation expenses than LED lighting because there is no need for the space for installing the surface light source with its less exothermic property. Accordingly, considering the prices including the space construction cost, OLED lighting is regarded as having as much price competitiveness as LED lighting, and LED & OLED lighting are getting the limelight as the eco-friendly next generation light source.

Accordingly, this study is intending to analyze the status of LED, OLED & technical development by manufacturer at home and abroad.

1.2 Research Method

First, this study did theoretical consideration of LED, OLED, Internet of the Things (hereinafter, referred to "IOT"), and function convergence, etc., and then surveyed the trends of lighting and technical development using the Website by home and abroad manufacturer and Internet search. This study arranged the results using the checklist.

2. THEORETICAL CONSIDERATION

2.1 LED (Light Emitting Diode)

LED is, as a sort of p-n junction diode, a semiconductor device using electroluminescence effect, which is a phenomenon of short wavelength light emission when voltage is applied forward. This diode is a thing made so that mutually different two matter can form p-n joint, and at the p-n phase, 'p' has a surplus proton while 'n' has a surplus electron. When p-n phase is formed, and DC voltage is applied to a semiconductor element, an electron flows from 'n' to 'p', and 'p' and 'hole' (a state free of electrons) moves towards 'n.' Near the joint, an electron and hole combines with each other. At this moment, light energy comes into existence, which is emitted by the energy, i.e. LED generated when such a combination phenomenon occurs. Unlike the existing lighting fixtures like a light bulb giving off light by getting heat to happen at the filament, LED gives off light using the phenomenon, in which an electric wave is generated in a certain direction when currents are applied, and LED is available for expression of not only infrared rays/ultraviolet rays but also visible rays covering all colors from red to violet according to the composition ratio of compound semiconductor.

2.2 OLED (Organic Light Emitting Diode)

OLED uses organic matter as a luminous layer, and electrical properties of the device is similar to the electrical properties of diode, so it is called organic light emitting diode. It has a spectrum of light close to natural light, so it causes less eyestrain, and this matter itself is the surface light source giving off light, obviating extra parts. OLED lighting is free of glare and heating, and representatively eco-friendly, not containing heave metals like lead and mercury, etc., so it is highlighted as a light source which could take the lead in the future lighting market.
On the strength of a surface shape light source, OLED makes it possible to reduce its prices because there is no need for additional parts, such as a lamp shade, or a diffuser plate, etc., of which a light bulb & fluorescent lamp were in need to be equipped with a surface shape.
Also, OLED is available for manufacturing with less than 0.1mm in thickness, and it is gradually distinguishing itself even in interior areas on the basis of the characteristic like non-fragile flexibility even when it is freely bended and distorted in case plastic board is applied to it. In addition, it has a strong point like its available underpricing thanks to its fast response speed, and available manufacturing in low temperatures, and simple manufacturing process, etc. In addition, power consumption and color reproducibility are excellent, which makes it possible to apply it to lighting and diverse areas.
As weak points of OLED, a short life span of organic matter, and deficiency in encapsulation process technique for preventing damage to organic matter were pointed out, but its manufacturers are realizing their improved process technology day by day.

2.3 IOT (Internet of the Things)

IOT referred to the system in which information is generated, collected, shared and used through mutual communication between a thing and a thing, and a thing and a human by putting a sensor and the Internet function into all sorts of things, such as home appliances, electricity, water supply, automobile, and clothing, etc. Its representative examples include 'Smart Home Service', in which household gas valves, and electrical plug, etc. can be easily controlled using Smart phone, and ' Smart Grid' which optimizes energy efficiency by exchanging information in two-way & real-time between a power supplier and a consumer.

Recently, a sensor linking a real life to virtual network and its related equipment are pouring out. A lot smaller, smarter sensors are embedded into not only goods manufacturing process but also small articles in daily life from clothing and accessories to urban transport network, and even up to energy network to be utilized. Notably, IOT is achieving diverse, valuable service creation by blending itself with the fields like infrastructure, or health & medical treatment.

3. RESULT & ANAYSIS

This study conducted a survey on lighting technology development & its status targeting 11 home & overseas lighting companies, and the survey results are as in <Table 1> below:

In general, lighting companies were found to concentrate themselves on development of OLED and LED, and they were equipped with the ability to control the color temperature & brightness of lighting. In case of functionality aspects, the lighting, which senses a user's existence status & location, and behavioral change, etc., is not only in control of on/off & dimming but it is available for automatic brightness control and brightness creation by time slot consequent on the daylight inflow rate into the interior. Actually, the development of lighting on/off, and lighting color/sense of brightness has been actively done through IOT, or Smartphone application.

To analyze the detailed development status by company, Phillips has developed security, weather, location information, and facilities like ventilation, heating, and fire, etc., alarm, sensing of a human body, and creation by time slot the most. The IOT technology, which has recently become known to the general consumers through Korean LG Electronics-developed IOT Technology, is the one available for the control of on/off function, color temperature and sense of brightness of lighting through application, and this study analyzed that various companies like Phillips, Toshiba, Mipow, and Samsung Electronics, etc. are developing and applying this technology. Panasonic launched lighting products in the light of the sunrise and bio-rhythm in time of rising through the research on Circadian rhythm, and in case of Fagerhult, they developed the technology that makes it possible to automatically do brightness control according to time slot by applying the e-sense control system to office space; also Zumtobel is providing lumination & light feedback by means of a sensor.

Lighting Company	Sorts of Light Source		Control		Function Convergence										Remarks
	LED	OLED	Lumination (light amount)	Color Temperature (Light color)	Security (Crime prevention)	Weather & location information	Facilities, such as heating, ventilation and fire, etc.	Alarm	Sensor	Creation by time slot	Dimming control	Creation of activity type	Control Mode	Product connection	
Zumtobel	○	○	○	○					○						• Sensor : Provision of feedback on lumination and light
Fagerhult	○		○	○					○	○					• Through the installation of lighting trail in the whole space, mounting of diverse lighting on the trail, such as LED Module, and down light, etc. • Provision of customized optics design index by space function to WebB • Sensor: Motion, indoor space brightness
Sharp	○		○	○					○						• Lighting color/brightness vary automatically according to daily life pattern • Sensor : Outdoor daylight, or brightness of other lighting apparatuses
Phillips	○	○ (product)	○	○	○	○	○	○	○	○		○		○	• Control function of lighting color/sense of brightness, etc. through exclusive application • Sensor : Temperature(℃), daylight, etc.
Panasonic	○	○ (battery)	○	○		○			○					○ (sound)	• Launch of lighting products in the light of bio-rhythm in time of the sunrise and getting up through the research on Circadian rhythm • Sensor : Number of persons to be admitted for infrared light
Toshiba	○	○	○	○	○		○							○	• Control function through the remote control/mobile phone-based connection between the network and the internet
GE Lighting	○		○		○						○			○	• Control function of lighting on/off, lighting color and sense of brightness from the inside and outside • Function of sleep & rising mode
Cloud	○		○		○		○							○	• Application of lighting embedded with a fire alarm, and function of checking a fire alarm and brightness control through the smart phone
Mipow	○		○	○				○						○ (sound)	• Function of music playback/lighting on/off & brightness, color control through Bluetooth using smart phone App • IOS & Android Support
LG Electronics	○		○	○	○			○	○					○	• Function of lighting on/off & color temperature/brightness control through the application of IOT technology • Function of brightness control to music sound (Only Android products are available) • Function of lighting control of a vacant house • Sensing of a person/thing & brightness control through the street lamp sensor
Samsung Electronics	○		○	○					○					○	• Function of use environment information through communication module & automatic control of lighting environment, and provision of diverse information

Table 1. Lighting & Technical Development Status by home & overseas manufacturer

4. CONCLUSIONS

The results of conducting lighting & technical development status by home & overseas manufacturer are as follows:

1. Generally, lighting companies are concentrating themselves on LED development, and they are equipped with the ability to control color temperature and brightness of lighting. In case of functionality aspects, the lighting, which senses a user's existence status, location behavioral changes, etc., is not only in control of on/off and dimming but it is also available for automatic brightness control and creation of brightness by time slot consequent on daylight inflow rate into the interior.
2. The lighting companies are analyzed to actively do development of lighting on/off, and control of lighting color/ sense of brightness control through IOT, or Smartphone application, and various companies like Phillips, Toshiba, Mipow and Samsung Electronics, etc. are developing and applying the technology available for the lighting on/off function, and color temperature & sense of brightness control through application.
3. In case of some manufacturers, they were analyzed to achieve the development of lighting control function through facilities like security, ventilation, heating and fire, etc., alarms, and sensors.

In the follow-up research, this study is going to conduct the research on what point should be developed in priority for the purpose of controlling color temperature & lumination, and function.

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Anatomy of Regulations Related to Environmental Color Design in Russia

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ABSTRACT

The history of regulations related to environmental color design in Russia was explored using a literature review, case studies and observations. The purpose was to determine (1) laws addressing environmental color design, (2) basic principles and (3) the most important planning instruments of urban color design in Russia. The content and functions of color certificates, color catalogues and albums of model projects, regulating Russian urban coloristic, were analyzed. The structural components of the system of regulations related to environmental color design in Russia were found, and its internal working processes (the anatomy) were revealed and discussed.

1. INTRODUCTION

The history of regulations related to environmental color design in Russia began in the XVIIIth century and was connected with the name of Peter I. The Russian Empire establishment was accompanied by an intense development of construction documentation, including regulations related to environmental color design. Over more than 300 years of development, the main peculiarity of Russian environmental color design regulations remained in the capital-centered orientation of these documents. The first color guidelines were exclusive to Saint Petersburg. Later, when the capital of the Russian state was officially changed to Moscow, additional regulations were issued for Moscow, and then their principles were simply "transferred" to provincial towns, where they were used as an essential basis and as a model. Though Russian color design still keeps its clearly defined "catch-up" character, nowadays the majority of cities and towns have a system of regulations related to environmental color design. The aim of the paper is to show the structural components of this system and to reveal its internal working processes (the anatomy).

2. METHOD

A complex integrated approach based on the appropriate methodological arsenal was used as the basis method. An important means of this study was a comparative analysis and its methodology. The study made use of a literature review, case studies and observations. A case study using field methods of qualitative research such as project analysis, historical documentation of color, content analysis, comparison of individual cases and a systematic qualitative data analysis was conducted. Cases provided information about local community, street space, and everyday practices. Complete observation was used to capture the real situation regarding the different urban structures and people's everyday.

3. RESULTS AND DISCUSSION

3.1 The Laws Addressing Environmental Color Design

The order of environmental color design is determined in accordance with government (see, e.g.: Decree No. 114–III) and city administration (see, e.g.: Decree No. 9295) regulations. The fundamental laws related to environmental color design are "The Regulation on Color Design of Building and Construction Facades" and "The Conception of Color Design of Streets and Urban Districts". Both documents reflect environmental color design guidelines, urban color norms and corresponding instruments of color planning in urban space. They include a list of construction materials that are not allowed in architectural design. They also contain information about the procedure of color change, color notation system and limits of tolerance for acceptable color (for instance, in Moscow the saturation shall not exceed the limits of tolerance set by 5% for facades colors defined in the Moscow Color Palette).

3.2 Basic Principles of Environmental Color Design

Environmental color in Russian cities and towns is designed to take into consideration the following criteria – functional zoning of cities and towns and building-level functionality assessment; visual perception zoning (skyline and panorama; "changeable" and "permanent" environmental colors; landmark objects; visual accents and dominants); building density and area development planning; existing architecture; geographical location and existing natural environment colors.

3.3 Planning Instruments

The list of the most important planning instruments of environmental color design in Russia includes color certificates, color palettes and albums of model projects (Griber 2015: 314–336).
4.1. Color Certificate
Color certificate is a document confirming that external facade color is approved in compliance with the existing government and city administration regulations.
The prototypes of modern color certificates were special documents issued for every building in Tsarist Russia before the establishment of the Soviet government. In Soviet times this practice was canceled and revived only in 1990-s at the initiative of L.V. Zhuk, who was in charge of the Facade Coloration and Design Department in Moscow.
In 1996, according to the decision of Moscow city government (Decree No. 940), color certificates became obligatory. They were designed using many powerful tools of computer graphics and database management systems (Efimov, Prokhorov & Fuks 1997: 1–3) and remained in force until 2012. Each color certificate contained a brief description of the history and architecture of the building, a layout plan, analysis of area density and area development, and photos of current building condition. The certificate also included a detailed front elevation drawing, where colors of all architectural elements (roof, walls, basement, doors, windows, etc.) were described using Natural Color System notation, later complemented by notation of the Moscow Color Palette specially created for this purpose. This version of color certificate held real color samples, colored with facades paints. The last section of the color certificate contained the design technology description, provided recommendations on how to fulfill facade works and a list of certified materials with contact details of manufacturers and suppliers.
In 2012 the forms of the color certificate were edited (Decree No. 114–). The new version of this document included 5 main sections: 1. General information (address, name, year of construction). 2. Object information (urban planning characteristics, functionality assessment, architecture, location within urban territory, object and environment photos). 3. Color plan (1 : 50, 1 : 100, 1 : 200). 3. Coloration and facade decor. 5. Information about color certificate editions.
The main difference between the previous version of the color certificate and the new one is that the new form doesn't include the section with the technical descrip-

tion and real color samples.
In addition to certificate structure updating the existing regulations were modified related to environmental color design. Today, a color certificate is not required for launching a project, but it should be obtained for facade works. Color certificate obtaining is also obligatory for general overhaul, for facades painting or repainting, as well as for any reconstruction or repair works on facade. Without color certification any facade works are prohibited.
Issuing color certificates is a public service, which is provided free of charge in accordance with the Moscow city government decree No. 114–III of 28.03.2012 (with amendments dated 13.09.2013) "On Color Design of Building and Construction Facades in Moscow City" (Decree No. 114–III).
Validity of the color certificate in Moscow city is not limited.
Today color certificates, modeled after the Moscow example, are used in urban-planning practices of the majority of Russian cities (see, e.g.: Decree No. 297–III) for the regulation of facade works.

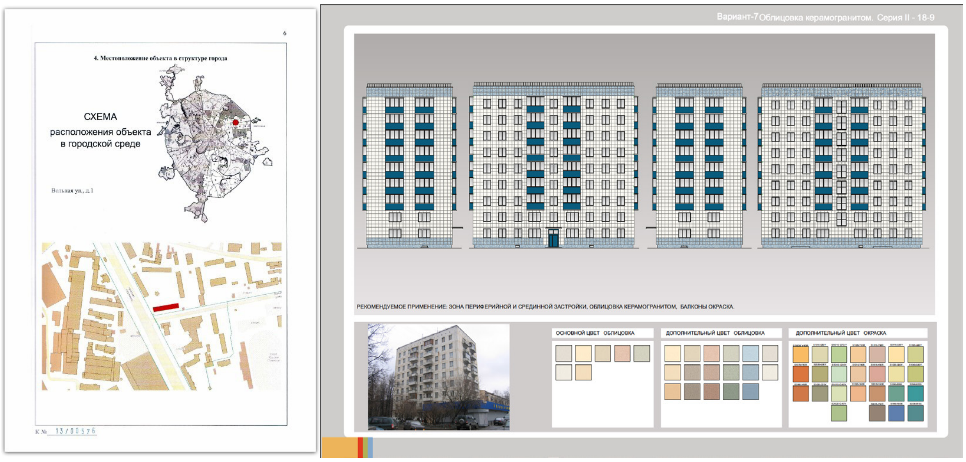

Figure 1: Color certificate (left) and a model project (right)

4.2. Color catalogue
Color catalogues are an important instrument for color planning in urban space. They are formed on the basis of analysis of historical documents, related to architectural development of a certain town or city.
From all the existing catalogues of this type the most famous is "Moscow Color Palette". This catalogue was elaborated in 2000 by the specialists from the Moscow City Architecture Committee using NCS notations and includes 416 colors, adjusted for seasonal weather variations and highly resistant to ultraviolet radiation.
Moscow Color Palette was approved by the Decree of the Moscow City Architecture Committee No. 76 of 29.06.2000 (Decree No. 76) and was intended to be used for the work of architectures, restorers and designers. Until 2012 the main catalogue purpose was color notation in color certificates issued in Moscow city. Nowadays this requirement is eliminated and the above-mentioned function of Moscow palette is no longer in use.

