



# **Book of Abstracts** of the International Colour Association (AIC) Conference 2022

**Toronto, Canada (online)**  
**13-16<sup>th</sup> June 2022**

**Organized by: Colour Research Society of Canada (CRSC)**  
**Published by: The International Colour Association (AIC)**





This publication includes abstracts of the invited talks, oral and poster papers presented in the International Colour Association (AIC) Conference 2022. The theme of the conference was Sensing Colour. The conference, organized by the Colour Research Society of Canada (CRSC), was held online, from June 13-16, 2022 and was originally planned to take place at OCAD University in Toronto.

More information at: [www.aic2022.org](http://www.aic2022.org) and [www.colourresearch.org](http://www.colourresearch.org)

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# Invited Speakers: Abstracts & Bios



MONDAY JUNE 13, 19:00-20:00

## Among Migwans Beam

### Gathering Colour

Many of my earliest memories are encountering colour with my parents, both practicing artists, and learning to know them as forces, personas with emotions and powers all their own. At three years old, I remember standing on a black paved driveway with my mother standing adult-tall above me. We were both looking up into a canopy of spring green maple leaves, the sun gleaming through them. I asked, “What colour is that?” and she said, “Chartreuse.” I stood feeling full of the gleaming gold colour, smelling the spring green scent of evaporating rain from pavement and leaves. I wanted to know the colour and there, sitting at the base of the tree, I ate the sprouts of budding spring maple and knew the taste of green.

I learned how to collect pigment with my father in the La Cloche mountain range close to home. He taught me how our ancestors made paint to make “mizzins” designs on rockface with hematite to share their histories, proud moments, and cautions. Now in my adult life I have returned to this practice with children of my own, experiencing making paint and colour with them. I have given myself the authority of my experience, and as a paintmaker I have decided to name all my colours in my own language. The act of paintmaking has continued to be a powerful shamanic act for myself as I learned it from my father, and now as I share it with other artists. Giving names to the colours is claiming an experience of the world, saying that it is not just the purview of European colour men and that tradition but also my own, which includes them and encompasses more, giving back to all creative people an experience of colour that grounds them in this land and all the stories it holds.

*Among Migwans Beam is a painter, mother, paint-maker, and curator, living and working in her home community of M’Chigeeng First Nation on Manitoulin Island. After studying art at the School of the Museum of Fine Arts Boston, OCAD University, and the Institute of American Indian Arts, she returned home to be a studio assistant for her father, Carl Beam. Her painting practice is in large-format oil on canvas. She is the founder of Gimaa Radio, Ojibwe-language radio CHYF 88.9FM. She maintains an independent curating practice and served as director of the Ojibwe Cultural Foundation before leaving to focus on her own practice and the art of paint-making. She is the founder of Beam Paints, where she combines an early education in Indigenous pigments from her parents Carl and Ann Beam, with a lifelong interest in art and colour. She has always loved the colours pink and green more than anyone should. She collects art, makes art, and is generally obsessed with all aspects therein. She recently showed her work at Campbell House Museum, in Toronto.*



TUESDAY JUNE 16, 08:45-9:40

**Anya Hurlbert**

### **Illuminating colour: Do people see the light?**

We humans see colour because light interacts with particles and surfaces and then with the sensors in our eyes. But the meaning of colour comes about because we attribute colour to objects as an intrinsic property, and this conceptual operation requires unpicking the interaction between light and surfaces. Put another way, to perceive objects as having stable colours our visual systems must disentangle changes in illumination over time from changes in object properties. The yellowing of banana skin is meaningful when it comes about from ripening changes in pigment composition; less so, when it arises from changes in the light spectrum illuminating the banana. How does the human visual system distinguish temporal changes in illumination from changes in the material properties of objects? Does its ability to do so depend on the spectral properties of the illumination? Does the human visual system perceive temporal changes in illumination at all? These are questions that are closely tied to the question of how and to what extent the human visual system achieves colour constancy. Is colour constancy optimised for the types of illuminations and illumination changes under which the human visual system evolved? And can colour constancy survive the challenges posed by the varieties of artificial illumination spectra which now light people's lives?

To address these questions, I will explore the spectral dynamics of natural illumination, and discuss evidence that visual and non-visual responses are tuned to these characteristics. New measurements of natural illumination, together with analysis of existing spectral irradiance databases reveal a characteristic pattern: rapid changes in chromaticity at the start and end of the day, when illuminance is lowest, with relative stability in between; with a slower, smoother rise and fall in illuminance, following the change in solar elevation, interrupted by unsystematic spikes due to weather-related factors. Behavioural experiments in which people are required to detect temporal changes in artificial illumination – generated by spectrally tuneable lamps in an immersive environment and mimicking natural illumination – reveal that the visibility of natural changes in illumination is generally low, and depends on the chromatic direction of change as well as the adapting chromaticity. Temporal changes away from extreme chromaticities (very warm or very cool chromaticities) towards neutral are significantly harder to detect than changes in the opposite direction when illuminance is held constant. This effect reverses when illuminance changes at the same time. The results suggest that the human visual system has evolved



mechanisms to dampen sensitivity to natural changes in illumination, maintaining perceptual stability of object colour. Concurrently, the non-visual system, fed by the melanopsin-containing intrinsically photosensitive retinal ganglion cells, is well suited to follow the slow, smooth changes of natural daylight. It is likely that the non-visual responses contribute to the feelings aroused by naturally changing illumination, even when those changes are visually undetectable.

Changes in illumination that violate the natural pattern are, on the other hand, readily visible, and difficult to distinguish from changes in object colour. Although these pose a challenge to colour constancy, they may also be exploited to enhance material properties, of artworks, for example, as well as the affective and aesthetic responses of the viewer.

*Anya Hurlbert is Professor of Visual Neuroscience and Dean of Advancement at Newcastle University. She trained as a physicist (BA, Princeton University), physiologist (MA, Cambridge University), neuroscientist (PhD, Brain and Cognitive Sciences, MIT), and physician (MD, Harvard Medical School). After doing postdoctoral research as a Wellcome Trust Vision Research Fellow at Oxford University, she moved to Newcastle University, where she co-founded the Institute of Neuroscience in 2003, serving as its co-Director until 2014. Hurlbert's research focuses on colour perception and its role in everyday visual and cognitive tasks, in normal development and ageing as well as in colour vision deficiency and developmental disorders. She is also interested in applied areas such as biomedical image processing, digital imaging and novel lighting technologies for enhancing mood, performance, and aesthetic experience. Professor Hurlbert is active in the public understanding of science, lectures widely on colour perception and art, and has devised and co-curated several science-based art exhibitions, including an interactive installation at the National Gallery, London, for its 2014 summer exhibition Making Colour. She is former Chairman of the Colour Group (GB) and Scientist Trustee of the National Gallery, and currently on the editorial board of the Journal of Vision, the Board of Directors of the Vision Sciences Society, and the Rank Prize Funds Optoelectronics Committee.*



TUESDAY JUNE 16, 15:30-16:10

**Robert DeSalle**

## **Sensing Colour in Nature**

All living organisms are swimming in a world of information made up of small molecules, sound waves, gravity and most importantly for this talk, light waves. Many of these organisms on our planet have figured out how to use light in a wide range of ways. And of course, “figured out” is just shorthand for “evolved”. The broad range of uses for light by organisms on this planet has probably evolved due to the plethora of different wavelengths of light hitting our planet. And there is a bonanza of things on our planet for the light to bounce off, or to be absorbed by. Most organisms use light to inform them of their surroundings, but some organisms use it as food for energy. Some organisms on our planet have learned to “sense” color without eyes, and even without brains. The perception of light in non-seeing, eye-lacking organisms starts the same way as we humans perceive colors – with light waves hitting cell surfaces followed by a cascade of inter and intra-cellular reactions. Organisms have evolved more complex perception of light and the ability to perceive different wavelengths of light as a way to stretch their utility of light wave information. To better understand the role of color in nature, we will delve into the biochemical and neurobiological levels of light and light detection in organisms, how color in nature is used by organisms to expand the information they receive from their surroundings and how organisms on our planet diversified as a function of color. This last goal is all about evolution. Color is a major factor in much of the adaptive change we see in organisms around us. Adaptation and natural selection have shaped the way color is distributed on our planet and is very tightly interlaced with our human impression of our colorful planet. Understanding the evolution of color and its place in nature is the first step to understanding the perception of color.