4.3. Album of model projects
Documents regulating Russian urban coloristics allow both unique and standard color design of exterior facades.
Standard color design is formed on the basis of the Album of model projects. The Architecture Committee of a city or town approves both structure and content of the

Album. The Album contains projects of facade coloration for the most widespread standardized buildings of a city. There are a number of color projects for every standardized building. There are also rules for choosing the most suitable color design for a certain city object. The rules recommend taking into account the following factors: location of the object in the city structure (center, medial zone or periphery); location of the object in the environment (city highway or square, see-front, pedestrian street, residential area); role of the object in the city image (dominant, accent or a background element of urban environment); color context of architectural and natural environment; functionality of the object (residential house, school, hospital, etc.).

4. CONCLUSIONS

In general, the main function of modern regulations related to environmental color design in Russia is the "restrictive" one. Laws and standards in the field of urban color design and city planning are intended as a contribution to color chaos control, stating rules and, in such a way, supporting regional identity. The choice of such strategy of urban color design as the key one is connected with certain changes of principles of environmental color design in a modern city. Never were colors as easy to use as now. Through all preceding centuries cities were built out of a limited set of available construction materials, and their color formed a balanced and steady settlement color image. Industrialization and rapid development of colorant production technology almost completely destroyed the color identity, formed over the centuries, and in such a way set a new vector of elated to environmental color design regulations redevelopment.

ACKNOWLEDGEMENTS

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POSTER SESSION 2

An Analysis of Japanese Tea Ceremony Silk Textiles Using Multi-angle Spectral Imaging

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ABSTRACT

Damask is a fabric that shows a pattern from irregularity of brightness and is characterized by changing the facial expression in response to the lighting environment. In this paper, we verify that the same colored warp weft silk satin damask represents the best features of damask from measuring L* distribution, then consider the aesthetic evaluation that has been accepted as conforming to the Japanese culture, especially relevancy of traditional tea ceremony. On this experiment, we selected two types of similar patterned silk satin damask, which is called FUKUSA used in the Japanese tea ceremony as a sample; the same colored warp weft and the different colored warp weft. A measuring system was applied using the gonio-photometric spectral imaging. The illuminate direction was 15, 45 and 75 degrees from a normal direction, and the detected direction was normal against the sample. Distribution on CIELAB Color Space is calculated from this spectral information and applied analysis of several fabric characteristics, and the correlation between human sense of texture and the range of distribution was researched. According to measurements, the L* value of the background area shows more large distribution in comparison to the figure area. In other words, flip-flop phenomenon of the contrast would be prompted by the L* value distribution of background area. Further, when the brightness sensation of the figure area is increased as compared to the background area, metallic luster sensation was recognized in addition to the glossy of silk. Since the color of warp weft is dyed yellow, the metallic gloss also accompanied golden sense, and the tactile texture sense emerged on the brightness flip-flop. When the color of monochromatic fabric is recognized as a "value", the sensitivity for brightness is increased, and threshold of brightness also increases. At that phase, the surface of extremely thin silk fabric would be observed as three-dimensional irregularities, in response to tactile modality. From the above point of view, same colored warp weft silk satin damask indicates a reasonable representation of the characteristics of silk damask on physical, and on perceptional phase.

1. INTRODUCTION

The traditional Japanese tea ceremony called SADO or CHANOYU, is a Japanese cultural activity involving the ceremonial preparation and presentation of green tea. The ceremony is performed with simplicity in a natural environment. The experience is based on a keen awareness of surroundings and the possibility of imperfection. SADO or CHANOYU represents the inner or spiritual experiences of human lives, called WABI and SABI. Silk textiles that absorb and reflect natural light are a crucial addition to the tea ceremony. Traditional Japanese clothing, known as KIMONO is worn. KOBUKUSA, small display cloths, or FUKUSA, utensil wiping cloths and pot holders are used during the ceremony. Aesthetic features of Damask (RINZU and DONSU) are often appreciated in the ceremony. It is a fabric that shows a pattern emphasized by the irregularity of light. It is characterized by a fluid, changing appearance based on its woven aspect and the light falling on the fabric. In this study, we verify that the same-colored warp weft silk satin damask represents the best features of damask by measuring the L*, a*, b* distribution in CIELAB color space. We then evaluate how well the fabric conforms to the aesthetics of Japanese culture.

2. METHOD

In this experiment, we selected two types of similar patterned silk satin damask. The sample is called FUKUSA and is used exclusively for the tea ceremony. The same-colored warp weft is called KATSURAGE-DONSU. The different colored warp weft is called RIKYU-UME. A method for measure color of the silk sample was applied using the gonio-photometric spectral imaging.

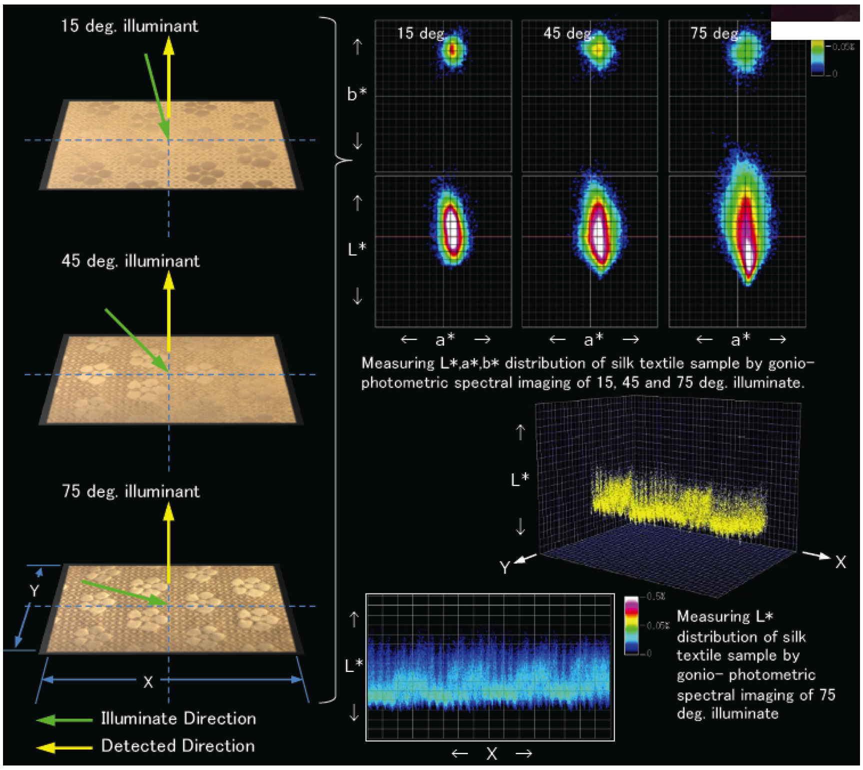

Figure 1 Schematic diagram of measuring way of KATSURAGI-DONSU silk textile by gonio-photometric spectral imaging and measuring L,a*,b* distribution of 15, 45 and 75 degree illuminate, and L* distribution of 75 degree illuminate*

This system comprises a liquid crystalline tunable filter, a white LED illuminant, and a Peltier cooling monochrome CCD image sensor. The illuminate direction was 15, 45 and 75 degrees from a normal direction and the detected direction was normal against the sample. The system can measure a gonio-photometric spectral imaging of 776 by 568 pixels and a visible range spectral image radiance factor from 420 to 700nm by each 10nm. To get a highly accurate gonio-photometric reflectance measure, each wavelength image was compensated by measuring the black/white lattice pattern in order to sense a small shift amount of x and y direction before measuring the silk sample. Before compensation, the measuring image showed a large part of color registration error around the black lattice line. Conversely, in the image of applied pixel shift compensation, the registration error disappeared. Using a sample of two kinds of FUKUSA silk textile, three angle illuminate images were measured. The distribution on CIELAB Color Space was calculated from this spectral information and analysis of several fabric characteristics was applied. Also, the brightness distribution in images was calculated and the correlation between human sense of texture and the range of distribution was researched.

3. RESULTS AND DISCUSSION

The calculated distribution in CIELAB Color Space of each illuminate angle was different. Most particularly, the image of the 75 degree angle had wide distribution of L* direction such as metal reflection. Conversely, images of 15 and 45 degree angles showed a narrow distribution profile. On a subjective side, the figure area that showed a large scatter of L* value, which seems to prompt a flip-flop of the contrast against the background area that shows narrow scatter of L* value. However, according to measurements, the L* value of the background area showed a larger scatter pattern in comparison to the figure area. In other words, a flip-flop of the contrast was prompted by the L* value scatter of background area. Further, when the brightness sensation of the figure area was increased as compared to the background area, the metallic luster sensation was recognized in addition to the glossy texture of the silk. Since the color of the warp weft was dyed yellow, the metallic gloss created an impression of gold, and the tactile texture sense emerged on the brightness flip-flop. The both silk textile measuring results are shown in Fig 2 and Fig 3. The space of tea ceremony room of SADO applied mild and diffuse lighting by SHOJI paper window. As the measuring result, there are full of expression surface of FUKUSA silk textile in the peaceful space of the tea ceremony room. These phenomena are related with spiritual culture, especially ICHIGOICHIE("Every moment is unique") importance of SADO, that is create of the fine crafts work by one of the dramatic interpretation with hospitality OMOTENASHI mind for the guest.

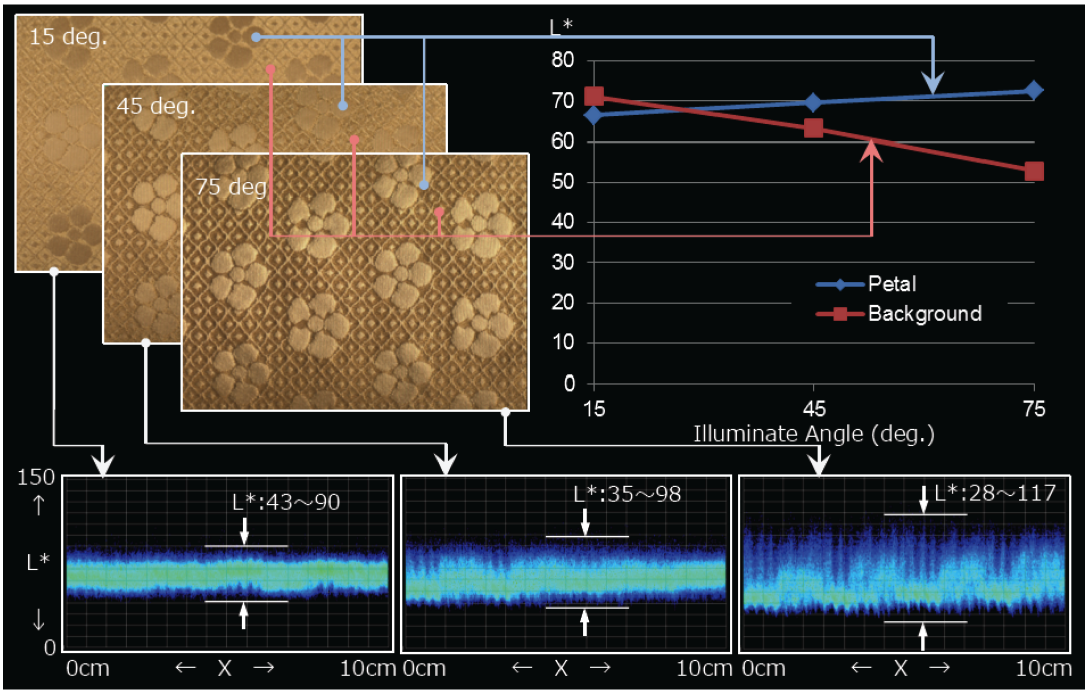

Figure 2: Measuring Result of KATSURAGI-DONSU silk textile by gonio-photometric spectral imaging and measuring L distribution of 15, 45 and 75 degree illuminate, and figure-background L* of 15, 45 and 75 degree illuminate*

4. CONCLUSIONS

To summarize the findings: When the color of monochromatic fabric is recognized as a "value", the

sensitivity for brightness is increased and the threshold of brightness also increases. At this phase, the surface of extremely thin silk fabric (almost closer to two-dimensional fabric) is observed as three-dimensional irregularities, in response to tactile modality. From the above point of view, the same-colored warp weft silk satin damask indicates a reasonable representation of the characteristics of silk damask on physical and on perceptional phase.

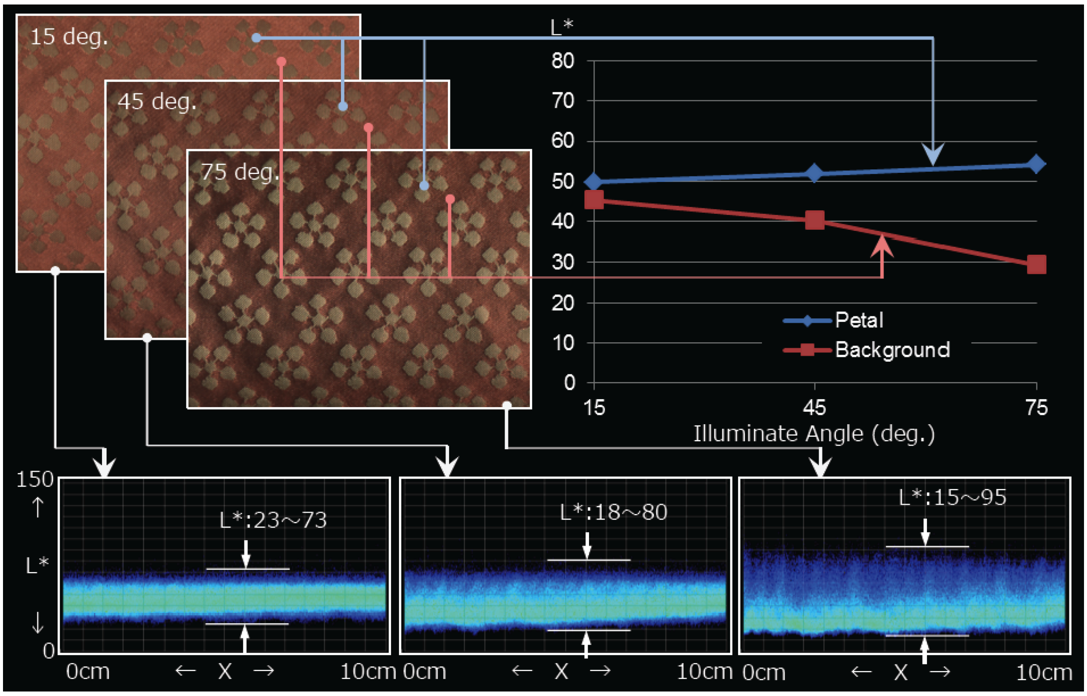

*Figure 3: Measuring Result of RIKYU-UME silk textile by gonio-photometric spectral imaging and measuring L*distribution of 15, 45 and 75 degree illuminate, and figure-background L* of 15, 45 and 75 degree illuminate*

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Impact of Tiles Panels on Lisbon Chromatic Environment

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ABSTRACT

This paper aims to explore the impact that tiles panels have on the city chromatism. Due to the Islamic occupation of the Iberian Peninsula, Portugal inherited the tiles techniques from the Arabs and they became an important part of the Portuguese culture, becoming the favorite covering material for exterior and interior walls of palaces, churches and popular buildings. By the mid-20th century, a trend has developed to cover large city spaces with artistic tile panels, created on purpose, which included various specific colours and textures. For their dimensions, colours, textures and significance, these panels became a landmark of the city and contribute to the transformation of the city dominant colours. In this paper, will be analyzed several of these tiles panels which are situated near the Tagus River, in a zone that encompasses the avenues Infante Santo and Cintura do Porto de Lisboa.

1. INTRODUCTION

The Portuguese name for tiles is azulejos, identical to the one used in Spanish language, and it may derive from the Arabian word "al zulaicj" (or alzulej) whose meaning is small flat and polished stone and is connected to the Mesopotamia precious blue stone called lapis-lazuli (Calado 1986:12).

Tiles are a simple decorative or painting support, composed by a clay plate, generally square and glazed in one face, the one that receives colour, drawings or relief. Their bright surfaces reflect light, heat and sound, so tiles are an isolator and hygienic material of long duration. The dimensions of Portuguese tiles are, usually, 14 x 14 centimeters, which are employed in groups of various elements, in compositions that cover totally or partially a pavement, a wall or a ceiling, punctually enrobing and garnishing the urban structure, like tattoos stuck and inscribed on human skin.

Due to the Islamic occupation of the Iberian Peninsula, the tiles techniques and its application gained, in this region, a significant relevance on the plastic manifestations, especially in Portugal where they became an important part of the Portuguese culture, and, consequently, Lisbon has been, since the 16th century a great tiles producer and exporter, applying them profusely on the walls and facades of its buildings.

In old times, tiles were usually employed on building coatings, but nowadays numerous Portuguese Artists and Architects developed a tendency to cover large city spaces with very ornamental tile panels, created on purpose, and introducing reliefs and tiles dimensions different from the usual. These large panels cover the walls of viaducts, ramparts, garden walls, among other places, adding colour patches to monotonous and almost achromatic city scenery.

On the 20th century middle decade, the architectural and urban development led to the institution of tiles panels with purely aesthetic functions, in pre-established spaces, designed by well-known artists, architects and designers invited for these purposes. These tile panels cover building facades, and also, the viaducts walls, the Lisbon Metropolitan, and other public works

2. LISBON TATTOOS

The tiles panels, presented in this paper, were created by well-known artists for the City of Lisbon, in order to enliven and enrich a new Lisbon avenue that establish the connection between the city

Figure 1. Avenida Infante Santo achromatism

in order to enliven and enrich a new Lisbon avenue that establish the connection between the city and the river. By their dimensions, colours, textures and significance, these panels became a landmark of the city and contribute to the transformation of the city dominant colours. The referred panels are situated in a zone that encompasses the avenues Infante Santo and Cintura do Porto de Lisboa.

2.1 Infante Santo Avenue

The south and lower part of Infante Santo Avenue is more recent than the upper part, and was built to open a new access to the Lisbon waterfront. Its buildings are mainly white or light grey making

Figure 2. Maria Keil tiles' panel

Figure 3. Carlos Botelho tiles' panel

the ensemble almost achromatic. In 1956, for this avenue was designed a set of five residential buildings separated by gardens and situated in a raised position related to the avenue level. For each stairway giving access to the gardens, several well-known artists were invited to design four tile panels. So, the tile panels, running north / south, were designed by Maria Keil, Carlos Botelho, Julio Pomar and Alice Jorge, and Rolando Sá Nogueira.

Maria Keil designed a panel that linked the city to the river, where the stairway was incorporated as part of the drawing, keeping up with the background constituted by waves and boats, with a fisherman as first plan figure. The design articulates plans, patterns and chromatic rhythms, in a sequence of blues, greens, roses and violets that brings the sky and sea colours to the city environment.

Carlos Botelho is the painter of Lisbon. In his colourful paintings he portrayed extensively the city and its population. The Infante Santo tiles panel follows the same line, representing a Lisbon landscape with rainbow tones, in his characteristic naïve style. The colour set of this panel, enlightens the grey monotony of the Avenue buildings like a coloured tattoo.

The next panel was authored by the couple of artists, Alice Jorge and Júlio Pomar. In it are represented popular scenes from the city in a Modernist style. These tiles colours are more discrete, with a dominance of yellowish green, so it has less impact on the environment colour. Also, they were in a very bad state and are being restored, hampering a more sensible analysis.

Figure 4. Pomar and Alice Jorge tiles' panel

Figure 5. Sá Nogueira tiles' panel

The last one of this panels series is from Rolando Sá Nogueira, who, like Maria Keil, represented the River and the fishing activities, with its dominant colours in blue, green and yellow. Contrarily to the Maria Keil panel, this one didn't take in account the stairway volume and its strong presence that, in a way, destroys the panel harmony.

Figure 6. Eduardo Nery tiles' panel and details

The set of these panels, excepting the one from Carlos Botelho, contribute with a dominance of blue and green colours, otherwise present only on the sky, and contrasting with the buildings grey, only enlighten by small strokes of red brick and rose. The several tones of rose and red are also present on the Carlos Botelho tiles, surrounded by blues, orange, yellow and white.

At the beginning of the 1990's decade, the painter and ceramist Eduardo Nery was commissioned by the organization of the "Lisbon 94   European Capital of Culture" to design a tiles panel for the last staircase, limiting the south side of the Infante Santo five buildings group.

More than a painter or a ceramist, Eduardo Nery was a researcher in light, form and colour, and its integration on urban spaces and architecture. For the Infante Santo Avenue panel, he explored the light and colour effects designing triangular prismatic tiles in two orange tones. These tiles were applied in different directions, creating optical wave compositions, resultant from the decomposition and dispersion of light. This panel colours and dynamism are a sun spot and the strongest tattoo in this achromatic Lisbon Avenue.

2.2 Lisbon Port Waistline

At the beginning of the 21st century, Eduardo Nery create a tiles mural for the viaduct on the Infante Santo Avenue southern end, which makes the connection to the avenue that constitute the

Figure 16. Structure and detail from Eduardo Nery tiles' viaduct mural

Lisbon Port Waistline, and establishes the link between the city and the river. This mural, which encompasses the viaduct, its support walls and the beginning of the Infante Santo archway, is like a scaled rainbow by the sequence and colour profusion much to the taste of Op Art.
The viaduct metallic structure is painted in a three-color scale of red, orange and yellow, being red the base; orange the supporting bars, and yellow the viaduct guards. These colours, by themselves, establish a very strong contrast with the greyish environment and, at the same time, are linked to the 25 de Abril bridge chromatic options. In this project, colour combination was the main element for Eduardo Nery. Each tile has one plain colour and is ranged in straight vertical stripes of various colours, sometimes following the solar spectrum, sometimes changing the sequence in order to create chromatic rhythms. The support wall at the viaduct south end applies the same graduations, but start and finishes with graduations of plain dark colours which are dark blue at one side, and black on the other, where is the author signature.

3. CONCLUSIONS

The Lisbon modern avenues are predominantly almost achromatic, with buildings in a range of colors that encompasses white, cream, light grey and rose. Therefore, the presence of these tiles panels gave to this city zone a livelier aspect, adding to the environment monotony coloured patches in blue and green tones, that make the connection with the proximity of the river, and multicoloured ones adding the rainbow colours to the greyish port zone.

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An Analysis of the Difference in Achromatic Color Names Between Korea and Overseas: Focused on the Automobiles, Nail and Eyeshadows

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ABSTRACT

In the past, color name is simply used as a tool for communication, but its means further has widened as color density of cultural and image transfer. The meaning of the color names further increases as a color image transmission, we recognized that color names' effect also increased to consumers. Recently unusual and unique color names appear a lot of color names that were an important media that not only establish the identity of each brands also associates the image of the products. My purpose is to identify the characteristics of the achromatic color names for the products. I analyzed the achromatic color names were chosen to Automobiles , Nails, eyeshadows, and then collect achromatic names based on product images on the official website of the brands. Findings of the study are as follows; the most frequent element in the automobile industry is the elements and mineral elements, in the nail industry is nature, in the eyeshadow industry is adjective. However, the most frequent words in the automobiles is ice, nail industry is snow, eyeshadow is night. Finally, it was observed that achromatic color names that colors in three different fields- automobiles, nails, eyeshadows. It is considered that identifies the characteristics of the achromatic color names for the product and provides clear data.

1. INTRODUCTION

Colors have visual attribute consisted of the combinations of chromatic colors and achromatic colors. Chromatic colors have the attributes of hue, brightness and chroma. Whereas achromatic colors range from white that reflects back almost all of the lights to black that absorbs almost all of the lights. Achromatic colors are said to have only the brightness among the three attributes of colors. With the development of big data, a lot of texts and information could be included in data and such data became digitized and formalized. In this process, word meaning has grown larger and color names have increasingly delivered images more. In such a situation, it can be estimated that the influence of color names on consumers also has grown larger. Recently, unique and special color names have increasingly emerged and they have become an important medium to establish each brand name identity while helping customers associate product images. As for products in achromatic colors frequently purchased by customers, in particular, since such products have no pre-set color names, their color names have even larger influence of delivering images. This present study was performed in recognition of the necessity to investigate the current situation of color names used in the domestic market and beyond. In this study, color names of domestic and overseas achromatic colored products were collected for comparison analysis with a view to understand the characteristics of achromatic colored products' color names and provide clearer basic data. The study findings are expected to be useful to refer to in naming the colors of achromatic colored products in the future.

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2. METHOD

This study investigated three products groups of automobile, nail product and eyeshadow for achromatic color naming cases. It is because these products show widest variety of brightness. The color names were collected from the achromatic product image colors displayed in the official homepages of selected brands herein. Domestic automobile brands were selected and top 1-10 overseas brands were selected on the list of 2015 consumers' best-worst choices reported by Newsday in January, 2016. As for foreign nail and eyeshadow products, top 1-10 brands were selected each in the Best Nail Polish segment on the Ranker webpage and Best Cosmetic Brands. Of the 5 South Korean automobile brand names and top 10 overseas brand names, one overlapping South Korean automobile brand was excluded to select 9 brand names. In the nail polish segment, 16 South Korean road shop brands and 1 domestic nail product specialized brand were included along with 10 overseas nail product specialized brands. Domestic eyeshadow brands were identically selected with the 16 domestic nail brands excluding BandiNail, a nail specialized brand. And top 10 overseas eyeshadow brands were chosen according to the overseas cosmetic brand no.1-10. (Table 1).

	Korea	Foreign
Automobiles	Hyundai, KIA, Chevrolet, Samsung, Ssang Yong	Lexus, Mazda, Toyota, Audi, Subaru, Porsche, Buick, Honda, BMW
Nails	Etude, Innisfree, The Faceshop, Missa, Skinfood, Tonymoly, Aritaum, Natural Republic, The Saem, Apieu, VDL, Clio, Espoir, It's Skin, VOV, Bandi Nail, Holika Holika	OPI, Essie, Sally Hanse, China Glaze, Zoya, Revlon, Orly, Nicole by OPI, Butter London, Loreal
Eyeshadows	Same Nail Brands without Bandi Nail	MAC, Nars, Urban Decay, Clinique, Dior, Bobbie Brown, Chanel, Lancome, Maybline, Benefit

Table 1. Achromatic color names analysis brands

2.1 Color Name analysis method

First, classify the achromatic images displayed in each selected brand's official homepages by comparing them with the Munsell 10 value scale on the monitor screen. Second, categorize the color names into object, nature, adjective, element& mineral, period & time, place, food, basic color name, behavior, person and emotion. The automobile part, however, is classified into 9 types since no color name related to behavior and emotion is found. Third, the Munsell 10 value scale is applied largely based on white, N8-9.5; grey, N4-7; and black, N1-3. Forth, follow the basic principle that, in the color name analysis, abstract meanings cannot be measured actually by color measurement system and specific meanings can be measured by color measurement system.

3. RESULTS AND DISCUSSION

3.1 Comparison analysis of frequency rank in each South Korea and overseas achromatic color area

The achromatic color names were compared in the entire areas of automobile, nail and eyeshadows. As a result, element & mineral was found to appear most frequently in the general automobile segment; nature, in the nail product; and adjective, in the eyeshadow, indicating difference therein. Both nature and adjective were found highly frequently in all of the sectors all the time whereas place was found frequent in overseas automobiles and behavior in nail products. Achromatic color names in these sectors of South Korea were compared. As a result, adjective was found most frequently in color names of Korean automobiles and eyeshadows while object was most frequent in Korean nail products. Nature, adjective, element & mineral and object were always found highly frequently but object showed the lowest frequency in Korean automobile color names. Overseas achromatic color names were compared in these sectors. The aspect of element & mineral, as a result, was found most frequently in overseas automobile color names; behavior, in overseas nail products; and adjective in overseas eyeshadows, representing differences. Overseas products commonly show adjective, nature and object frequently in all of the segment but overseas automobiles show low frequency of using those in color names.

3.2 Comparison analysis of frequency rank in each brightness of South Korea and overseas achromatic color names

As a result, nature was found most frequently in the white color names of automobiles and nail products whereas adjective in the eyeshadow products. Nature, adjective, element & mineral and object are all highly frequent but in the automobile products, their frequency of use was low as color names. Behavior was found frequently in name product color names. Concerning grey color names, automobile and eyeshadow showed high frequency of using adjective whereas nail product used object most frequently. Object, nature, element & mineral were found highly frequently in all of the three research segments herein with the difference that nail product used behavior the most; and eyeshadow, emotion. Regarding the black color analysis, automobile showed element & mineral the highest frequency while nail and eyeshadow, adjective most often. Nature and adjective commonly appeared more frequently. Element & mineral was the most frequent in automobile but moderately frequent in nail and eyeshadow.

3.3 General frequency rank of South Korea and overseas achromatic color elements

Frequency was analyzed based on the criteria of 10% or higher and 3% or lower. The entire domestic and overseas achromatic color names (842 names in total) were classified under 11 different elements. The most frequent element was adjective (20%) with basic color name (3%) being the least frequent. The entire domestic achromatic color names (395 in total) were analyzed. As a result, nature (20%) and adjective (20%) were found equally most frequent. Person (3%), behavior (3%), and emotion (2%) were found less frequently. The whole overseas achromatic color names (448 in total) were analyzed. Adjective (19%) was found most frequent. Basic color name (3%) and food (3%) showed low frequency. When comparing the charts of three groups, adjective, nature, element & mineral, and object were identically found highly frequently and behavior also appeared highly frequently in overseas achromatic color names. In the three groups' charts, basic color name showed low frequency commonly in the overall and overseas cases. (Table 2)

Whole Achromatic color names (Total 842)		Achromatic color names in South Korea (Total 394)		Achromatic color names in overseas (Total 448)	
Adjective	20%	Nature	20%	Adjective	19%
Nature	18%	Adjective	20%	Nature	16%
Element&Mineral	14%	Object	15%	Element&Mineral	14%
Object	13%	Element&Mineral	14%	Behavior	11%
Behavior	8%	Period&Time	7%	Object	10%
Place	6%	Food	6%	Place	8%
Period&Time	5%	Place	5%	People	6%
People	5%	Basic color name	5%	Emotion	6%
Food	4%	People	3%	Period&Time	4%
Emotion	4%	Behavior	3%	Basic color name	3%
Basic color name	3%	Emotion	2%	Food	3%

Table 2. General frequency rank of South Korea and overseas achromatic color elements

3.4 General white, grey and black color name analysis in South Korea and overseas cases

In the color names each of white, grey and black, those with frequency not less than 5 are displayed. In the white color, star, crystal and diamond included in element & mineral were found most frequently as well as ice in nature. Concerning grey, sparkling included in the adjective and platinum in element & mineral were found highly frequent. Concerning black, night in nature, and black in basic color name were found often. Overall, color names in element & mineral were more frequent.

3.5 General frequency rank of achromatic color names in South Korea & overseas case

According to the criteria of overlapping frequency not less than 10 times, snow and pearl were identified equally frequent in achromatic color names both in domestic and overseas cases. In the whole color names, element & mineral aspect including pearl, crystal and diamond was found most frequently followed by nature including snow and ice in two color names.