*Rob is a curator at the American Museum of Natural History working in comparative genomics. He is also a professor in the museum's graduate school, The Richard Gilder Graduate School, and has been adjunct professor at New York University, Columbia University, City University of New York and Yale University. He recently received a Fulbright Professorship to work in Australia and a von Humboldt Fellowship for work in Germany. His scientific work at the museum is complemented by exhibition outreach for which he has curated a permanent hall on Human Evolution and seven temporary exhibitions including Brain: The Inside Story, Our Senses and currently The Nature of Color He has written over twenty books including Our Senses (Yale Press), Troublesome Inheritance (Columbia University Press) and A Natural History of Color. (Pegasus Books). He lives in the East Village of New York City with his wife and son.*



WEDNESDAY JUNE 17, 08:30-09:10

**Anna Franklin**

## **How do infants and children see and think about colour?**

Colour is a ubiquitous feature of human perceptual experience. Colour provides cues for perceiving and understanding objects and scenes, we talk about colour, have an emotional response to colour, colour is symbolic and has a role in aesthetics. The question of how humans perceive colour is the focus of ongoing research from across many disciplines, involving a broad range of questions, from understanding the neurobiological basis of colour to the use of colour in art. Much of this research focuses on adults' perception and experience of colour. A parallel stream of research from developmental science is asking questions about colour perception in infants and children. Infants and children have both immature visual systems and less perceptual experience than adults. Investigating their colour perception has potential to provide insight into the mechanisms that underpin human colour perception, as well as the processes that drive perceptual development. Investigating colour perception in infants and children also has potential for informing infant and child centred design, and for understanding how infants & children interact and respond to the world around them.

In this talk I will review what is known about how infants and children see colour. I will identify the main take home messages from the last few decades of research, and discuss recent studies from our own baby lab. I will tackle 5 main questions. First, when does trichromatic colour vision develop and how does experience shape the development of colour discrimination? Second, when do humans start to develop the ability to use colour cues to perceive and think about objects and their scenes? Third, when and how does colour categorisation develop and what are the challenges for children learning colour terms? Fourth, at what age do colour preferences appear and what influences their development? Finally, on the topic of neurodiversity, how do children with neurodevelopmental disorders perceive colour, and what impact does colour vision deficiency have on children's wellbeing and educational engagement? I will outline research that has tackled these questions, explain the methods used, and identify the issues on which further research is needed.

The overall message of the talk is that even young infants have the ability to perceive and think about colour, yet their perception of colour is rudimentary and it takes many years, even as late as adolescence, for many aspects of colour perception to mature. I show how this protracted maturation provides an opportunity to understand the relative contributions of biology, culture and environment to human



colour perception. I also provide examples of how this research can be applied to the Arts and Industry, for example to ensure that products for infants and children, such as toys, books, and art, are designed with their immature colour perception in mind.

*Professor Anna Franklin investigates human colour perception using methods drawn from cognitive psychology, developmental science, and neuroscience. Much of her work investigates the development of colour perception, both to understand perceptual development and to establish the origins and underlying mechanisms of perceptual colour phenomena. She led a six-year European Research Council (ERC) funded project on colour categorisation, with one of the key findings being that infants use the biological mechanisms of colour vision to categorise colour at just four months. She is currently leading another large-scale ERC project which is investigating how colour vision tunes and calibrates to chromatic scene statistics both in adulthood and during early development. Professor Franklin has led several applied projects: She has developed a gamified psychophysical app with her collaborators which tests for colour vision deficiency in young children, and has worked with industrial partners on projects related to infant visual perception and developmental aesthetics.*



WEDNESDAY JUNE 17, 15:30-16:10

**Michael J. Murdoch**

## **Color in Layers: From Pepper's Ghost to Augmented Reality**

Augmented reality (AR) is a tantalizing, developing technology that promises to seamlessly blend virtual, computer-generated objects into the real world. AR is already being used in industrial and medical applications, has enjoyed its first hype cycle with gaming, and will likely impact education and retail applications, among others. One type of AR, optical see-through AR (OST-AR), is implemented in a goggle- or glasses-like headset using an optical combiner such as a beam splitter to create a transparent display where virtual content can be overlaid on the real world visible behind it. Because the transparent display is unable to block out the real-world background, the appearance of AR content can vary, from apparently solid to transparent or ghostly.

Ghostly images via glass beam splitters have an interesting history in theatre, popularized in the mid-nineteenth century in London during the era of phantasmagoria. Attributed to John Henry Pepper, Pepper's Ghost is the reflected image of an off-stage, spotlighted actor who appears glowing and transparent, able to interact with and even physically pass through the other actors on the stage. The ethereal effect was a sensation at the time, offering a surprising visual experience that seemed inexplicable except by magic.

AR is similarly compelling in part because it is novel and challenging to explain. However, transparent reflections are actually no surprise at all, as they accompany everyday windows and other transparent, glass-like objects. How do we interpret the reflections in a transparent object? In a window, we usually ignore the reflections, but sometimes pay attention to them. In water, reflections similarly vary: we may see all the way to the sandy bottom below, we may see the reflected sky and hills, or we may see the medium itself: blue, aqua, white, ever-changing. In an object such as a cut diamond, we are mesmerized by the reflecting sparkles and apparent multitude of facets.

Our recent research has shown that in OST-AR display systems, which function similarly to Pepper's Ghost, viewers perceive a blend of layers: the virtual AR "ghost" foreground and the real-world background. As with glass windows, when looking at the reflected ghost, the background layer is ignored to some extent; when focusing on the background, the ghost layer is ignored instead. We model the relative impact of the AR foreground layer and the real-world background layer as a perceptually-weighted sum. However, because the discounting of layers is inconsistent, depending



on the visual task and the attention of the viewer, the perceptual weighting varies. Current work continues to measure the magnitude of discounting effects in layered transparent AR environments with the goal to model them robustly. Such a model will enable proper accounting for perceptual effects, which will help ensure that AR content can be reliably, naturally, and comfortably delivered to viewers. Acknowledgment: This material is based upon work supported by the National Science Foundation under Grant No. 1942755.

*Michael J. Murdoch is an Associate Professor in the Munsell Color Science Laboratory at the Rochester Institute of Technology, where he teaches topics including colorimetry, psychophysics, lighting, and imaging. He leads a research project on color appearance in augmented reality (AR) funded by the U.S. National Science Foundation, and additionally conducts research on displays and temporally dynamic LED lighting. Through his career, Mike has enjoyed working on color system modeling and human-centered design for solid state lighting, LCD, and OLED display systems, previously working at Kodak Research and Philips Research. He holds a BS in Chemical Engineering from Cornell, MS in Computer Science from RIT, and PhD in Human-Technology Interaction from Eindhoven University of Technology in The Netherlands.*

THURSDAY JUNE 16, 13:00-14:00

## Angélica Dass

### Humanae: Celebrating how colourful we are

Humanæ is a photographic work in progress by artist Angélica Dass, an unusually direct reflection on the color of the skin, attempting to document humanity's true colors rather than the untrue labels "white", "red", "black" and "yellow" associated with race. It's a project in constant evolution seeking to demonstrate that what defines the human being is its inescapably uniqueness and, therefore, its diversity. The background for each portrait is tinted with a color tone identical to a sample of 11 x 11 pixels taken from the nose of the subject and matched with the industrial pallet Pantone®, which, in its neutrality, calls into question the contradictions and stereotypes related to the race issue. More than just faces and colors in the project there are almost 4,000 volunteers, with portraits made in 20 different countries and 36 different cities around the world, thanks to the support of cultural institutions, political subjects, governmental organizations and non-governmental organizations. The direct and personal dialogue with the public and the absolute spontaneity of participation are fundamental values of the project and connote it with a strong vein of activism. The project does not select participants and there is no date set for its completion. From someone included in the Forbes list, to refugees who crossed the Mediterranean Sea by boat, or students both in Switzerland and the favelas in Rio de Janeiro. At the UNESCO Headquarters, or at a shelter. All kinds of beliefs, gender identities or physical impairments, a newborn or terminally ill, all together build Humanae. All of us, without labels.