4. CONCLUSIONS

First, in the whole automobile segment, element & mineral factors were found most frequently in color names and overseas cases showed more diversified color names than domestic names. In South Korean automobile names, adjective was the most frequently found factor but in the overseas cases, element & mineral was the most frequent. In the general automobile segment, place was found highly frequent and nature was found to include color names with most diversified repetition frequency. In South Korea, color names with abstract meaning were more whereas in overseas cases, specific meaning was used more often. Ice was the most frequent color name in automobiles. Second, in the whole nail product sector, nature was found the most frequent in color names. Korea was found to have used more diverse color names than overseas cases. In the Korean nail products, nature was found the most frequent whereas behavior was the most frequent in overseas names. In South Korea, specific meaning was found more often in color names, on the other hand, abstract meaning was found more often in overseas color names. The highest repetition frequency was found in nature and snow was used most frequently in nail products. Third, in the general eyeshadow segment, adjective was found most frequently and more diverse color names were found in overseas names than Korean cases. Both the domestic and foreign eyeshadow product names showed adjective most frequently. They both also showed more abstract color names and repeated adjective most frequently. In the eyeshadow segment, night was found the most frequently used color name. Forth, based on the color name classification criteria according to white, grey and black brightness; automobile showed more abstract color names regarding white and grey while specific color names regarding black. in the nail product area, abstract meaning was shown more often in all brightness levels. Concerning eyeshadow names, white was found to include only specific-meaning color names whereas grey included more abstract names and black included only abstract names. Concerning white, pearl was found to have the highest repetition frequency; grey, sparkling; and black, night. Fifth, of the achromatic color names, adjective recorded the highest frequency and nature, adjective, element & mineral and object were found highly frequent in most of the achromatic color areas. On the other hand, basic color name showed the lowest frequency. As for color names, the most frequently utilized color name in South Korea was snow and pearl. All of them, excluding pearl, were found to have abstract meaning.

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The Planning of Color Specialization Area in the New Administrative City of Korea

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ABSTRACT

This study drew the color application plan for the place which has been designated as a color specialization area within the new administrative city of Korea. Also, this study designated some areas of the new administrative city of Korea, in which diverse colors use, such as primary color use, etc. is strictly forbidden, as a color specialization area. In addition, this study applied the diverse colors arrangement pattern to a building facade using techniques of achromatic color harmony, contrast harmony, value contrast, and color contrast while using an achromatic color, mid-value/mid-chroma thematic color together.

1. INTRODUCTION

In 2013, Korea constructed a new administrative city as a plan to solve the excessive population concentration of Seoul, capital city by relocating all key ministries to Sejong City-the center of Korean territory. Construction of Sejong City is under way aiming for its completion by 2030. The concept of color planning for this city is to secure “Unity” of the whole cityscape. To secure such unity, this study primarily applied the dominant color extracted to be well harmonized with nearby natural environment to the whole cityscape. In addition, the use of diverse colors like the use of primary colors is strictly restricted by the authorities. However, to secure a sense of change, this study designated some areas as a color specialization district. This study drew the color application plan for a place which has been designated as a color specialization area within the new administrative city of Korea.

2. COLOR APPLICATION PLAN

The color specialization district is aimed at providing dynamic attractions by allowing diverse colors to be used. There are some sorts of principles in color planning as follows.

2.1 Apartment House

In case of high-rise apartment houses, this study did color planning for inducing a sense of change and neatness at the same time through cross-application of the building whose dominant color is an achromatic color, and the building whose dominant color is mid-chroma color in R, YR, Y, GY, B series. In addition, in case of mid-story apartment houses, this study did color planning so that they can give a sense of visual fun by applying the dominant color to them in achromatic colors but applying mid-chroma colors in R, YR, Y, GY B series in case of their pattern. Also, this study did color planning for low-rise apartment houses so that they can give a strong impression of colors through the application of point color arrangement to the whole of elevation.

2.2 Detached House

This study did color planning for detached houses by dividing them into two types. First, to the detached houses in proximity to apartment houses, this study applied the value contrast technique through restrained materials and texture other than splendid color application. On the contrary, in case of the detached houses which are separated from apartment houses, this study created a merry, cheerful atmosphere by applying color arrangement of the mid-chroma colors in R, YR, Y, GY, B, PB, RP series through the color contrast technique.

2.3 Educational facilities and Public office building, Industrial facilities

This study created a restrained atmosphere overall by applying the off-white color to the educational institution like kindergartens, and elementary, middle-high schools, and public facility like a community center, as well as industrial facility as a dominant color while applying the color of mid-chroma, or pastel tone as the accent color to only a part of them. Also window frame in a bright gray color.

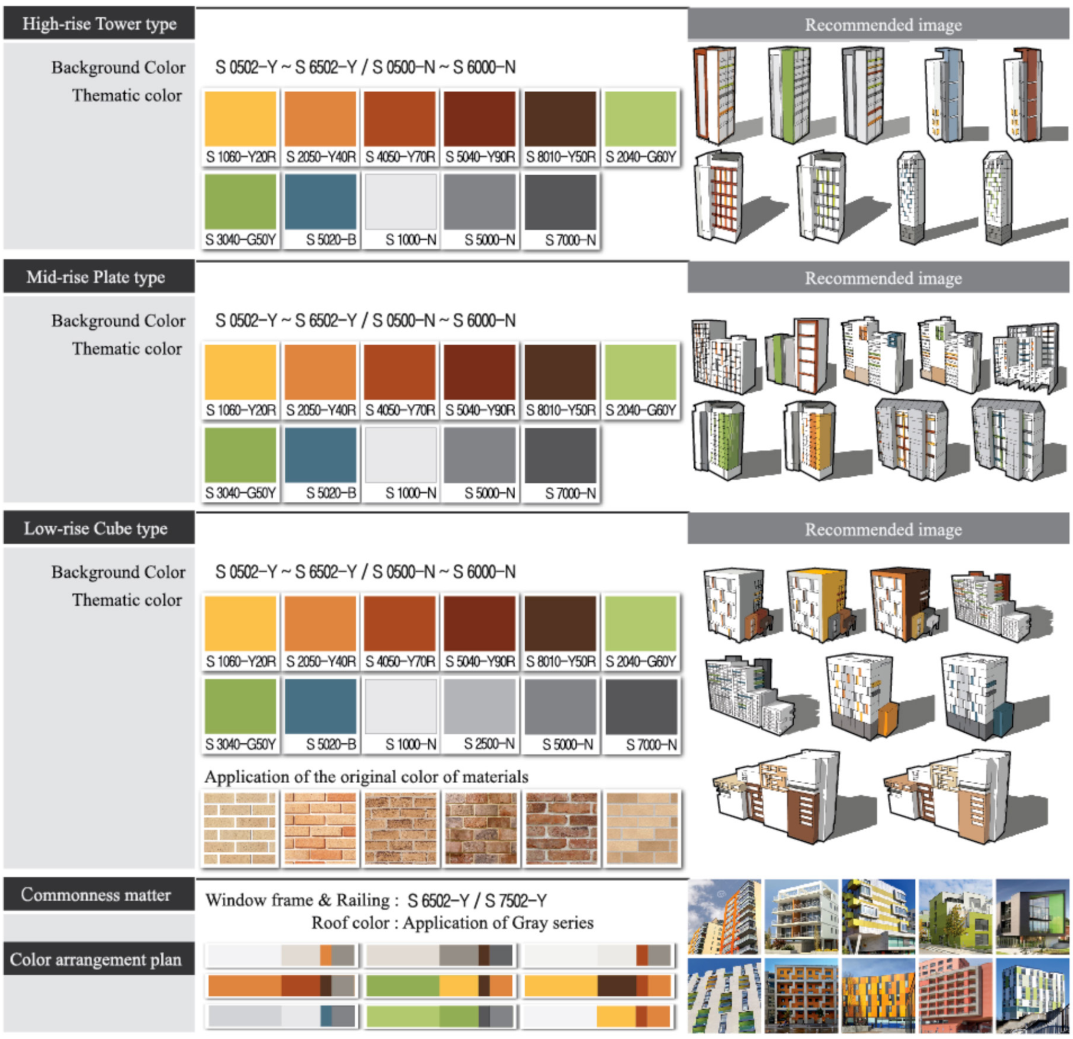

Figure 1. Color Palette & Application images of Apartment Housing

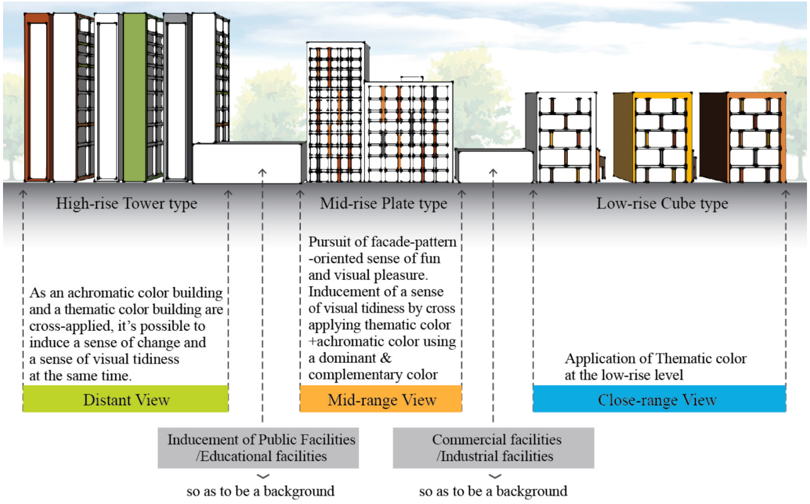

Figure 2. Simulation of Apartment Housing

Figure 3. Color Palette & Application images of Detached House

Figure 4. Color Palette & Application images of Educational facilities and Public office building, Industrial facilities

3. CONCLUSIONS

This study drew the color application plan for the place which has been designated as a color specialization area within the new administrative city of Korea. Also, this study designated some areas of the new administrative city of Korea, in which diverse colors use, such as primary color use, etc. is strictly forbidden, as a color specialization area. In addition, this study applied the diverse colors arrangement pattern to a building facade using techniques of achromatic color harmony, contrast harmony, value contrast, and color contrast while using an achromatic color, mid-value/mid-chroma thematic color together. In case of an apartment house, this study used an achromatic color as a background color, and used mid-chroma color of R, YR, Y, GY, B series as a thematic color. In case of the pastoral type of a detached house, this study restrained the painting color, but gave a sense of change from the difference of materials and texture through the expression of material color. In case of the general type of a detached house, this study used mid-chroma color of R, YR, Y, GY, B, PB, R series as a thematic color. Also, this study applied off white as a dominant color to education facilities, public office building and industrial facilities, and applied mid-chroma color, or pastel-tone color as an accent color to some facilities only.

3. CONCLUSIONS

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A Study on a Senior Citizen's Discrimination Capacity for Color Perception Consequent on Brightness

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ABSTRACT

The purpose of this study was to examine the color perception discrimination from the eyes of the elderly by brightness using four basic colors such as red, yellow, green and blue. The results are as follows.

The visibility in accordance with the difference of black chromaticity and black pure chromaticity is high regardless of the brightness. If the difference is more than 10 %, it would be instantly readable. On the other hands, the visibility in accordance with the difference of pure chromaticity is high. If the amount of red and blue differs more than 10 % regardless of brightness, it would be instantly readable. However, the readability of yellow and green is declining when the brightness is decreased. In the case that 100 lx is given, when the amount of pure color differs more than 10 %, it can be instantly readable. The visibility in accordance with the change of color mixing ratio is low. The readability is decreased with decreasing brightness. In the case that 1,000 lx is given, when the amount differs more than 10 %, it can be instantly readable. However, in the case that 100 lx is given, it can be instantly readable only when the amount of red differs more than 20 % or the amount of yellow, green and blue differs more than 30 %.

1. INTRODUCTION

M Physical, physiological, and mental functions are decreased with increasing age. Among physical functions, more than 80 % of external information is acquired through the vision. Thus, the elderly face many difficulties in everyday lives due to aging eyes and age-related eye diseases.

According to the survey of distribution of eye diseases by patients performed by Ku, Han Mo (1993), the cataract accounted for 44.0 %, which was ranked no. 1. According to the results of survey of diseases causing vision loss at senescence, the cataract accounted for 58.8 %, which was ranked no. 1. In addition, according to the results of Framingham Eye Study performed by Kahn et al. (1977), the prevalence of cataracts has been reported to be 41.7 % in people age 52 to 64, 73.8 % in those age 65 to 74 and 91.1 % in those age 75 to 83. Sasaki et al. reported that the prevalence of cataracts was 33.9 % in the 40s, 62.8 % in the 50s, 76.2 % in the 60s, 84.0 % in the 70s and 100 % in the 80s. Those studies exhibited that the prevalence of cataracts was significantly increased with increasing age.

Previous studies associated with yellow tinted intraocular lenses and opacification (cataract) examined visual characteristics of the elderly and worked on color plans by using senior visual correspondence filters or conducting survey or interview with the elderly people. The results of previous studies targeting the elderly people showed higher accuracy of color perception and no problems in changes in color perception discrimination than those of studies using senior correspondence filters. However, there are not many studies on specific and quantitative ranges for color perception discrimination.

Thus, in this study, we examined the color perception discrimination from the eyes of the elderly by brightness using four basic colors such as red, yellow, green and blue when the test surface is 1,000 lx on the basis of the previous study on the color perception discrimination of the elderly (Lee, Jin Sook et al., 2013).

2. METHOD

2.1 Light cabinet & D65 Standard light source

The experiments were carried out in the space without windows in order to exclude the influence of daylight and ambient artificial light sources. The dimension of the Light cabinet equipped with D65 standard light source for the test is 610 (length), 500 (width), and 450 (height) [mm]. The inside is covered with non-glossy colored paper in achromatic color of N5 (medium brightness). For measurements of physical quantity of luminance, the luminance and color temperature were measured by using the luminance meter (Minolta, T-10) and the chroma meter (Minolta, CL-200), respectively. Spectral distribution and color rendering index of light sources were measured by using the spectroradiometer (Minolta, CS-1000A). Physical properties and spectral distribution of light sources are shown in Table 1.

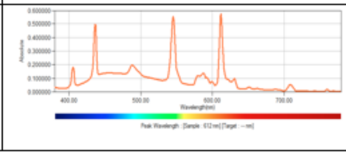
Type of light source	Color temperature [K]	Illuminance [lx]	General color rendering index	Color coordinate		Spectral distribution
				x	y	
D65 Standard light source	7,054 K	100 lx 500 lx 1,000 lx	94	0.3051	0.3194	

Table 1. Physical properties and spectral distribution of light source

2.2 Evaluation items

The colors used in the experiments were four basic colors in the NCS (Natural Color System) such as red, yellow, green and blue. Each color was used in 100 %. Colors were made according to black chromaticity, pure chromaticity, black pure chromaticity, and the change of color mixing ratio. Color matching works for evaluation items were made in Adobe Illustrator 10.0. To correct printed colors, we measured printed colors by using the spectrophotometer (Minolta, CM-2600d) and then we corrected colors by making the color difference (E*ab) between printed colors and color papers produced by the NCS in less than 3 according to the standards of CIE Lab. The dimension of evaluation items was 300 mm (Length) X 60 mm (Width). Arabic numbers were written on them. Horizontal and vertical ratio of letters was 1:1. Thickness of letters was 40 mm. In addition, when the color was close to the background color, the number was presented twice in color. presented twice in color.

2.3 Subjects

8 Subjects over 74 years participated in the evaluation experiments. All subjects visited the ophthalmologist to assess eye conditions prior to the evaluation experiments. Detailed information on subjects is shown in Table 4.

2.4 Experimental methods

Evaluation items were placed in the center of the light cabinet and the light was vertically given. Subjects looked at the items at a 45-degree angle with a distance of 30 cm from the evaluation item. An investigator gave the light with luminance of 100 lx, 500 lx and 1,000 lx to the experimental surface by using the D65 standard light source. Subjects were asked to loudly read the number written on the evaluation items.

The investigator wrote the instantly readable or unreadable colors on the evaluation form. It was found that healthy adults with normal vision had 100 % correction rate of color perception.

Discrimination \ Color series	R series	Y series	G series	B series
Difference in black chromaticity	S 1040-R, S 2040-R S 3040-R, S 4040-R S 5040-R	S 1040-Y, S 2040-Y S 3040-Y, S 4040-Y S 5040-Y	S 1040-G, S 2040-G S 3040-G, S 4040-G S 5040-G	S 1040-B, S 2040-B S 3040-B, S 4040-B S 5040-B
Difference in pure chromaticity	S 3020-R, S 3030-R S 3040-R, S 3050-R S 3060-R	S 3020-Y, S 3030-Y S 3040-Y, S 3050-Y S 3060-Y	S 3020-G, S 3030-G S 3040-G, S 3050-G S 3060-G	S 3020-B, S 3030-B S 3040-B, S 3050-B S 3060-B
Difference in black pure chromaticity	S 5020-R, S 4030-R S 3040-R, S 2050-R S 1060-R	S 5020-Y, S 4030-Y S 3040-Y, S 2050-Y S 1060-Y	S 5020-G, S 4030-G S 3040-G, S 2050-G S 1060-G	S 5020-B, S 4030-B S 3040-B, S 2050-B S 1060-B
Difference in color	S3040-Y80R, S3040-Y90R S3040-R, S3040-R10B S3040-R20B	S3040-G80Y,S3040-G90Y S3040-Y,S3040-Y10R S3040-Y20R	S3040-B80G,S3040-B90G S3040-G,S3040-G10Y S3040-G20Y	S3040-R80B,S3040-R90B S3040-B,S3040-B10G S3040-B20G

Table 2. Overview of evaluation items

Color series	Example
R series	
Y series	
G series	
B series	

Table 3. Illustration of evaluation items

Gender	Females : 3	Males : 5
Age	74 ~ 85	
Vision	Left : 0.2~1.0	Right : 0.02~0.5
Presence and types of cataracts	Yes	No
	Cortical cataract : 1 Nuclear sclerosis cataract : 4	3
Progression stages of cataracts	Mid	Mid~Late
	2	3
Cataract surgery	Yes	No
	3	5
Total	8	

The scene of evaluation

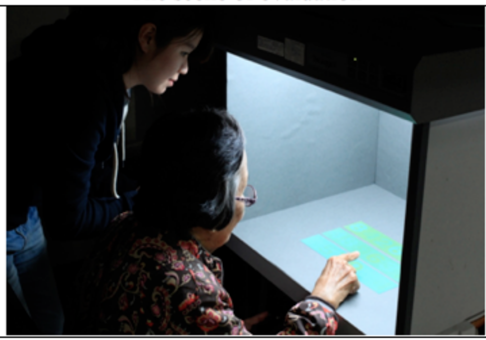


Table 4. Information on subjects

3. RESULTS AND DISCUSSION

Red and blue were found to be momentarily legible when black chromaticity, pure chromaticity, and black pure chromaticity bore no resemblance by more than 10%. However, yellow and green were found to be higher in visibility consequent on the difference between black chromaticity, and black pure chromaticity, but the visibility consequent on the difference in pure chromaticity was found to be lower as brightness became darker. In short, it was found that in case brightness is 1,000 lx, and the color content bears no resemblance by more than 10%, it's legible momentarily, but in case brightness is 100 lx, the momentary legibility is not possible unless the color content bears resemblance by more than 20%. In addition, it was found that in case brightness is 1,000 lx, red, green and blue are momentarily legible when color mixture ratio bears no resemblance by more than 20%, whereas yellow is legible, but it was simply a blur. Also, legibility consequent on color mixture ratio was found to become lower as brightness gets darker. In other words, it was found that in case brightness is 1,000 lx, and color mixture ratio bears no resemblance by 10%, it was legible in spite of taking time, whereas subjects couldn't read them because it was difficult for them to tell ground color from colored number. The experiment result showed that when brightness is 100 lx, red is legible momentarily when the color mixture ratio bears no resemblance by more than 20%, whereas yellow, green and blue are momentarily legible only when the color mixture ratio bears no resemblance by more than 30%.

4. CONCLUSIONS

The purpose of this study was to examine the color perception discrimination from the eyes of the elderly by brightness using four basic colors such as red, yellow, green and blue. The results are as follows.

The visibility in accordance with the difference of black chromaticity and black pure chromaticity is high regardless of the brightness. If the difference is more than 10 %, it would be instantly readable. On the other hands, the visibility in accordance with the difference of pure chromaticity is high. If the amount of red and blue differs more than 10 % regardless of brightness, it would be instantly readable. However, the readability of yellow and green is declining when the brightness is decreased. In the case that 100 lx is given, when the amount of pure color differs more than 10 %, it can be instantly readable. The visibility in accordance with the change of color mixing ratio is low. The readability is decreased with decreasing brightness. In the case that 1,000 lx is given, when the amount differs more than 10 %, it can be instantly readable. However, in the case that 100 lx is given, it can be instantly readable only when the amount of red differs more than 20 % or the amount of yellow, green and blue differs more than 30 %.

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The Analysis of Perceptual Uniformity of Color Images Evaluated from CIE Color Spaces – Using Natural Scenery Images as Tested Samples

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ABSTRACT

In recent years, most researches focused on developing mathematical methods to calculate principle color component value and color difference of tested images. However, CIE recommended color spaces can be applied to predict which spectral power distributions perceived as the same color, but among them are not perceptually uniform to each other. A preliminary study was conducted to evaluate the precision of calculation of principle component color between CIE color spaces via using complex natural scenery color images as test samples. A group of 51 natural scenery color images were selected. An image analysis tool, ColorSpace Convertor, was developed to analyze ΔE from the principle component colors of tested color images, derived from CIE color spaces CIEL*a*b* and CIEL*u*v* respectively. The experimental results indicated that there existed a mid-high correlation, r = 0.81, but with overall variations, CV (%) = 23, of the principle color component values between CIEL*a*b* and CIEL*u*v* color spaces. The largest color difference about 38 in terms of CIEL*a*b* unit occurred between evaluated results has been found. It is to suggest that further experiments need to be conducted to test on other color spaces.

1. INTRODUCTION

Color perception is best described in terms of a set of primary colors - red, green and blue violet (RGB) - modeled through the additive mixture of three monochromatic lights. On this basis the quantitative description of color mixture or colorimetry was developed. Up to now, CIE recommended color spaces can be applied to predict which spectral power distributions perceived as the same color, but is not particularly perceptually uniform. Perceptually uniform represents that a change of the same amount in a color value should produce a change of about the same visual importance. This requires a function of the reference color in order for the just-noticeable-difference (JND) threshold to be constant throughout the gamut (range of colors). In the CIE 1931 color space, the tolerance contours are defined by the MacAdam ellipse, which holds L* (lightness) fixed. As can be observed on the chromatic diagram, the ellipses denoting the tolerance contours vary in size. Empirically, ΔE value of 1.0 is often mentioned that has a JND (just noticeable difference), but in a recent study, Mahy et al. (1994) assessed a JND of 2.3 ΔE. These non-uniformities are important because the human eye is more sensitive to certain colors than others. A good metric should take this into account in order for the notion of a "just noticeable difference" to have meaning. Otherwise, a certain ΔE that may be insignificant between two colors that the eye is insensitive to may be conspicuous in another part of the spectrum. The purpose of the preliminary study intends to evaluate the precision of calculation of principle component color in terms of perceptual uniformity of color appearance between CIELAB and CIELUV color spaces using complex natural scenery color images as test samples.

2. METHOD

2.1 Experiment Devices

Experiments were carried out, recorded and analyzed. A personal computer with Window 7, ColorSpace Convertor image converter tool, 51 scenery images test samples, Farnsworth-Munsell 100 Hue, and Microsoft Office PowerPoint & Excel, are used to conduct the experiments.

2.2 Experiment Workflow

Literature review

↓

Select 51 scenery images test samples

↓

Analyzed by ColorSpace Convertor image analysis tool

↓

Statistical analysis

↓

Experiment results and discussions

↓

Conclusions

2.3 Experiment Data Analysis

ColorSpace Convertor image analysis tool is adopted to analyze and record 51 scenery images test samples for each of 1st component color and 2nd component color. ΔE is calculated between color spaces and top 5 ΔE values are selected for further analysis. After plotted selected ΔE values on both CIEa*b* plane and CIEu*v* plane, the comparisons of the precision of calculation of principle component color between CIELAB and CIELUV color spaces in lightness, chroma, and hue, are examined by their covariance (CV %) and correlation coefficient (r).

3. RESULTS AND DISCUSSIONS

3.1 Tested Image Samples Analyzed by CIELAB Color Space

Due to each of 1st component color and 2nd component color of every 51 scenery images varied from each other. Therefore, ColorSpace Convertor is used to analyzed and recorded principle component color values of each images via CIE*a*b* color plane. The distributions of 1st component color values are plotted on Fig. 1, and the distributions of 2nd component color values are plotted on Fig. 2.

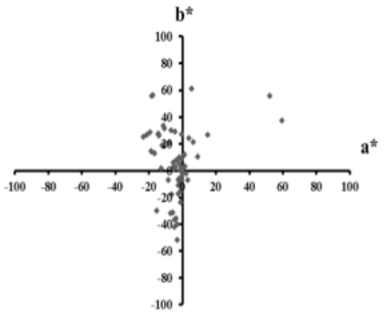

*Figure 1: Distributions of 1st component color of test images via CIEa*b* plane.*

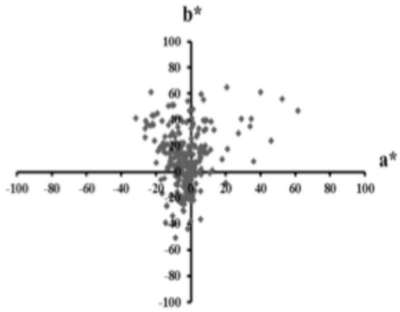

*Figure 2: Distributions of 2nd component color of test images via CIEa*b* plane.*

3.2 Tested Image Samples Analyzed by CIELUV Color Space

Same analysis repeated again via CIELUV color space. ColorSpace Convertor is used to analyzed and recorded principle component color values of each images via CIE*u*v* color plane. The distributions of 1st component color values are plotted on Fig. 3, and the distributions of 2nd component color values are plotted on Fig. 4.

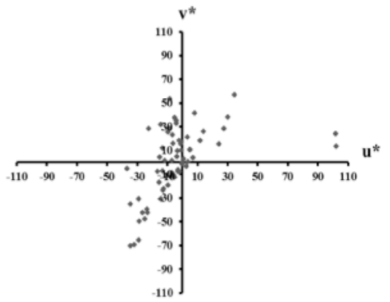

*Figure 3: Distributions of 1st component color of test images via CIEu*v* plane.*

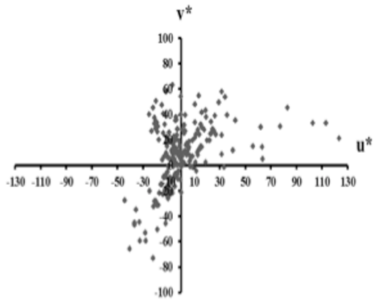

*Figure 4: Distributions of 2nd component color of test images via CIEu*v* plane.*

3.3 The Comparisons of Calculated Principle Component Colors via Two Color Spaces

3.3.1 Analysis of color difference (ΔE) on 1st component color between two color spaces

Color difference formula is used to calculate ΔE on 1st component color between two color spaces. Top ΔE values with largest variance are selected, shown on Table 1. Maximum ΔE value is 38.45, minimum ΔE is 0.36, and averaged ΔE value is 9.54.

Sample(S)	ΔE
S1(ab01) (uv01)	32.83
S15(ab02) (uv02)	28.11
S19(ab01) (uv01)	30.57
S20(ab02) (uv02)	38.45
S51(ab03) (uv02)	28.96

Table 1. Top 5 ΔE values of selected 1^{st} component color

3.3.2 Analysis of color difference (ΔE) on 2nd component color between two color spaces

ΔE calculation repeated on 2nd component color between two color spaces, shown on Table 2. Maximum ΔE value is 47.69, minimum ΔE is 0, and averaged ΔE value is 11.56.

Sample(S)	ΔE
S1(ab03) (uv02)	47.69
S1 (ab05) (uv05)	40.94
S12(ab05) (uv05)	36.40
S16(ab03) (uv02)	43.62
S50(ab07) (uv05)	44.09

Table 2. Top 5 ΔE values of selected 2^{nd} component color

3.3.3 Analysis of correlation of principle component colors between two color spaces

Among 51 tested images covering all colors, there is no significant difference (ΔE) of principle component color in lightness and hue (Fig. 5 & 7), but significant difference in chroma (Fig. 6). For example, the principle component color in sample 19 is closed to blue in both color spaces, which is found with no significant difference in hue. But in sample 15, there existed a significant difference in lightness, chroma and hue. The results, shown in Fig. 8, indicated that even there existed an overall variations, CV(%) = 23, among calculated principle component colors between two color spaces, but still with a high linear relation, *r = 0.81*

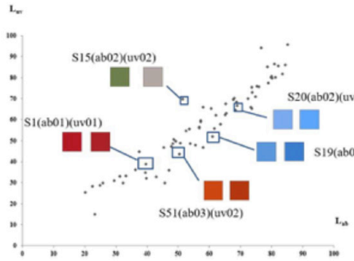

Figure 5: Correlation of principle component color of all test images in lightness between two color spaces, r = 0.95, CV (%) = 12

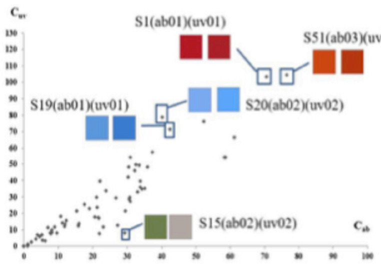

Figure 6: Correlation of principle component color of all test images in Chroma between two color spaces, r = 0.92, CV (%) = 50

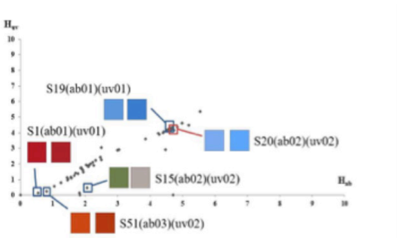

Figure 7: Correlation of principle component color of all test images in Hue between two color spaces, r = 0.91, CV (%) = 34

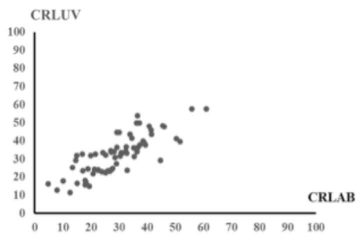

Figure 8: Correlation Coefficient of principle component color between CRLAB and CRLUV color spaces, r = 0.81, CV (%) = 23

4. CONCLUSIONS

Among 51 tested images covering all colors, the distributions of 1st component color were found less spread out than 2nd component color in both of color spaces, CIE L*a*b* and CIE L*u*v*.

A significant finding is in sample 15 that the 1st component color is different between CIE L*a*b* and CIE L*u*v* color spaces, but correlation coefficient (r) is 0.90. Covariance, CV (%), found medium high in hue and chroma, medium low in lightness. Another finding in the analysis of 2nd component color shown that there existed a high correlation, with an average r > 0.9, between CIE L*a*b* and CIE L*u*v*, but with a medium high covariance, CV (%), in hue, chroma, and lightness.

The results indicated that even there existed an overall variations, CV (%) = 23, among calculated principle component colors between two color spaces, but still with a high linear relation, r = 0.81.

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Lightness and Brightness Match under Colored Illuminants with Spatial Illuminant Gradients

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ABSTRACT

This paper reports an investigation of perceived colors under colored illuminants with spatial illuminant gradients. In performed experiments, two types of illuminant distribution were used; in one the illuminant strength changes suddenly at the center of an image and in the other the strength changes linearly throughout the right and left side of the image. Subjects were asked to match the test patch area to identify the same luminance as the reference one (called the brightness match) or to match the area to be cut from the same piece of paper as the reference one (called the lightness match) under white illuminant or reddish illuminant. The results showed that the response of the subjects in the brightness match is affected by the luminance of the test patch area; however, the lightness match the response is slightly more stable than the brightness match. This tendency occurred in both illuminant distribution patterns. When using a reddish illuminant, response of the subjects was lower than that for the white illuminant.

1. INTRODUCTION

It is well known that the colors of objects in a scene can be estimated even when the illuminant color is changed. That is, the color of a white paper is estimated as "white" even if the scene is illuminated under a reddish or bluish light. This human characteristic of color perception, called color constancy, is useful for computer vision and augmented reality (AR) or mixed reality (MR) applications because the object colors can be estimated constantly independent of the scene illuminants.