Currently more than 4000 images exist in the project. They have been taken in 36 cities, in 20 different countries: Arteixo, Madrid, Barcelona, Getxo, Bilbao and Valencia (Spain), Paris (France), Bergen (Norway), Winterthur, Chiasso (Switzerland), Groningen, The Hague (Netherlands), Dublin (Ireland), London (UK), Tyumen (Russia), Gibellina and Vita (Italy), Vancouver, Montreal (Canada), New York, San Francisco, Gambier, Pittsburgh and Chicago (USA), Quito (Ecuador), Valparaíso (Chile), Sao Paulo and Rio de Janeiro (Brazil), Córdoba (Argentina), New Delhi (India), Daegu (South Korea) Wenzhou and Shanghai (China), Ciudad de México, Oaxaca (Mexico) and Addis Abeba (Ethiopia).

*Angélica Dass is an award-winning photographer born in Brazil and based in Spain. Her practice combines photography with sociological research and public participation in global defense of human rights. She is the creator of the internationally acclaimed Humanæ project—a collection of portraits that reveal the*



*diverse beauty of humanity. Her work has traveled to over 80 cities around the world, from PhotoEspaña, to the World Economic Forum (Davos), UN Habitat III, London Migration Museum, AMNH, Montreal Fine arts Museum, Dublin Science Gallery; to the pages of National Geographic, Time Magazine, Foreign Affairs and other relevant media. Her TED Talk exceeded two million views confirming the great potential of her work to go beyond photography, becoming a tool for social change, which promotes dialogue and challenges cultural prejudices. Angélica's work transcends the museums and finds in school classrooms a great universe of work. She amplifies the educational message of Humanae through institutional collaborations around the world, such as collaborations with city councils of different cities in the Basque Country, teacher training schools in Madrid, high schools in the Czech Republic, or with UNESCO and the Government of Chile, reaching an impact of more than 50 thousand students in a week.*

THURSDAY JUNE 16 16:25-17:05

## Joseph Ingoldsby

### Requiem for a Drowning Landscape

The artist's work involves research, scientific collaboration and examination, documentation, and analysis and synthesis using art, science, and technology for environmental advocacy. Trained in art and landscape architecture, the observation of nature and culture has been a central focus of Joseph Ingoldsby over the years.

Landscape Mosaics looks at the pattern of the landscape from satellite imagery to the ground plane, the study of the palette of plants within each ecosystem, the conflicts of development, and fragmentation. Drawings and color studies developed into site installations for highlighting concerns for sensitive landscapes and endangered species. Requiem for a Drowning Landscape traces the life and death of the salt marsh from dormancy, growth, maturation, reproduction, senescence, to death. The gallery space becomes a place for the remembrance, recollection, and retelling through portraits, projections, and narration that describe the life and slow death of the coastal landscape to the rising seas. Anadromous Awakening traces out the return of anadromous fish from the ocean to their natal freshwater streams to spawn in a cyclical celebration of life, death, and rebirth.

*Joseph Ingoldsby is an environmental designer, ecologist, and artist whose work over the past thirty years has sought to understand the interrelationship of geology, hydrology, soils, vegetation, and wildlife within the natural landscape. His Landscape Mosaic series began as a layered and temporal mapping of visible ecological patterns using satellite, aerial, land-based, and microphotography. A colorful visual 'mosaic' of vegetation, earth, and water, changing with the seasons and years, emerged as each geographical area was studied immersively. Colour palettes were explored as narratives of the changes occurring in the landscape with the ongoing impact of development and anthropogenic climate change. The work progressed beyond documentation to specific 'kinetic colour installations' set in salt marshes, along tidal rivers, and within sand plains and dunes. These highlighted the patterns of coloration shifting over time, indicating damage and deterioration of the natural ecosystems. The temporary artworks provided opportunities for 'viewing stations' along roadways, with on-site education panels, developing public interest and engagement with threatened landscapes and endangered species. Gallery installations linked to these sites included artistic/poetic works and technological installations, using the art/technology to explain the science. Ingoldsby's art-science projects have been exhibited at major museums including MIT and NYSCI and published in Leonardo, Landscape Architecture Magazine, Orion, and other journals.*

*Ingoldsby's artistic oeuvre illuminates how landscape color and pattern can be*



*described in scientific terms to denote chemical composition, health, environmental factors, temperature, salinity, water levels, and stress. His aerial images and studies of the salt marsh along the New England coastline show what is termed 'salt marsh dieback', an ecological disaster compounded by rising seas. Ingoldsby's work is an important and timely call for public participation, understanding, and focus on the anthropogenic impacts affecting vanishing landscapes and endangered species. The artist can play an integral role in the raising of the public consciousness through advocacy. Art can be used to communicate complex ecological and scientific principles to an audience outside of the confines of the academy.*



# Panel: Light, Colour, and...

THURSDAY JUNE 18, 10:00-10:40

Organized by:

**Tom Butters** Lighting Agora (Moderator)

**Venkat Venkataramanan** Canadian National Committee of CIE



**Tony Esposito** *Founder and Head Research Scientist of Lighting Research Solutions, Philadelphia, PA, USA*

## Light, Colour and the Importance of Modern Lighting Metrics

Architectural lighting has many impacts on human visual and non-visual functioning. One important impact, driven by light's intensity and spectrum, is the color rendering of objects. In this brief talk, I will attempt to convince you that good light source color rendition is critically important in the built environment. IES TM-30, a color rendering system from the Illuminating Engineering Society, will be briefly discussed.

*Tony Esposito, PhD, is the Founder and Head Research Scientist of Lighting Research Solutions, a lighting consultancy providing services in research, education, and development. Tony holds a doctorate in Architectural Engineering from Penn State University with a minor in statistics. His specialties include color science, color discrimination, IES TM-30, human factors research methods, circadian metrics, and spectral modeling and optimization. His primary research goal is to develop an accurate and intuitive color discrimination metric for applied lighting. He currently serves as the Co-Chair of the IES Color Committee and previously led the task group that developed IES TM-30 ANNEX E, a set of recommended specification criteria meant to ease the use of TM-30.*

**Mariana G. Figueiro** *Director of the Light and Health Research Center at Mount Sinai and Professor in the Department of Population Health Science and Policy at the Icahn School of Medicine, New York, NY, USA.*

## Light, Colour and Health

In addition to its well-known visual effects, light can also elicit a direct (acute) and a phase shifting (alter the timing of the biological clock) effect on humans. These are typically referred to as the “non-visual effects of light”. This presentation will provide an overview of the impact of light color on the direct and phase shifting effects of light and demystify the notion that all we need is blue or “blue-enriched” lights to elicit these non-visual effects on humans.