Various studies have shown that humans can estimate the colors of stimuli under illuminants whose strength changes spatially in the scene. In a couple of early studies (Arend 1990, Kawamura 1994), two types of experiments, one on lightness match and the other on brightness match, were conducted using several subjects. In the experiments, stimuli were shown as images generated using the colored Mondrian pattern. The color image as the stimulus consisted of several colors and the strength of the simulated illuminant of the image was varied throughout the image. A test patch and a reference patch were set to the center of the right or left half of the pattern and these patch areas were illuminated under different illuminant conditions. In the lightness match task, subjects were instructed to adjust the color or strength of the test patch area to match that of the reference patch so that it would look like both patch areas were cut from the same piece of paper. Similarly, in the brightness match task, subjects were instructed to adjust the color or strength of the test patch area to match that of the reference so that it would look like both patch areas had the same luminance.

The results of these early studies showed that the subjects could match the reflectance of the patch when they observed the stimulus as an object (such as a piece of paper) and that their responses about the luminance were influenced by the illuminants. Specifically, the subjects' matches were lower/higher than perfect matching when the luminance values derived by subject responses were the same as those for the reference patch area when the illuminant of the test patch side was brighter/darker than that of the reference side.

However, the color of the illuminants was set to simply white in those studies, and until now the effect of colored illuminants has not been considered. Our research objectives were to clarify the effects of color perception under colored illuminants whose strength changes spatially throughout the image.

2. EXPERIMENT SETUP

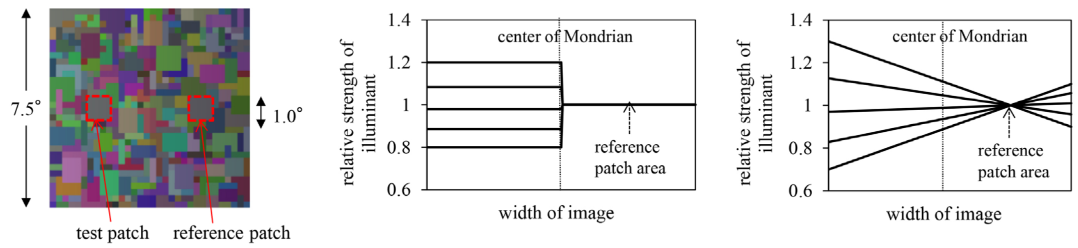
2.1 Stimuli

We conducted experiments to study how humans perceive colors under colored illuminants with spatial gradients. The stimulus we used was a colored Mondrian pattern under a white or reddish illuminant.

The Mondrian pattern we used consisted of 750 colored patches (Fig. 1 (a)). The average color of both the right and left sides was the same as 50 % level of gray and the average colors of each side (left and right) were controlled to have 50 % level of gray. Test and reference patches were located at the center of each side of the Mondrian pattern and set to be gray. In Fig. 1 (a), each small square area with a broken line corresponds to the test (left) and reference patch (right). When the subjects observed this Mondrian pattern image, the viewing angle was 7.5 degrees and the area of both test and reference patches was viewed as about 1.0 degrees.

In the experiments, we used two types of illuminant distribution, one in which the illuminant strength changed suddenly at the center of the Mondrian pattern (called the step pattern) and one in which the strength changed linearly throughout the right and left side of the pattern (called the linear pattern). These distribution patterns are shown in Fig. 1 (b), which illustrates the relative illuminant strength for the horizontal location of image pixels. The illuminant strength of the reference patch is always the same for both the step and linear patterns while that of the test patch is relatively higher or lower than the reference one.

Two types of illuminant color patterns were used. In one the illuminant color was the same as white and its strength was different between the left and right sides of the pattern In the other both colors and illuminant strength changed between the left and right, which means the illuminant color in the reference patch area (right side) was set to be white and that in the test patch area (left side) was set to be red. The images we used in the experiments were expressed as the colors of simulated reflected light from the Mondrian pattern under the spatially varied illuminants.



(a) Mondrian pattern

(b) Distribution of illuminants: Left graph shows the illuminant distribution of step pattern, right graph shows that of linear pattern

Figure 1: Mondrian pattern and illuminant distribution used in the experiment

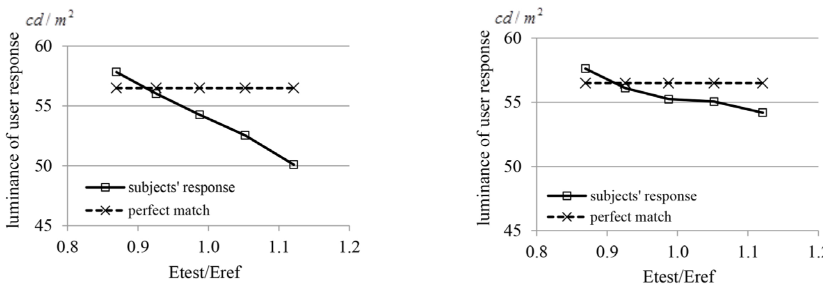
2.2 Procedure

The display used in the experiment was EIZO Color Edge CG246 and the luminance derived from the display was adjusted to be linear in advance. The distance between the display and subjects was set at 1,045 mm; accordingly, the viewing angle of the Mondrian pattern was 7.5 degrees.
The two types of tasks we used were lightness match and brightness match, the same as those in the early studies described above. Subjects were told to match the strength of the test patch to that of the reference patch. There were 30 subjects for the lightness match and 21 for the brightness match. The age of subjects ranged from 10 through the 70s and each subject performed only one type of task.

3. RESULTS AND DISCUSSION

3.1 Results of brightness match and lightness match under white illuminant

For a white illuminant, the luminance value of the subjects' response for the brightness match task was higher/lower than the perfect match when the average luminance of the area surrounding the test patch was darker/brighter than that of the area surrounding the reference patch. Figure 2 (a) shows the response of the subjects in the brightness match under a white illuminant for a step illuminant pattern. In the figure, Etest and Eref show the average luminance value of the left or right side of the image. Squares indicate the luminance of the subjects' response while crosses indicate that of a perfect match. This tendency of dependence on the luminance of the surrounding area occurred in both illuminant distribution patterns (step and linear). In the lightness match task using a white illuminant, the subjects' responses were influenced by the average luminance value of the area surrounding the test patch (Fig. 2 (b)) and the notation is the same as that for Fig. 2 (a). However, these tendencies were not especially significant, and the subjects' responses were more stable than those they provided for the brightness match. These results support the idea that under varying illuminants the responses in the lightness match are closer to the luminance of the 50 % level of gray which corresponds to the reflectance of the patch than the luminance of the reference patch area.

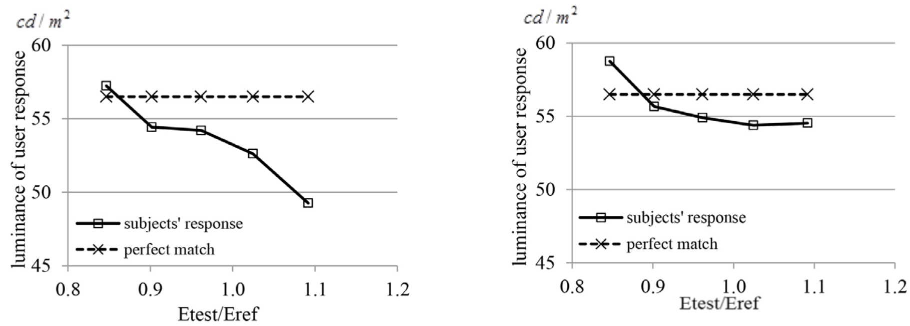


(a) brightness match *(b) lightness match*

Figure 2: Experiment results of brightness and lightness match under white illuminant

3.2 Effects of colored illuminants

When using both reddish and white illuminants, the subjects' responses were similar to those they provided when only a white illuminant was used. The responses showed no dependency on the illuminant distribution pattern, but were comparatively lower than those they showed when only a white illuminant was used. This means that the subjects perceived that the images simulated under the reddish illuminant were brighter than those simulated under the white illuminant. The subjects' response results for the brightness match and the lightness match under a reddish illuminant of the step illuminant pattern are respectively shown in Fig. 3 (a) and (b). The Etest/Eref and the marks in the graph are the same as those for Fig. 2.



(a) brightness match *(b) lightness match*

Figure 3: Experiment results of brightness and lightness match under reddish illuminant

4. CONCLUSIONS

We studied the effect of human color perception under colored illuminants that changed spatially. Our findings revealed a difference in subjects' responses between a lightness match task and a brightness match task, which is in line with the results of earlier studies. However, when a reddish illuminant was used, the subjects tended to perceive the colors as being brighter than those they perceived when a white illuminant was used.

A couple of issues remain to be resolved, namely, whether the above tendency using a colored illuminant also occurs in the case of using a bluish illuminant and whether the response would change if the subjects could adjust the value of the hue component of the test patch when the pattern is illuminated under the colored illuminant. We will address these issues in our future work.

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Who is Afraid of Red and Blue? Approaches to Colour in Architecture and Design

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ABSTRACT

"Who is afraid of red and blue" includes several studies collocated with my on-going artistic research "Colour between art and architecture" at the Bergen Academy of Art and Design in Norway. The research is investigating the currentness of colour in Architecture and design, seen against the historic frame. I aim to inspire and encourage professionals, students, and laypeople to revitalize their colour tools. The focus is on the transdisciplinarity of colour, asking how especially architects can benefit from collaboration with artists, as well as looking into art practice and colour theory. This implies a deeper understanding of colour interaction, materiality and dimensions. As an architect and artist myself I'm curious of the complexity, dynamics and mutual benefit of "the crossover effect". How can colour balance between functionality and meaning, articulation of space/volume and artistic expression? As interlocutors I choose professionals from the past and present who have developed palettes, philosophies or methods in their use of colour. For the studies within the context of "Who is afraid of red and blue", the colour philosophy of the Swiss architect and artist Le Corbusier (1887-1965) has provided the guidelines. The project Kongsvinger Colour Plan is one of these studies becoming alive.

1. INTRODUCTION

My artistic research "Colour between Art and Architecture" investigates colour in education and practice, as well as executing specific projects and studies, in order to achieve transdisciplinary approaches and methods that can provide guidelines and inspiration for students, professionals, and laymen. "Who is afraid of red and blue/ Approaches to colour in Architecture and design" is an ongoing project within this frame. It comprises several studies, of which one is presented here, with a focus on urban design and revitalization through colour. The target is the Norwegian town Kongsvinger. It is a study about colour as identity and its aesthetic aspects, as well as its psychological impact. The approach is also in line with the current focus on social sustainability, colour being vital for wellbeing.

The backdrop for the artistic research (as well as the project) is the persistent Chromophobia that for decades has characterized the Norwegian building industry, a grey monotony that is sweeping facades and interiors. We have seen bold international trends using coloured light, paint, prefab and natural materials in clever integration, but these trends are not hitting our northern shores at the moment, although media, seminars, exhibitions and courses have laborated on the topic. The psychologist Eirik Glambek commented in an article: "To paint and build everything in shades of gray, is to deprive people of colour stimuli. There is a reason why sensory deprivation is a torture method."

Most architects are escaping the discourse. Colour is marginalized in the everyday struggle with time, budget, entrepreneurs and clients. If that is not enough, they are working in the face of various global crises, be it war, poverty, climate threats or crime. Since colour plays a weak role in their education, they do not have the power

(1) Colour refusal. Greek: Chromos: Colour, Fobi: Fear
(2) D2 (magazine) "Norge i svart, hvitt og grått" 01.10.2015

to integrate it. The lack of courage is compensated with rejection. In the quest for honesty in materials and expression architects also see colours as seductive and unpredictable. “No tricks” makes you think of the ancient philosophers Plato and Aristotle who considered the painter´s work as mixing of “drugs”, or Pharmacon .
Apart from the “white lies” of the history books, discrimination of colours has long traditions and influential disciples in Norway. The internationally famous architect and professor at the School of Architecture in Oslo, Sverre Fehn (1924-2009), said in an interview that he was not a “colour man”. The colour for him appeared in the choice of building material, wood, concrete, bricks, etc. If he were to work with colours it had to be raw and brutal, not as a “thin film on the surface”. Fehn, who in 1997 received both the Pritzker Architecture Prize and the Heinrich Tessenow Gold Medal represented, with his poetic minimalism, a manifest for contemporary practice. He was part of a generation of Norwegian (and international) architects who largely rejected Polychromy . It was as if the hues violated the volumes. Fehn was, however, fascinated by Le Corbusier’s personal approach to colour. If he were to paint, he would have liked to work like the Swiss master, with genuine pigments and articulate definition of volume and space. He expressed a frustration at the fact that we have lost touch with the natural colour sources, the earth or the surrounding plants, stones and animals, thus pointing to another reason why colour has lost status. Through industrialization and the use of nomenclatures as design tools it has become an abstract readymade, the sensuality of colour as material is lost.
The current wholesale adoption of clean, colourless environments is also linked to the trademark of “Scandinavian design”, implying natural materials, pale paints, canvas and leather, with roots firmly planted in the fifties. The style represented a social democratic thinking, a beautiful life for everyone. It has since developed in to a more minimalistic version, disconnected with the sociopolitical recognition, and its hitting facades as well as interiors. In a more positive light the trend reflects the Japanese notion of emptiness (J.kū), which is not something static and hollow, but dynamic, constantly changing and evolving. Architecture seen as a latent potential where anything might happen and colours may manifest themselves at any time. As to the notion of sustainability, natural materials and their inherent colours will always exist in the field of architecture. The symbolic value is understandable when it comes to “reduce, reuse, recycle”, but why should our responsibility with the Earth’s resources leave us without saturation? A scientist recently discovered a brilliantly bright, durable pigment, called YInMn blue, that if applied, actually helps cooling down the exterior.
Those who want to demonstrate the diversity and complexity of contemporary environments, promote Polychromy. They see social design and the architecture of empathy as tactile, sensual and colourful. Some exaggerate, but our times are challenging, and there is room for great contrasts. The young generation should grasp the opportunity. The question is whether the current education encourages such experimentation, freed from the shackles of “Nordic noir?”

(1) From Greek: Adapted from pharmacos, is a biologically active substance
(2) Rejection of Greek Polychromy and other falsified reconstructions of architectural colour
(3) Greek: Chromos: Colour, Poly: Many
(4) Discovered in 2009 by chemist Mas Subramanian and his team at Oregon State University

1. 1 Kongsvinger Colour plan

We do not have a tradition for holistic colour strategies and regulations, like those you might find in many other European countries. A personal, intuitive or ad hoc expression is more typical, which at its best has given us lucky coincidences, but also great disharmonies and even “violations”. A few decades ago the use of bright synthetic hues lead to “colour pollution”, today the situation has reversed into a disturbing colour loss. In the town of Kongsvinger we saw this happening and set out to investigate how a colour plan could reverse this process and act as a comprehensive tool to empower the urban identity for the municipality.
The town of Kongsvinger is situated in Mid-Norway, surrounded by pinewoods with a harsh winter climate. The town rose as a trading centre during the 17th century. Situated on a hill west and north of the Glomma river, it stood astride the ancient Vinger Royal Road , which connected Norway to Sweden as well as being the north south Norwegian route along Glomma. As Kongsvinger formed a key junction point for these routes, fortifications were constructed to protect against invasion from the east. The old historic part of the town is today known as “Øvrebyen” (the Upper City), a colourful and charming cluster of wooden houses in the hills underneath the fortress. Location of the railway and station later caused considerable construction on the south side of Glomma, and the area was incorporated into the market town in 1876. The old historic town stagnated gradually in favor of the growth of a new city centre on the north bank. Despite several bridges over the river and a cohesive plan in 1922, which sought to fuse the different parts, it must be held that Kongsvinger still is a twofold-, or even threefold city today.
The colour plan for a future Kongsvinger aims to unite these historic values with the contemporary identity. It will also greatly encourage artistic interventions.

2. METHOD

An initial analysis of the existing use of colour in Kongsvinger concluded with the following: “A colour strategy for the whole centre should be based on the natural pigments/earth colours of the historic “Upper Town”, so as to make references across the river. This would be a way of securing the historic identity and connect the different parts of the city, at the same time provide a constructive “base palette”. Simultaneously the plan should apply a more saturated colour palette wherever appropriate, as well as allowing “decorative” elements to integrate as historic or artistic references.
The plan, NATURE +, was inspired by Le Corbusier’s concept of using natural pigments as constructive colours for walls, to create pleasing atmospheres, and the synthetic to create highly contrasting, more emotional effects. The notion of “red and blue” in the headline of this paper hints to his modulation of space and volume with light (warm colours) and dark (cool colours). Red and blue were the dominant colours in his repertoire.
The street Glommengata was selected as a pilot project, being the main street on the south side of Glomma. It is one of the important gateways to Kongsvinger and welcomes you when you arrive by train. Over time it had developed into a derelict shopping area, loosing customers to malls on the outskirts. Both the streetscape and the variegated architecture needed upgrading.

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(1) The road through Eidskog to Sweden, Eskoleia, was mentioned already in the sagas.
(2) A garden city plan by Sverre Pedersen, architect. 1882 -1971
(3) Le Corbusiers Colour Concept. Katrin Trautwein. ktCOLOR 2013

A preliminary sketch was developed through 2010-11. In 2012-13 the Municipality received NOK 1 000 000 from The Norwegian Housing Bank and Hedmark County Council as subsidy for employing competence and implementing new colours in Glommengata. In 2013 they also received NOK 100 000 from the Directorate for Cultural Heritage, for colour studies in the co-pilot in the Upper Town, excavating the base palette.
A specific goal for the Glommengata pilot was to empower the street and its identity. That implied encouraging owners, through stimulation grants, to upgrade facades during 2014-15, a demanding dialogic process. The concept included detailing and new signage. This in turn would make the street more attractive for businesses and rental. Finally, an important issue was the integration of the Street Art project, Q14 in 2014. This event received immense media attention and helped put Glommengata on the international map. A 150-meter long, drab concrete façade became, after negotiations with the owner, the wall piece of the Canadian participant Roadsworths. Another smaller façade received a magnificent treatment by MrDeHo from Portugal. The pavements were also canvases for international artists together with the youngsters of Kongsvinger

Figure 1. From Glommengata pilot 2015. Inspiration from Le Corbusier's Colour Keyboard

3. RESULTS AND DISCUSSION

Glommengata has 21 properties. 5 buildings had satisfactory facades. 11 properties were upgraded in line with the colour scheme in 2014-15. 2 facades got Street Art on walls. 5 properties were not included in the scheme because they have future rehabilitations planned. 14 new signs are produced. Contrasting colours on details and artistic intervention has helped to improve the identity of the street. A few properties have started to implement original hues on their facades in The upper Town. In 2014 a seminar on the use of colour in architecture and design was held, with 90 participants. The process has also been a hot topic in local newspapers and social media. Final reports with detailed information and the final colour palettes are available on the web.

4. CONCLUSIONS

Glommengata has undergone a transformation from a rundown disorder to a welcoming and attractive city street. The final result shows that a conscious colour scheme can help to improve the quality of a city street and strengthen its identity. Stimulation grants have helped realize a more exciting and comprehensive use of colour. The urban practitioners have a new awareness and competence in the use of colour. The scheme has thus been a boost for the Municipality and has had positive repercussions for the whole town. The expertise and the grants have been crucial for the project, as well as the (at length) dialog with the owners. No more fear of red and blue.

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Colorarch: A Colour-Combination App Running Le Corbusier's Salubra Colour Keyboards

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ABSTRACT

We have developed a mobile App that allows end-users to choose from the 312 four-colour combinations put forward by Le Corbusier in the colour keyboards commissioned by Salubra in 1931 for its painted wall paper collection. These combinations are shown in a standard colour notation such as Natural Colour System (NCS). The application allows you to browse the colour space NCS, which is shaped like a double inverted cone and to observe the spatial position of each of the 32 Salubra colours, addressing three perceptual variables: hue, blackness and chromaticity. Users can select any of the colour combinations with 1, 2, 3 or 4 targets, evaluate its position in the NCS solid and determine if combination criteria exist based on the similarity of hue, blackness or chromaticity, or on the contrast among any of these perceptual variables. One can also assessed if the colours belong to the same hue range or are complementary, if they share the same value of blackness or have contrast, if they are bold or dull colours (low chromaticity), etc. The application also indicates the recurrence of each pair of two colours from the total of 1248 matched pairs in the Salubra keyboards. Any recurrence reflects Le Corbusier's interest in said colour combination, whether it was a usual pairing throughout the Salubra charts or whether on the contrary, it was uncommon. In short, our application identifies the colour combinations put forward by Le Corbusier in 1931 for the Salubra colour keyboards, and shows the colour combination criteria in a visual colour space that customers may browse in order to select their preferred palette. This App was a result of earlier research by the authors about the "colour combination criteria in Le Corbusier's Purist architecture based on Salubra claviers from 1931", and published in Colour Research and Application (© 2015 Wiley Periodicals, Inc. Col Res Appl, 41, 85–100, 2016).

1. EARLIER RESEARCH INTO THE 1931 SALUBRA COLOUR KEYBOARDS

In 1931, the Salubra wallpaper manufacturer (Basel, Switzerland), commissioned Le Corbusier to compile an architectural colour chart, with a second version being completed in 1959. The first was conceived as a harmonic series, similar to the way in which the keys of a piano are organized, thus the name colour keyboards. In 1997, both colour charts were republished with an unpublished text by Le Corbusier (1931: 94-143) Architectural Polychromy, which dates back to late 1931 and early 1932, without doubt the most important document for understanding colour in the designs of the Swiss architect. A number of authors have carried out in-depth studies of the Salubra colour charts: JL. Caivano (2007) explains how it is organized and how it functions; M. Colli (1987) organizes the colours into keyboards; A. Ruegg (1997) undertakes an in-depth analysis of the colour charts in addition to the Architectural Polychromy text while J. de Heer (2009) carries out an exhaustive study of the chromatic aspects in the writings and Purist architecture of Le Corbusier, attested to by the high degree of freedom in the use of colour in the projects built that went beyond the Salubra claviers. Our research is innovative because it graphically shows, with supporting statistical data, some of the principles of Le Corbusier's colour preferences, such as the combination of colours with equal chromaticity, his interest in a certain contrast in blackness, or the frequent contrasting of cool and warm colours, something slightly different to the contrasting of complementary colours.

Figure 1. Screen shot of the ColorArch App interface showing the Navigation Drawer with the 63 Salubra colours sorted by preference, and the 3D NCS colour space showing the selected green and all its combinations. See how it works at https://youtu.be/EHq-ib3UsAo

2. REVIEW OF SIMILAR COLOUR-COMBINATION APPS

Certain applications enable users to combine colours to generate personalized colour palettes that can then be outputted to standard design programs. Some of the better known ones are as follows: Adobe Kuler, Paletton, NCS Navigator tool or Coolors. Other applications allow users to create a colour palette from a photograph, such as: Photocopa or Copaso. There are also specialized paint business applications where you can colour the interior of virtual space or photograph: Tollens, Bruguer Visualizer, Valentine colour planner, etc.

Nevertheless, said applications organize the colours according to the laws of contrast and harmony based on the classical theories of colour, but not on the aesthetic sensitivity of an internationally acclaimed architect and with buildings that can attest to it. Furthermore, there are no Apps like ColorArch that allow you to combine colours in 3D. Although colours are always described in variables of perception (tone, saturation and luminosity), the applications that combine colours can only do so with 2D drawings, and enable users to modify the variables individually, or two by two, but never simultaneously and in three dimensions.

In addition, the colours in other Apps appear in sRGB (screen colour) format, or even in the colour notation of the paint company itself. sRGB cannot be considered a "stable" colour space because it varies from one viewing device to the next, the graphics card, colorimetric purpose and other colour-management factors. The use of a standard colour notation system (NCS, Munsell, etc.), irrespective of the device, enables users anywhere in the world to get the exact colour supplied by any company for any support.

3. DESCRIPTION OF THE COLORARCH APP

ColorArch allows users to select a combination of colours following a set of criteria employed by a renowned architect and presently the Le Corbusier module is available. The application facilitates an accurate colour notation using a standard notation system such as the NCS (Natural Colour System), which enables one to standardize colour to such an extent that the end user can approach a supply company and be assured of a perfect match between the selected colour and that employed by the referred architect. The accuracy of the colour notation has been attested to in earlier research, studying the original colours and measuring them with the help of specialized equipment. In the case of Le Corbusier, taking measurements with the help of a Konica Minolta CM 100spectrophotometer at the Le Corbusier Foundation in Paris from the original colour charts conserved there.
Upon opening the application, users can select the architect/designer of their choice and the colours to be used. In the case of Le Corbusier, users can select from a dropdown menu in a "Navigation Drawer" one of the 43 Salubra 1931 colours. Le Corbusier suggested combining 3 or 4 colours from 13 colour charts called "colour keyboards", for their similarity to a piano. Each one of these "colour keyboards" received its own name to identify it: wall, sky, space, etc.
Selecting one of the colours, all colour combinations where that colour is present appear, sorted in order from most to least preferred by Le Corbusier. A text shows the name of the colour in the original Salubra notation and optionally in NCS. In addition, it provides the name of the keyboard to which that colour combination belongs. The Navigation Drawer can be tucked away to one side to enable users to navigate through a 3D model that represents a colour space. The 3D model can be navigated and enables users to select any of the 43 spheres. Upon doing this, a series of lines indicate the colours with which said colour can be combined. The rest of the spheres appear "deactivated" and greyed out. By moving the 3D model, users can evaluate the preferred colour combination criteria of Le Corbusier.

4. DISPLAY OF THE SALUBRA COLOUR COMBINATIONS

Viewed straight on, the 3D model enables users to see if Le Corbusier preferred to combine colours with others of a similar blackness, using a harmonic criteria based on "high colour ranges" (light colours), "low colour ranges" (dark colours) or "medium colour ranges"; or whether he was looking for chiaroscuro contrast between the selected colours. Viewed from above, the model gives users an insight into whether the architect in question preferred to combine colours with others of a similar chromaticity or brilliance (equidistant from centre of the colour wheel), or contrasted with regard to the chromaticity (at unequal distances from the centre of the colour wheel). Viewed from above, the model also enables users to understand if Le Corbusier preferred to combine colours with others of a similar tone, in other words with similar angular distances from the centre of the colour wheel, or on the contrary, with colours from the other side of the colour wheel. For the latter, users can see the use of complementary colour combinations such as red-green, yellow-violet, blue-orange, or conversely, cold-warm colour contrasts etc.

5. CONCLUSIONS

ColorArch is an App developed in Android that can be downloaded free of charge from Google Play and facilitates the work of architects, designers and end users when deciding on the finishes for a building, following the rules of colour combination attested to by icons from the world of architecture. In this way, the colour sche-

mes of the great master architects become universally available, are normalized, and are at the finger tips of the general public.
From an educational perspective, even today there are still too many professionals who are unaware that modernist architecture did not exclusively use the colour white. It is essential that the colour schemes used by the modernist masters are put into the spotlight in order to guide professionals when making colour-based decisions. And ColorArch could be just the ideal tool to do this.

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Sensory compensation media for color detection in the environment

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ABSTRACT

The human visual system consists of a series of complex tasks specific organs for capturing and decoding of color that allows us, among other sensory stimuli interact with the environment around us. However, when we are deprived of the visual stimulus, we are limited in much of our daily tasks. For several authors (Cattaneo & Vecchi, 2011; Kosslyn (1973, 1980, 1994, 2006), Pylyshyn, (1973, 1981, 2003)), lack or deficiency in the functioning of the visual apparatus, does not mean that the subject does not you can respond to a visual stimulus, however, these authors acknowledge the existence of sensory Compensations, i.e., the body derives visual stimuli to other sensory devices. Cattaneo et al. make a review of the most appropriate sensory offs between the other senses (touch, hearing, taste and smell), reviewing previous experiences made with people with total or partial visual impairment, concluding that both stimuli haptic and auditory offset sensorially of best visual stimuli. On the other hand, Kosslyn and Pylyshyn state that, although a person can be prevented from seeing through sensory compensation added to the record of previous experiences, the subject is able to generate pictorial or descriptive imagery.

This research is the result of an initial search to establish possible sensory compensation through the design of technological devices to which I call media compensation. That name is meant as specialized extension that allows ridding the body for performing other tasks (McLuhan (1962, 1964); Hall, (1959)). Both, Hall and McLuhan recognized as technological support a natural extension as both sensory bodies for the subject's interaction with their environment. In this case, preliminary tests hereby focus on the recognition of three basic levels: Color, Form and Distance.

Using techniques and algorithms of Computer Vision, experiences of recognition are performed both video and images in order to recognize certain color ranges, factors that could alter this measurement, the selection of the location of the body where sensory compensation will be made and finally the choice of suitable electronic components to carry out such compensation.

While recognizing color, digital devices, is not new. Various techniques and instruments have been developed with the passing of the years to capture and detection of colors (colorimeters, scanners, etc.) However, when it comes to emulate the functions of the eye in humans, capture conditions must they are conditioned otherwise. Moreover, the choice of components (cameras and sensors) is conditional on performance aspects of hardware and environmental conditions where the capture and detection is performed. This paper reports the first experiences focused exclusively on color recognition and behaviour of the hardware devices in order to reach the most accurate measurement possible.

Occupational Colour Vision Needs with Emphasis on Aviation

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ABSTRACT

The novel experiments and tests developed for this study yield new data that describe how combinations of luminance contrast and Red / Green (RG) and Yellow / Blue (YB) colour signals affect task completion times (TCT) and the overall accuracy the operator can achieve.
With appropriate design and choice of colours, it is possible for deutan applicants with thresholds < 4 standard normal CAD units to perform as well as normal trichromats when suprathreshold colours with RG and YB components are employed in visual displays. As many as 22% of deuteranomalous subjects can be included in this category. In spite of their congenital colour deficiency, such applicants can operate safely in the Air Traffic Control (ATC) environment as well as in many other occupations that involve the use of large-field, visual displays.

1. INTRODUCTION

Colour is arguably a very effective and compelling but also attractive and efficient method to enhance performance on visual displays. The use of colour signals can benefit visual performance in a number of ways:
• Colour signals enhance the 'effective' contrast of objects defined by luminance contrast (Barbur & Forsyth 1988). When luminance contrast is low, the addition of colour signals, particularly to targets defined by luminance increments, results in improved visual performance and shorter task completion times.
• Pop-out and parallel processing of colour signals (Treisman & Gelade, 1980) is particularly useful when the working task involves the use of crowded scenes in large visual displays. Objects of reasonable size that in addition to luminance contrast are also coloured can often be detected and localised in crowded scenes without the need for any eye-movements. In such cases, the visual search is reduced to a single saccade, which directs the subject's point of regard onto the target.
• Signalling and enhancing information by means of colour coding can be a very effective way of improving visual performance. The display of weather patterns in an airplane cockpit uses specific colours to differentiate between levels of precipitation. The detection and correct naming of reds and whites from a large distance in the Precision Approach Path Indicator (PAPI) lights when landing an airplane is a good example of a safety critical task.
• Segmentation of complex scenes into areas of interest by means of colour can also be of great benefit in visually demanding tasks. The human visual system organizes complex scenes into meaningful objects and / or spatially distinct regions. This is often described as 'segmentation' (Pinker 1984). Visual segmentation can focus attention and enhance performance by making the visual task less demanding and less tiresome. For example, a controller can spatially separate the aircraft situations area, or the number of aircraft of immediate responsibility from the menu areas in a radar display.
Technology advancements in the design and production of visual displays have increased greatly the use of colour to provide many of the benefits described above. The obvious requirement is that the operator must be able to make use of colour signals and this often assumes the need for normal trichromatic colour vision. Several studies carried out in selected working environments have, however, demonstrated that

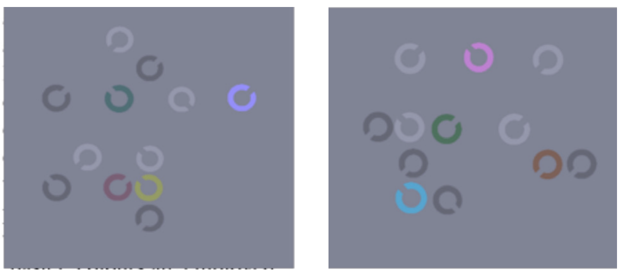
although colour vision is needed to enhance visual performance and to carry out visual tasks that are often safety-critical, subjects below specified levels of colour vision loss can cope with the safety-critical, suprathreshold, colour-related tasks with the same accuracy as normal trichromats (Barbur and Rodriguez-Carmona, 2012). The aim of this study was to investigate the use of colour signals in occupations with emphasis on Air Traffic Control (ATC) applications.