*Mariana G. Figueiro, PhD, is the Director of the Light and Health Research Center at Mount Sinai and Professor in the Department of Population Health Science and Policy at the Icahn School of Medicine. She is well known for her research on the effects of light on human health, sustainability, circadian photobiology, and lighting for older adults. Dr. Figueiro is a Fellow of the Illuminating Engineering Society (FIES) and the author of more than 140 scientific articles in her field of research. She has brought attention to the significance of light and health as a topic of public interest through her TEMED talk.*



**Deborah Gottesman** *Principal, Gottesman Associates*

## Light, Colour and Design

How do humans sense colour? Seeing colour accurately is intricately related to the light source. Deborah will discuss how humans perceive colour, introduce some colour metrics, and what is required to sense colour accurately. The discussion will be rounded out by showing how colour can be leveraged to advantage in design.

*Deborah Gottesman, MBA, P.Eng., LC, IES, Assoc. IALD, CIE Principal Deborah has a unique contextual understanding of lighting from all perspectives; her career spans over 30 years in all facets of the lighting industry, including design, engineering, management, education, and manufacturing. Since establishing Gottesman Associates in 1999, Deborah's creative, rigorous, passionate and client-driven approach have brought award-winning lighting designs to a wide range of satisfied and repeat clients. An electrical engineer with an MBA in Real Property, Deborah has successfully worked on projects in many sectors, and has taught lighting at all levels to a wide audience from students at colleges and universities to senior architects. Deborah currently sits on the International Technical Committee 3- 59: The Integration of Daylight and Electric Light of the Commission Internationale de L'Eclairage (CIE).*

**Patricia Rizzo** *Healthcare Segment Manager at Axis Lighting*

## Light, Colour and Application Strategies from Classrooms to Patient Rooms

The colour of light can play a more important role than we realize in our everyday lives – not only for overall circadian health and wellbeing, but for safety as well. When we weave colour purposefully into the design of a space, we can positively affect a child's classroom experience, and we can minimize the risk of falls for patients or older adults as they navigate from bed to bathroom across a range of healthcare facilities. We will look at these two very different environments, and also see how research and real-life conditions have influenced product design to enable these applications.

*Patricia Rizzo, MSc, EDAC – as Healthcare Segment Manager at Axis Lighting, Patricia integrates the latest global research and design principles into technology advancement, applications, and product design – with a focus on circadian lighting and healthcare solutions. She draws on the expertise of specifiers and sales teams – who have first- hand knowledge of the customer – to drive the development of products required by today's stringent healthcare environments; and engages with hospital end users, to listen to and address their needs and concerns. Educator, researcher, lighting designer, and program manager are but a few roles she has enjoyed throughout her 22-year career. Prior to her position at Axis Lighting, she spent over four years as Senior Lighting Applications Developer at Philips Research NA, and fifteen years at the Lighting Research Center, as Lead Researcher, Design Program Manager, and Adjunct Associate Professor.*



# Oral Presentation Abstracts

TUESDAY JUNE 14 09:45 – 10:45

## Session A Colour Science I

**Satoko Taguchi** *Tokyo University of the Arts*

**Co-authors:** Yae Ichimiya, Kaori Takahashi, Hirotaka Kakizaki, Sayako Kuroda, Shino Okuda, Katsunori Okajima

### Color materials and techniques in John Gould’s “Folio Bird Books” – A comparison with R.P. Lesson’s “Histoire Naturelle des Oiseaux Mouches”

English naturalist John Gould (1804-1881) produced a number of “Folio Bird Books” between 1831 and 1888. “Folio Bird Books” depicts the ecology of birds in hand-colored lithographs based on scientific research. Tamagawa University Museum of Education has a main collection of Gould’s “Folio Bird Books.” Gould collected bird specimens and made observations of them in producing “Folio Bird Books.” Therefore, he might select colour materials and techniques to precisely depict the characteristics of the birds. However, the colour materials and techniques used in their production are still unclear. In this study, we investigated colour materials and techniques for “Purple-throated Carib” and “Purple-backed Thornbill” in “A Monograph of the Trochilidae, or Family of Humming-birds” using a two-dimensional spectroradiometer, an X-ray fluorescence (XRF), and a digital microscope. In the “Purple-backed Thornbill,” the digital microscopy and the XRF revealed the use of gold. The results of the Spectral reflectance and XRF analysis show that the green colour materials used in the “Purple-throated Carib” and “Purple-backed Thornbill” can be classified into three types. We also conducted research on René Primevère Lesson’s “Histoire Naturelle des Oiseaux Mouches,” which preceded Gould’s “Folio Bird Books,” and compared the colour materials and techniques.

**Ikumi Hirose** *Chiba University*

**Co-Authors:** Kazuki Nagasawa, Norimichi Tsumura, Shoji Yamamoto

### Texture management for glossy objects using tone mapping

In this paper, we proposed a method for matching the colour and glossiness of an object between different displays by using tone mapping. Since displays have their own characteristics, such as maximum luminance and gamma characteristics, the colour and glossiness of an object when displayed differs from one display to another. The colour can be corrected by conventional colour matching methods, but the glossiness, which changes the impression of an object, needs to be corrected. Our practical challenge was to use tone mapping to correct the high-luminance part, also



referred to as the glossy part, which cannot be fully corrected by colour matching. Therefore, we performed colour matching and tone mapping using high dynamic range images, which can record a wider range of luminance information as input. In addition, we varied the parameters of the tone mapping function and the threshold at which the function was applied to study the effect on the object's appearance. We conducted a subjective evaluation experiment using the series category method on glossy-corrected images generated by applying various functions to each display. As a result, we found that the differences in glossiness between displays could be corrected by selecting the optimal function for each display.

### **Tucker Downs** *RIT*

**Co-authors:** Olivia Kuzio, Michael Murdoch

#### **Image based measurement of augmented reality displays and stimuli**

Perceptual research of see-through augmented reality (AR) displays faces many challenges in the design of display stimulus and viewing conditions for effective psychophysics experiments due to the many known and unknown factors that can affect the appearance of transparent stimuli. The decisions made about the stimulus presentation may be very difficult to document in a simple or intuitive way and very few tools for describing and designing experiments for AR displays exist. In this paper we describe an application specific imaging technique for documenting visual experiments for AR displays. Imaging these stimuli presentations simplifies the recording of the known stimulus presentation factors, as well as recording factors that may become relevant for future comparative studies. This imaging technique borrows inspiration from other multi-channel imaging approaches. Besides the application need in AR, the design of this imaging technique might be applied to many other areas of imaging where only a specific application is required, and color accuracy must be as high as possible. The approach used here, with the particular application factors described resulted in an imaging system capable of imaging AR stimulus presentations with an accuracy of around  $1 \Delta E_{2000}$ .



**Taisei Horimoto** *Chiba University*

**Co-authors:** Yshitsugu Manabe, Noriko Yata

## **Study of measurement of 3D shape and spectral reflectance by Multi-View Stereo**

Recently, many methods of measuring spectral images and 3D shapes have been proposed because they are more realistic than 2D RGB images. However, there are many that integrate spectrum and 3D shape. Especially our previous system to measure 3D shape and spectral reflectance targeted only small objects. It did not work well for large objects and outdoor environments. Therefore, we propose a measurement method of 3D shape and spectral reflectance using Multi-View Stereo, enabling large and dense measurement. In our method, the past method generates the spectral intensity image, and the point cloud is generated by using the spectral intensity image. Furthermore, we aim to improve the accuracy compared to single point cloud generation by integrating multiple point clouds, including spectral intensity, into one point cloud. In addition, we realise more complex colour expressions than RGB measurement based on the spectral information acquired by the integrated point cloud. In the future, we will construct a system based on the proposed method and evaluate the spectral information and the shape of the 3D point cloud. Our method contributes to improving the quality of digital archives.

TUESDAY JUNE 14 09:45 – 10:45

## Session B – Design

### Montaha Hidefi *Color Marketing Group*

#### Color Marketing Group: Six decades of colour forecasting

Colour Marketing Group® (CMG) an international, not-for-profit association of colour professionals with a mission to create accurate and relevant colour and trend forecast information to its members was founded in the United States in 1962. For the past sixty years, CMG expanded to cover many more countries and its focus industries have evolved. Its members are composed of designers, marketers, colour scientists, colour consultants, educators, and artists, representing a broad range of industries such as appliances, automotive, pigments, interior design, fashion, surface finishing, visual communications and more. They come together at local and international forecasting workshops to create colour forecasts. To celebrate its 60th anniversary, CMG allowed access to its archives to a limited number of members to research and make the details of its colour forecasting history and progression known to the wider public.

This article exposes the historical progression of the association and how it has helped thousands of colour professionals around the world to communicate through the language of colour and how it became a reliable source of colour forecast information around the world.

### Sibel Ertez Ural *Bilkent University*

#### Aesthetics and emotions of color harmonies in architectural context

In the architectural context, colour is a multifaceted problem. Harmony of colours is one of the major concerns of design. Architects and designers may refer to various sources for their initial colour inspirations which embody both aesthetic and emotional features at the same time. Developing a colour palette is related with subjective sensations and objective parameters of design, and during the architectural design process various criteria are effective over colour design decisions. This paper aims to observe such a process for exploring emergence, continuity, and changes of colour design decisions on colour harmonies during sequential stages of the colour design process. The results indicated that subjective/intuitive criteria were apparent in initial stages of design. While passing into the architectural context, subjective/intuitive criteria (preferences and emotions) started to leave their place



to objective/knowledge based/analytic ones (systematic, formal, and functional criteria). It is also observed that aesthetic and emotional aspects of colour harmony are significantly correlated at all stages of the colour design process. For the designer/architect, there is no clear distinction between aesthetically harmonious and emotionally pleasant colour design.

**Ana Laura Alves *São Paulo State University (Unesp)***

**Co-authors:** Mirela Riquena De Giuli, Luis Carlos Paschoarelli

### **Color influence on the usability of kitchen utensils: An empirical study in ergonomic design**

Color can influence human perception and behavior during interaction with a product. However, it is still unclear how color could interfere in instrumental activities of daily living, such as human-kitchenware interaction. Therefore, the main aim of this study was to investigate the color effect on the usability of two sorts of kitchen utensils. As a secondary aim, age was also considered in the statistical analysis as it is a recognized variable on usability tests. A total of 120 female participants (18-29 and 30-55 years old) evaluated a garlic peeler (Experiment I) and a potato masher (Experiment II) in green, red, and gray colors. The usability was measured by a SUS questionnaire (satisfaction), task precision (efficacy), and time of activity (efficiency). In both experiments, the results indicated a color effect on satisfaction ( $p < .05$ ) and age significantly influenced efficiency ( $p < .05$ ). The industrial application of these findings may contribute to the product's development and tests to create user and color-driven designs. Additionally, this study might contribute to further research.

**Anna Kmita *Academy of Fine Arts and Design Katowice***

**Co-authors:** Saara Pyykkö, Francesca Valan

### **Wood colours in contemporary architecture and Design: A comparison in three European countries**

Wood is an incredibly universal and eco-friendly material. Currently, many initiatives in Europe aim at directing attention to the universality of wooden and wood-based products, to foster a more sustainable future and promote the development of healthy living spaces and new objects built of wood. European countries have set different targets to increase the use of wood in architecture. However, in this context there is little discussion about colour. The “natural colour of wood” may indicate different colours in different countries, which can have different



local wood specifiers, different traditions to use wood, and different ways to protect it with paint or other ways. This research refers to the colour scheme and characteristics of wood in three countries: Italy, Poland, and Finland. The authors studied how the selected types of wood commonly used in these three countries are applied in architecture. Is there a colour “specifics” of wood – different for three countries in Europe? Can we speak of a typical colour palette of products made of wood in the context of these countries? What is the main challenge with the colour and the wood in the national and international perspective?



TUESDAY JUNE 14 11:00 – 12:00

## Session A – Colour & Language

**Donald Dedrick** *University of Guelph*

### Two kinds of explanations for basic color terms

Different types of explanation have been proposed for basic colour terms (BCTs). This paper makes a distinction between local and global explanations and argues that these different explanation types need not be in conflict. They have different explanations. Local explanations explain the origin of BCTs in local cultures. Global explanations target the role of BCTs in abstract colour classification.

**Junglim Lee** *Ewha Womans University*

### The difference in colour categorization between Korean and Chinese language

There has been a long debate between universalists and relativists on how language affects people's perception of colours. This study aims to investigate whether different languages affect how people categorise colours that illustrate linguistic differences. A total of 30 Native South Korean and Chinese speakers were asked to classify fifteen colour chips selected from blue-green spectral regions and free-sort those that appeared similar together, allowing them to be grouped that shared the same colour terms in their native language. After classifying them into different numbers of groups, they were asked to name them with standard colour terms in their language and the number of groups and the names they assigned each group were then analysed. The findings indicated that in general, they showed similar grouping behaviour categorising the colour chips, but showed different colour naming for the groups, especially for one particular colour, "blue-green", which is a familiar colour term for Korean speakers, Cheongrok, but unfamiliar for Chinese speakers. Also, compared to Chinese participants who divided the green into light and deep, Korean participants did not have such division for the green colour chips. Overall, this experiment showed that the people from different languages demonstrate different colour categorization. It seems that people's way to divide the colour spectrum is a perceptual phenomenon, but it also seems that depending on how people learn the colour names in their own language, the way they categorise colours is affected. Thus, this study seems to support both views that colour categorical perception is language-relative as well as universal in that two forces seem to be at work together in colour categorization.



**Merle Oguz** *Tallinn University*

**Co-author:** Mari Uusküla

### **A comparative analysis of Estonian, Swedish and Turkish colour idioms**

Previous research has shown that there are both universally recognised colour idioms as well as culture-specific opaque ones. We collected colour idioms from three languages that belong to three different language families: Swedish (Indo-European, Germanic), Estonian (Finno-Ugric, Finnic) and Turkish (Altai, Turkic). We analysed the colour idioms of these languages using the conceptual metaphor theory. The results reveal that at the conceptual level, the meaning of the idioms in the three languages is often similar, even though it can seem to be different at first glance. Black mostly bears a negative connotation in all three languages, whereas white can have both a positive and a negative meaning.

**Jodi L. Sandford** *University of Perugia*

### **“The painters had done it all in green” In COLOR\* – A cognitive linguistic construction analysis**

How do we structure the conceptual nature of language and our experience of colour? I discuss one of the ways in which we conceptualise and sense colour through the construction [IN \*COLOUR]. IN is one of the three most frequent prepositions to be used with basic colour terms, together with OF and WITH (as emerged in the Corpus of Contemporary American English). A STATE IS A LOCATION is one of the basic conceptual metaphors that allows us to structure our colour sense. Duly the primary perceptual embodied experience of COLOUR and SEEING directly involve the establishment of a process of mapping between the source domain of COLOUR/SEEING, both as a substance/object and a light/object, and the target domains of the occasion. It follows that COLOUR may be conceptualised according to the SPACE, PATH, and CONTAINER image schemas, developing through the 45 different senses of in. The senses stem from metaphors such as COLOURS ARE LOCATIONS, as in the painters had done it all in green, where it is used to indicate “qualification of a condition”, which is thought of as a place. This paper presents corpus data on the polysemy of this COLOUR construction; and proposes a cognitive analysis of meaning evolution to describe the data.

TUESDAY JUNE 14 11:00 – 12:00

## Session B – Colour in Architecture I

**Eva Storgaard** *University of Antwerp*

### Polychromic space: Architectural agencies of colour

This paper discusses the art and colour installation Polychromic Space (Copenhagen, DK, 2021-22) and the ideas and approaches, historical as well as contemporary, that led to its creation. It is a colour statement and an argument against chromophobia which has overshadowed architectural and interior design practice since the advent of modernism.