2. METHOD

Normal trichromats and many subjects with congenital colour deficiency took part in this study. Each subject's colour vision was investigated with a number of conventional colour vision tests and the class of colour vision and severity of loss were determined using the Colour Assessment and Diagnosis (CAD) test (Barbur and Connolly, 2011). A new, CRATO test was also designed specifically for this study. The Colour Requirements for Air Traffic Operators test measures the mean speed of response (labelled as 'Task Completion Time' (TCT)) and the percentage correct scores (PCS) for visual tasks that involve large visual fields and for stimuli of equivalent size and contrast to the data blocks employed in ATC displays. Although the objects employed are somewhat abstract since they consist of similar targets and distractors, the use of such stimuli makes it possible to evaluate how target contrast and colour affect visual performance. Stimuli were presented over a square region subtending ~ 20° of visual angle on a high resolution, 'spectraview', NEC monitor (PA301W, Tokyo, Japan). The background field was set at a luminance of 32 cd/m2 and had a chromaticity of xb = 0.305, yb = 0.323 in CIE-x,y 1931 colour space. The coloured stimuli in all experiments were defined as chromatic displacements from background chromaticity (xb, yb) in specific colour directions. The programs needed for the study were developed by City Occupational Ltd (London, UK). The display calibration programs were the same as those employed in the CAD system (Barbur and Connolly 2011).
The CRATO test was used with a limited number of subjects: 33 normal trichromats and 37 subjects with deutan- and protan-like colour deficiencies. The age of the subjects ranged from 17 to 65 years (mean 37 years, median 34 years). Subjects had a visual acuity of 6/9 or better.

2.2 Principal Experiment

The study involved many visual search experiments with targets defined only by spatial cues, spatial cues and colour or only by colour. In each experiment the subject had to search the visual scene to find the test target and to indicate this as quickly as possible by pressing a button. This recorded the TCT. The subject was then required to press one of four buttons to indicate either the orientation of a gap in a Landolt ring stimulus or its colour in order to measure the subject's PCS. The most important experiment involved the use of colours that isolate either RG or YB chromatic mechanism (Fig. 1A) or 'pastel' colours defined by combined RG and YB signals (Fig. 1B).



(a) RG or YB isolating colours

(b) 'Pastel' colours

Fig. 1 (a, b). Examples of RG and YB isolating colours (a) and 'pastel' colours (b). The latter are defined by a combination of RG and YB colour signals. Congenital colour deficients with thresholds < 4 CAD units perform as well as normal trichromats when saturated 'pastel' colours are employed, but have longer TCTs for RG isolating colours (a).

3. RESULTS AND DISCUSSIONS

The results confirm well established findings, which show the importance of luminance contrast and the use of colour signals in visual search. In addition, the following new experimental findings have emerged from the study:

• Targets with higher luminance contrast can be detected quicker and easier than those of lower contrast, but the addition of colour signals to such targets can greatly reduce TCTs and also improve task performance accuracy.

• TCTs decrease gradually with increasing colour signal strength with little additional benefit above 10 to 12 standard normal (SN) CAD threshold units (Rodriguez-Carmona et al., 2012). This is also the case when spatial cues are involved and the task can be carried out in the absence of colour signals.

• Both RG and YB colour signals yield significant advantages by shortening visual search times (often as much as four fold), even when colour is used redundantly and the task can be completed without the use of colour signals.

• When task specific information is displayed over large visual fields, YB colour signals have some advantage over RG, largely because YB chromatic sensitivity falls off less rapidly with increasing distance on the retina between the point of regard and the target location. Although RG signals, particularly when small targets are involved, have advantages over YB signals in central vision, the opposite seems to be the case when the working visual field is large.

• Colour signals are more effective when added to targets defined by increments in luminance (i.e., when viewing bright as opposed to dark objects presented against a uniform background). This observation applies to both RG and YB stimuli.

• In general subjects with even mild congenital RG colour deficiency perform less well when the task involves the use of colours of low chromatic saturation which they confuse, i.e., colours that differ mostly in RG content. The same, mildly deficient subjects perform as well as normal trichromats in the same task when YB colour signals are employed.

• Subjects with mild congenital colour deficiency (e.g., those with thresholds less than ~ 4 SN CAD units) can perform colour related tasks when several coloured targets are involved, but only when larger chromatic saturations are employed (i.e., > 10 SN CAD units). The addition of YB colour difference signals to targets defined by luminance and RG colour contrast ensures that mild congenital colour deficients perform visual search tasks with virtually the same speed and accuracy as normal trichromats.

• Visual performance in dichromats and also in subjects with severe loss of RG colour vision is significantly worse when compared to normal trichromats except for colours that rely heavily on YB colour differences.

4. CONCLUSIONS

The key conclusions listed below are based on measurements of visual performance in large field, visual displays which quantify the advantages of adding RG and / or YB colour signals to objects defined by luminance contrast.

• If the visual task requires detection and naming of colours for small signal lights (e.g., red, green, yellow, blue and white, etc.), or the discrimination of the smallest possible colour differences in order to judge uniformity of colour reproduction in manufactured goods, or the need to adhere to the commonest appreciation of perceived colour appearance and colour names and / or the ability to use efficiently faint, desaturated colours to segment objects into groups on visual displays, a pass requires normal trichromatic colour vision.

• If large chromatic saturations are employed, subjects with mild RG colour deficiency (e.g., those with RG thresholds ≤ 4 CAD units) will be able to make use of the reduced RG colour signal to carry out the colour-related task, but these subjects will be a little slower than normal trichromats when the tasks require visual search in large displays.

• When suprathreshold YB colour difference signals are also added to objects defined by luminance and large RG colour contrast, congenital deficients with RG thresholds ≤ 4 CAD units can perform multi-colour visual search tasks with the same accuracy and speed as normal trichromats.

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Does Shape Affect Color Harmony and Color Emotion

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ABSTRACT

It has long been questioned that does the shape affect color harmony and color emotion? To answer this question, a psychophysical experiment was carried out to clarify the influence of shapes and color combinations upon emotions.
The two-color combinations were applied onto a color configuration made by a cuboid shape configured with side circle, frame, loose voronoi diagram, and dense voronoi diagram. In terms of color combinations, 11 basic colors were used as main color and four-color design techniques to produce second color. Totally, 184 color-shape combinations were used as experimental samples. Each experimental sample was assessed on 21 scales by using 7-step categorical judgment. Ninety-eight observers took part in the experiment. The Balanced Incomplete Block Design (BIBD) method was used for observers randomly assessing the experimental samples.
The shape effect on the color emotions and color harmony was found to be a little. The results also showed the sum of lightness and sum of chroma determined most of color emotions.

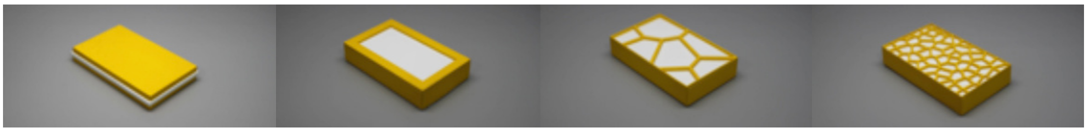
1. INTRODUCTION

The appearance of product includes color and shape attributes. How to make shape and color attract customer is an important task for product designers. Many studies(Lee, Luo, and Ou 2009, Ou and Luo 2006, Ou et al. 2012, Ou et al. 2004) have been carried out to explore how colors affect the emotions. The experiments conducted in these studies used color chips or simple shapes as experimental sample. It raises a question that does the shape affect color harmony and color emotion? To answer this question, a psychophysical experiment was carried out to clarify the influence of shape and color attributes upon emotions.

2. EXPERIMENTAL PLAN

To see if the shapes affect color emotion and color harmony, two-color combination was used to apply onto a two-color configuration. In terms of two-color combination, 11 basic color terms (red, orange, yellow, green, blue, brown, purple, pink, white, black and gray colors) purposed by Berlin and Kay(Berlin and Kay 1969) were selected to be the main color. Each main color was produced according to their boundaries in CIELab space proposed by Lin et.al.(Lin, Luo, MacDonald, et al. 2001, Lin, Luo, et al. 2001b, a) On the base of the main color, the secondary colors were chosen according to the four design techniques, "tone on tone (different tone with same hue)", "tonal (same tone with different hue)", "chromatic-achromatic combination", and "achromatic-achromatic combination" purposed by (2006). In total, 46 color combinations were made. Each color was measured by a GretagMacbeth® Eye-One. The CIELAB values were calculated under CIE D65 and 1964 standard colorimetric observer.
These 46 color combinations were applied onto 3D two-color configuration made by a cuboid shape configured with four shape features, including side circle, frame, loose voronoi diagram, and dense voronoi diagram, as shown in Figure 1. Totally, 184 experimental samples were made. Each sample was assessed on 20 emotional scale together with harmonious scale by using 7-step categorical judgment. These 21 scales included "active-passive", "heavy-light", "warm-cool", "simple-complex", "hard-

soft", "strong-weak", "elegant-vulgar", "modern-classical", "tense-relax", "fresh-stale", "masculine-feminine", "ordinary-unique", "new-old", "beautiful-ugly", "happy-sad", "clean-dirty", "serious-humorous", "clever-absurd", "like-dislike", "comfortable-uncomfortable" and "harmonious-disharmonious".
Each experimental sample was displayed in a viewing cabinet and illuminated by a D65 simulator. The viewing distance was about 45 cm with a 45/45 illuminating/viewing geometry.
In order to prevent the fatigue caused by the long experiment, the Balanced Incomplete Block Design (BIBD) method was used for observers randomly assessing the experimental samples. Each experimental sample was judged by at least 30 observers. Totally, 98 observers took part in the experiment, including 42 male and 56 female, the averaged ages is 22 years.



(a) (b) (c) (d)

Figure 1: The four shapes used in the experiment. A cuboid shape configured with (a) side circle, (b) frame, (c) loose voronoi diagram and (d) dense voronoi diagram features. In this figure, the yellow color was used as main color, the white color secondary color.

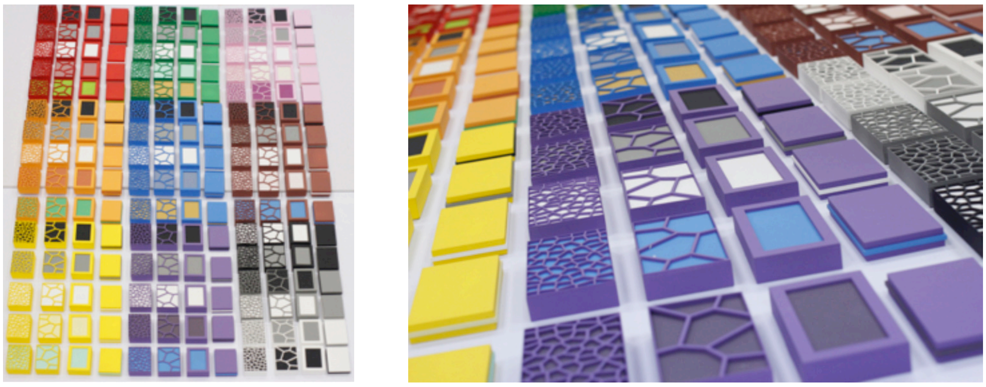


Figure 2: The experimental samples.

3. RESULTS

In order to see how both color and shape attributes simultaneously affect the color emotion and color harmony, the multiple correlation coefficients were evaluated. In terms of color attributes, the two-color interrelationship was calculated by using addition and subtraction between the CIELab color attributes of two colors. The addition two-color interrelationship included sum of lightness (L^*sum), sum of chroma (C^*sum), sum of a^* values (a^*sum) and sum of b^* values (b^*sum) together with the middle angle between two hue angles (cos(hmid) and sin(hmid)). The subtraction two-color interrelationship included lightness difference (L^*), chroma difference (C^*), a^* difference (a^*), b^* difference (b^*), color difference (E^*) and hue difference (h). In terms of shape attributes, the measurement are based on appearance of shape, including quantity of feature (Q), height of feature (H), width of feature (W), area of feature (A), volume of the sample (Vol), feature turns (FT) and appearance turns (AT).

Table 1: The results of stepwise multiple regression analysis. The emotional scales are dependent variable, color and shape attributes independent variables.

		active-passive	heavy-light	warm-cool	simple-complex	hard-soft	strong-weak	elegant-vulgar	modern-classical	tense-relax	fresh-stale	masculine-feminine	ordinary-unique	new-old	beautiful-ugly	happy-sad	clean-dirty	serious-humorous	clever-absurd	like-dislike	comfortable-uncomfortable	harmonious-disharmonious
	R	0.81	0.70	0.82	0.82	0.64	0.64	0.68	0.62	0.63	0.70	0.65	0.67	0.66	0.61	0.75	0.65	0.78	0.60	0.59	0.64	0.59
	R^2	0.66	0.50	0.67	0.68	0.41	0.40	0.47	0.39	0.40	0.49	0.43	0.44	0.44	0.37	0.57	0.42	0.60	0.36	0.35	0.41	0.35
color attributes	L^*_{sum}	-0.30	**0.62**	-0.13	-0.12	**0.50**	**0.51**	-0.41	-0.25	**0.54**	-0.32	0.36		-0.41	**-0.48**	-0.41	**-0.53**	0.36	-0.25	**-0.46**	**-0.51**	-0.33
	C^*_{sum}	**-0.54**	0.29	**-0.26**		0.33		0.16			**-0.36**		**0.39**	-0.15		**-0.53**		**0.58**	0.23			
	a^*_{sum}			-0.27		0.16						0.18										
	b^*_{sum}																					
	$\cos(h_{mid})$	-0.10		-0.41		0.16			0.31			**0.48**	0.14			-0.10	0.22		0.21			
	$\sin(h_{mid})$		-0.12	-0.26		-0.24	-0.39	0.13			0.16	-0.16	-0.16	0.14				-0.11				
	$\triangle L^*$	-0.17					-0.19	-0.23							-0.21	-0.17	-0.22			-0.26		
	$\triangle C^*$	-0.13				-0.18	-0.13								-0.20	-0.13	-0.13		-0.16			
	$\triangle a^*$	-0.23		-0.11	0.16			**0.30**					0.17		0.14			0.15	**0.34**		0.24	**0.42**
	$\triangle b^*$			-0.16																-0.21		
	$\triangle E^*$								**-0.40**		-0.36		0.28	**-0.42**					-0.15		-0.13	
	$\triangle h$																					
shape attributes	Q																					
	H			0.10																		
	W				**0.82**					-0.34												
	A																					
	Vol	0.14																				
	C																					
	FT				0.32																	
	AT												-0.18				-0.18		-0.14	-0.16	-0.22	-0.14

The results were summarized in Table 1. In this table, the top two rows show the multiple correlation coefficient and multiple determination coefficient, respectively, indicating how well color and shape attributes simultaneously related to the emotion scales. The former are ranged between 0.59 and 0.82, the latter between 0.35 and 0.68. The significant standardized coefficients are summarized in Table 1, the attribute having greatest influence on emotion scales is highlighted in bold.

In Table 1, it can be seen that the influence of shape attributes was found to be a little, except "simple-complex" scale. Most of the emotional scale, including "harmonious-disharmonious", were determined by color attributes. The color attributes of L*sum and C*sum were found to determine most color emotions, except "elegant-vulgar", "modern-classical", "masculine-feminine", "new-old", "clever-absurd" and "harmonious-disharmonious".

4. CONCLUSIONS

To answer the question if the shape affect color harmony and color emotion, the current study used different shape features applied onto a cuboid as color configuration to analyze the influence of color and shape on 21 scales. The results of multiple regression analysis showed the shape effect was found a little. This tells designers that color design is more important than shape design on the appearance of object. The future study will devote to analyze how each appearance attribute determine the color emotion and color harmony. In addition, the appearance of objects consists of color, shape, texture, gloss and pattern. The current study only focus on color and shape, the future study including other attributes are strongly recommended.

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