First, we introduce the idea of polychromic spaces as spatial experiments that evolved in art and architecture at the beginning of the 20th century in Europe. Some artists and architects questioned, each within their own creative principles, the conventional space perception by intervening with space through the application of colour and colour planes. They operated in an interdisciplinary field in which architectural space and art blended into new, immeasurable spatial dimensions. Second, we explore how we can recapture and appropriate the historical, almost forgotten, spatial concepts from the early 20th century by means of the installation Polychromic Space. Stating that space can be shaped using colour, this project illustrates how spatial dimensions can be influenced, – how properties such as heights, lows, distance, and proximity can be elicited, how the spatial framework can be manipulated and figuratively dissolve – and how colour can turn static surfaces into plastic, dynamic elements.

**Verena M. Schindler** *AIC Study Group on Environmental Colour Design*

### On different colour approaches to architecture

This paper explores different approaches to colour applied to architecture in France referring to three colour protagonists in France: Bernard Lassus, Jean-Philippe Lenclos, and Atelier F&M Cler. Each of them reveals a specific way of dealing with colour in architecture and urban design. In this context it is not relevant to ask what colours were dominant and what meaning they were given. Rather, it is important to discuss what kind of approach was being used to bring colour to housing estates, new towns, and urban environments. The first of the three approaches concern Lassus, who painted genuine images of urban and natural landscapes on building façades, covering the whole surfaces like a trompe-l'oeil. The second approach is related to



Lenclos, who used large-scale graphics, typography, and geometric imagery to cover large building surfaces, which at that time became known as supergraphics. The third and last approach discussed in this paper is that of the Atelier F&M Cler, who always used urban space as a point of departure, including not only the building façades, but also maps. It is interesting to note that these three different approaches continue to be applied today.

**Verónica Conte** *Lisbon School of Architecture*

**Carrazedo: Colours and stories of a transient landscape**

The starting point for this research was a concern with how the image of the rural landscape is shaped and risks being impoverished by current architectural reconstruction. Colours, memories, new architectural values, and forgetfulness were all found to be aspects of the image of a place during the search for the architectural use of colour in the schist village of Carrazedo (Northeast, Portugal). This revealed above all, the complexity and transience of the landscape and of its image, contributed to the enrichment of local memory and enhanced the possibilities for the image of the place.



TUESDAY JUNE 14 16:15 – 17:30

**Session A – Colour Education: Traditional Colour Theory: History & Innovations**

**Adam Lauder** *OCAD University*

**Josef Albers’s Chromatic Perspectivism**

This paper proposes a new path of approach to the influential colour praxis of Josef Albers, one that puts his Bauhaus-inflected pedagogy into relation with the “perspectivism” that Eduardo Viveiros de Castro identifies as a defining feature of Indigenous phenomenologies of the Americas. I simultaneously complement and complicate existing, architectural readings of Albers’s artworks that connect the ambivalent volumes figured by Tenayuca (1942-43) and related studies with archaeological sites that the artist obsessively documented on visits to Mexico undertaken with his spouse, the artist Anni Albers. I extend the recent scholarship of Joaquín Barriendos on Josef Albers’s engagements with Mesoamerican architectonics as generating a “chromatic condensation of a pre-Columbian abstract visual concept.” But in lieu of Barriendos’s portrait of Albers as a “mystical architect of vision,” I apply de Viveiros Castro’s theorization of Indigenous perspectivism to propose a materialist reading of Albers’s chromatic investigations, one that simultaneously recognizes Indigenous peoples as co-creators of the insights conventionally attributed exclusively to Albers.

**Esther Hagenlocher** *University of Oregon*

**Colour-connections in the oeuvre of Fritz Seitz**

This paper refers to the work of the late Fritz Seitz (1926–2017), artist, professor, colour scholar, graphic designer, author, and consultant. He is considered one of the most important representatives of the “Deutsche Farbenzentrum” (DFZ) German Colour Association in the 1960s-early 2000s. This paper addresses ongoing research investigations of Fritz Seitz’s approach to colour. It attempts to shed light on his fine art and applied art, his writings and lectures, his teaching, and how he has dealt with the phenomenon of colour.



**Zena O'Connor** *Design Research Associates, Colour Collective Sydney*

**Exploring the origins of Itten's color theories using digital color mapping**

Johannes Itten was a leading colour theorist and educator of the twentieth century and his influence remains strong decades after his death. At the Bauhaus, Itten was responsible for the introductory Basic Course which included a colour component and, after the Bauhaus closed, Itten continued to teach colour in Zurich and at the Ulm School of Design, plus he published several influential texts on colour including *The Elements of Colour*.

Attempts have been made to identify the origins and inspirations of Itten's ideas about colour and some have suggested that Itten's former painting teacher Adolf Hölzel may have played a key role. However, this is debatable and Itten himself noted the following, "For me, the theories of Goethe, Runge, Bezold, Chevreul and Hölzel have been invaluable" (Itten, 1970).

This research applied a new approach to investigate the origins of Itten's colour theory ideas. Using digital colour mapping, this research explored patterns of similarity and difference between colour data published by Itten and Philipp Otto Runge. Outcomes from this research indicate that Runge may have had a stronger influence than previously acknowledged. Further case study research into the other colour theorists cited by Itten may provide additional insight.

**Robert Hirschler** *AIC Study Group on Colour Education*

**Co-authors:** David Briggs, Andreas Schwarz, Stephen Westland

**Contemporary analysis of traditional colour theory**

We define "traditional colour theory" as a loose collection of propositions about colour that disregard the findings of modern colour science beginning with Young, Maxwell, Helmholtz, and Hering, very often oversimplified and misinterpreted, taken, among others, from the writings of LeBlanc, Field, Goethe, Chevreul and popularised in Itten's *the Art of Color*. We discuss four of the major misconceptions found in the literature and, alas, widely taught in schools – from pre-school to university level. These misconceptions are those related to the "primary colours"; the hue circle (colour wheel); simple rules to establish harmonious colour combinations; and the problems associated with using vague colour categories or simple hue names, supposed to be sufficient to attach meaning and effect to colours. After pointing out the fallacies contained in these misconceptions, we conclude that 21st century colour education should break away from the shackles of traditional colour theory and treat colour as something to be experienced and enjoyed, and not just taught.



**Ingrid Calvo Ivanovic** *Universidad de Chile*

**On colour bibliography for design disciplines: A Study to the references proposed by 34 colour courses**

This paper is part of a doctoral research which inquired on the current issues of colour education, documented by several authors during recent years. The study presents an analysis of the bibliographic references proposed in the syllabus of 34 colour courses taught in design programmes during the last decade (2010-2020). The courses analysed were taught in English, Spanish or Italian in different countries (Latin America, North America, Europe, and Oceania). The analysis concentrated on: (i) identifying the most referred authors and sources for all courses analysed; (ii) identifying the most cited books in all languages (English, Spanish and Italian); (iii) studying the year of publication of all the referred sources; (iv) performing a comparison of the most cited sources in English and Spanish; and (v) individuating the inclusion of women authors' works as part of the sources suggested for the courses. The bibliography was analysed to understand what sources support the delivery of the contents provided by colour courses and to identify novel, innovative and updated materials, or bibliographical resources for the support of a didactic itinerary on colour for design.

TUESDAY JUNE 14 16:15 – 17:30

## Session B – Colour in Architecture II

**Justyna Tarajko-Kowalska** *Cracow University of Technology*

### “Thinking pink in architecture” – survey on perception and preferences of pink color by architecture students from “millennial generation”

The article’s primary goal is to present the author’s online survey results. The study aimed to investigate what architecture students think about pink-colored buildings and if the popularity of so-called “millennial pink” affected their current perceptions and general preferences of that colour. The study showed that the colour pink is no longer stereotypically perceived by the students and that it is treated in the same way as any other hue in architecture. Pink was usually appreciated and positively assessed, especially in the buildings where it was consistent with the function and architectural style of the object. As the survey shows no prejudice behind pink, thus the young generation of architects could usher in a new era of pink in architecture. It is, however, difficult to state unequivocally if the popularity of “millennial pink” played a significant role in this change in pink’s identity. Although the survey participants were limited only to architecture students from just one University, the results may contribute to a broader discussion on the role and future of pink colour in architecture.

**Elisa Cordero-Jahr** *Universidad Austral de Chile*

**Co-author:** Gonzalo Cerda-Brintrup

### Color and modern architecture in the south of Chile

The period called “second modernity” in architecture in southern Chile had its peak between 1960 and 1980. During such a period, colour appears in many works in the form of ceramic, and vitreous and coloured glass coatings, endowing cities with an atmosphere never seen before. This article focuses on iconic works in the southern cities of Concepción, Chillan, and Valdivia, which have colour in their facades and interiors, in the form of coatings or coloured light. While these materials are no longer manufactured in the country due to lack of demand, the buildings remain nostalgic for a period of urban chromatic splendour of great quality.



### **Ollier Xavière *Nacarat***

#### **Color and collective housing, color at the service of the 20th century heritage: Case study of the Harlequin of Grenoble**

The Cité de l'Arlequin, the Harlequin, opened on the Jean Verlhac Park, in Grenoble, France, is a major architectural and urban project of the 60's and 70's. Based on innovative social ideas, it fits into the landscape with a very particular aesthetic and a claimed polychromy. Today, in parallel with the major urban renewal project, the facades of the Harlequin are rehabilitated. This article studies the history of this remarkable heritage of the 20th century and the methods of its revival, enriched by the expertise of an agency of colorists consultants.

### **Gisele Carvalho *Lisbon School of Architecture***

#### **The colors of the housing buildings in the neighbourhood of Boa Viagem, Recife, Brazil**

Analyzing the wealthier class multifamily buildings in Recife, Brazil, it was noticed an almost unanimous use of a chromatic palette formed by tones of beige, brown, gray, white and black. Thus, this research questioned to what extent is the use of this chromatic palette, called classic, in the south zone Boa Viagem neighborhood buildings, and what conditioned their choice over the decades. And also, is there a relationship between the use of this palette as a symbolism chosen to value classicism as an aesthetic option, historically adopted from the European Neoclassical Movement, with rebounds in Recife. The methodology was based on the method used by M. M. Loder, which consists of photographing the facade and digitally removing the colors of the building's body and its details, and thus setting up tables with the color palette of each building. The conclusions of the ongoing research are that most of the colors observed correspond to the so-called classic palette, with less constant variations that explore light shades of blue and green. Other reasons, in addition to the symbolic ones, such as the indicative use of glass for east facades, as well as the economic ones, also account for its use.



TUESDAY JUNE 14 15:45 – 19:00

## Session A – Teaching Innovations and Methodologies

**Emmanuel Kodwo Amissah** *University of Education*

### Colour preferences and use in textiles design and decoration amongst Ghanaian students

Colour is the most important and exciting element of design that catches one's attention for fabric selection. Colour plays important roles in the designing and production of textiles artefacts. It gives life to the textiles product as they become what they are because of their inherent colours. Batik and tie-dye making are textiles products that predominantly depend on colours (dyes) for their decoration. It is an aspect of textile production on which students exhibit a wide range of creativity in fabric decoration. Various tints and shades of colours are uniquely characterised by blended schemes in their productions. So, how do students describe their works? How appropriate are the colours they choose for dyeing their works? Why do they prefer specific colours for decorating their fabrics and what influences their choice of colours? These are the key questions guiding this inquiry into the preferences and uses of colours by student-designers in their freestyle fabric designs and decorations. The study found that students' preferences for the choice of colour for their batik and tie-dye works are influenced by the Ghanaian colour symbolism, the cultural environment, and purpose and uses for which the designs were made.

**Maggie Maggio** *Smashing Color*

**Co-Authors:** Paul Green-Armytage, Ellen Divers

### Two voids in the language of colour

In this paper we highlight the lack of generally understood terms for two key colour concepts. First, there is not a commonly understood term for the totality of colours we can perceive or imagine. Terms currently under consideration to fill this void are the 'Colour Universe' and the "Universal Gamut'. Second, although the measurable attributes of colour are well defined, there is not an equally well-defined term for the aspect of colour appearance illustrated by sets of colours of different hues that share similar perceptual characteristics, such as pale, dark, or muted colours. We propose the term 'colour character' and argue that the adoption of this, or another more suitable term, possibly NCS 'nuance', would be helpful in describing colours since it is this aspect of a colour's appearance, more than its hue, that is useful in communicating meanings.



## David Briggs *National Art School, Sydney*

**Co-author:** Eva Fay

### A Shillito student portfolio from the mid-1940's

We illustrate and describe a remarkable portfolio of colour exercises and notes produced at the East Sydney Technical College (now the National Art School, Sydney) by Helen Jean Burgess (1926-2018) while she was a student in the Design diploma course in 1943-47. The portfolio comprises a woven fabric cover and 36 loose boards in three sections, "Shillito Theory", "Ostwald Theory", and "Munsell Theory". Forty-four typed sheets are attached to the reverse sides of 24 of the boards. The first includes Shillito's distinctive double-primary hue classification, but the remainder in their entirety closely paraphrase or copy verbatim passages from just seven texts, namely Henry Barrett Carpenter's *Suggestions for the Study of Colour* (1915, 1923), Maitland Graves' *The Art of Colour and Design* (1941) and five texts on the Munsell and Ostwald systems. We compare the influences evident in these sheets with lecture notes recorded thirty years later by one of us (Eva Fay) as a student at the Shillito Design School and find that these also closely paraphrase or copy verbatim most of the same sources, including Graves and especially Carpenter, with minor additions including some passages from Birren, but no text we can attribute to Itten or Albers.

## Doreen Balabanoff *OCAD University*

**Co-authors:** David Pearl, Sharyn Adler Gitalis

### 'Colour, Light & Environment': An experiential course opens up the conversation about colour

This paper/presentation documents and reflects upon a unique introductory course for pre-architecture students as a contribution to the discourse on architectural colour studies. Three collaborating faculty present and reflect upon the key goals, approaches, and outcomes developed over ten years of teaching the course. A hands-on studio course for second-year undergraduates in Environmental Design, 'Colour, Light & Environment' attunes students to noticing and considering how colour, light, and materiality work together in spatial settings. Offering opportunities for personal and physical experimentation and exploration, the course opens phenomenological understandings of spatial experience, cultural awareness of colour meanings, and sensitivity to colour needs and desires. Students learn that these arise from and respond to local geography and meteorology, spatial temporality, cultural context, programmatic needs, and diverse users. The authors provide examples of student work and highlight key aspects of environmental colour/light learning that have emerged as significant through the years of developing the course and its diverse projects.



## Ellen Divers *Ellen Divers Design*

### Weaving the senses: Learning about color through sound and taste

Recent studies suggest that value and chroma, more so than hue, are what dictate the connection between colour and the feelings they evoke and can be explained using Pleasure-Arousal-Dominance (PAD) Theory. As a practical matter, though, lecturing students on PAD Theory may be less efficient than offering them opportunities to discover the dynamic on their own through observation and activities that engage more than just their cognitive faculties. Studies on cross-modal correspondences (CMC), seemingly innate connections between the senses, may facilitate the learning process. The correspondences between colour and sound, for example, may enable students to approach the study of colour through music or everyday sounds. Although the CMC are less pronounced between taste and colour, this sense may also be useful in understanding the process of design where the choice of colour “ingredients” and their proportions can create very different types of experiences, just as they can with food. Letting students explore colour through other senses, not just vision, opens endless opportunities for creative engagement in design projects that may deepen their understanding of how people feel about colour.

TUESDAY JUNE 14 16:15 – 17:30

## Session B – Colour & Buildings

### **Xuechang Leng** *The University of Edinburgh*

#### **Powerful red on the buildings of the Qinzheng Hall complex at the Garden of Clear Ripples (Beijing)**

The Emperor Qianlong (1711-1799) built the Garden of Clear Ripples known as the Summer Palace in the suburb of Beijing, China. Within this palace, the Qinzheng Hall complex known as the Hall of Diligent Government was where the symbolic Imperial Court was located. For this study, the only available image of the Qinzheng Hall complex during the Qianlong Reign (1735-1796) is the documentary handscroll Longevity Blessing. According to this handscroll, there were four conspicuous and meaningful colours on the buildings of this complex, red, qing (grey with a blue-green tinge), green, and white. Among those, red was the only one that was markedly associated with the ruling power. Based on a close reading of the red architectural elements recorded in the handscroll and related recompiled archives, this paper suggests that on buildings of the Qinzheng Hall complex, red was used in a strict systematic way to distinguish the hierarchy for the people of the ruling class, furthermore, in using the red colour to manifest the Emperor-centred power structure, the colour variances in the chromaticity and blackness between all red architectural elements were omitted by the people.

### **Alessandro Premier** *University of Auckland*

**Co-author:** Julian Rennie

#### **Colin McCahon's house and its colours: A glimpse of New Zealand beyond its Colonial past**

Colin McCahon's Titirangi Kauri-forest nestled house was not only a tiny and humble house for his wife and 4 children for the years of 1953-60, but it was the birthplace of some beautiful paintings and (what has turned out to be) culturally important images for New Zealand emerging from its colonial past. This period of Colin's work was totally focused on producing warm colourful images, as opposed to the Black paintings with White lettering of his later years. The Northland panels, 1958, is an important painting of that period, made up of eight vertical unframed, canvas panels. They evoke a spirit of place that seemingly many Kiwis can easily relate to. The colours of these panels seem to also adorn the surfaces of the house. This paper unpacks the colours of his house, which still stands today. The colour palette



collection, surveyed and analysed through a field study, has been compared with colour theories and relevant palettes available at that time. The final aim of the paper is to extend our knowledge on this important artefact for New Zealand's culture and help with its future conservation.

**Yajun Wen** *Pusan National University*

**Co-author:** Jaehoon Chung

**Research on the influence of the natural environment of residence on city color preference: A case study of Busan, Korea**

The city colour guidelines were established under the leadership of the government recently in Korea. However, the colour regulations in urban planning led to the question of how to deal with residents' preferences for city colour. In the context of colour preference as a cultural phenomenon and the geography of colour, it is believed that different natural environments in various regions will shape the different colour preferences of local residents. Therefore, this study used data obtained from a questionnaire survey in Busan City. Through the chi-square test, the correlations between the natural environment and city colour preferences were analysed, along with the colour preferences of people with different residential locations, including hue preferences, value preferences, and chroma preferences. It was found that the natural environments affected residents' urban colour preferences, and residents of different living natural environments have different urban colour preferences. including hue preference, value preference, and chroma preference.

**Chen-Hsin Yang** *National Cheng Kung University*

**Co-author:** Tseng-Ping Chiu

**An investigation of color-realm visual perception: The effectiveness of multi-color appliance of Design Hotel (DH) interior design in Taiwan**

Design Hotel (DH) is a hotel type that emphasises the role of design throughout the visual display inside its environment (Chen, 2018). To create such a unique sensory experience for the travelers, designers usually use various colour strategies creating an image for improving the customers' experience (O'Connor, 2018). Since colour is a significant interior element with the power to influence emotions and behaviours in a particular environment (Cho & Suh, 2020). In this content, multi research methods including Colour Image Scale related questionnaires (Kobayashi, 1981) & eye-tracking,



aims on investigate the preferred and highly connotative total appearance consist of numerous colour combinations among the largest domestic travel group: Taiwanese ageing from 20 to 30 years old, and also creating the atmosphere that the DH owners can express the theme, resulting in suitable colour planning as a reference for DH interior design related colour planning industry.

WEDNESDAY JUNE 15 9:15 – 10:30

## Session A – Colour & Cultural Preferences

**Mahshid Baniani** *University of Tsukuba*

### Everyday objects color preferences among university students

The purpose of this study is to investigate and identify the association between colour preferences and everyday objects. For this reason, an experiment was conducted among 122 Japanese university students. Red and blue hues were among the most favourite colours of the participants. Blue hues were mainly considered masculine, while red hues were considered feminine. Turquoise and lavender were considered the most beautiful. Lavender, dark mauve, and violet were the most elegant colours, while light blue and pastel blue were considered the most refreshing. White, black, grey, and blue hues were considered formal. Moreover, colours considered formal, and masculine were used for the men's suits, while colours considered elegant, beautiful, and refreshing were used for the night gown. Participants mainly chose black for the frying pan. They chose warm sepia for chopsticks as it is the colour wood, and they chose grey hues for cutlery. They said they like silverware. In sum, it was observed that rather than using their preferred colour for every item, the participants used colours which they thought were most suitable for the product.

**Chu Wen Wang** *National Taiwan University of Science and Technology*

**Co-authors:** Yi-Sheng Chen, Hung-Hsu Cheng, Li-Chen Ou

### Color meanings of lucky charms in Taiwan

This study aims to investigate whether the colour of Taiwanese lucky charms has an impact on the viewer's expectation about the lucky charm's meaning and, if yes, whether such an impact can be affected by the viewer's religious faith. To achieve this aim, a psychophysical experiment was carried out using images of Taiwanese lucky charms. Each lucky charm was colored based on the 11 basic colour names proposed by Berlin and Kay, including red, orange, yellow, green, blue, purple, pink, brown, white, grey, and black. Six most common meanings for lucky charms in Taiwan, including safety, health, love, fortune, business, and learning, were used in rating the lucky charm colours via a 4-step scaling method, ranging from "strongly agree", "agree", "disagree" to "strongly disagree." Experimental results show that in general, warm colours were mostly regarded as having a strong link with a good luck for all of the 6 common meanings of Taiwanese lucky charms as described above, while cold



and achromatic colours tended to have a weaker link. Religious faith was found to have little impact on colour meanings of the lucky charms in Taiwan.

**Hsien-Hsiang Meng** *The Graduate Institute of Design Science*

**Co-authors:** Ray-Chin Wu and Li-Chieh Chen

### **The effect of facial mask colour tones on the image of retail services**

Since the COVID-19 pandemic, mask wearing has become routine for retail staff in Taiwan. This new appearance for staff may have an influence on whether customers approach staff or not. According to previous research, hue played an important role in the masks that should be worn. However, other research has found that lightness and chroma were more important than hue in terms of colour emotion. Thus, this study intends on supplementing previous work with incorporating other mask samples with various lightness, chroma, and hues to investigate the influence of colour theory on retail staff image. Based on previous methodology (Meng et al. 2021), the ranking for these four attributes for staff images are finalised and the popular colours of masks are identified through these criteria. With the results from this study and previous literature, the angles of hue for these popular masks are located in the first and fourth quadrant. It indicates hues play an important role in the masks of retail staff service image. Besides, the tones of these popular masks are low chroma with high lightness. These results can be provided to retail staff management for retail practice.

**Yan Lu** *University of Leeds*

**Co-author:** Kaida Xlao

### **Modelling facial attractiveness from various colour characteristics**

Colour is a perceptual stimulus which is essential in daily life and is often considered in terms of aesthetics. Various colour characteristics have shown their influence on facial attractiveness. Previous studies have assessed the impact of each single colour characteristic on facial attractiveness, yet very few of them established the quantitative relationship between various factors and facial attractiveness. The present study was designed to model facial attractiveness from various colour characteristics using multivariate statistical techniques. Sixty-eight colour characteristics including average/local skin colour, feature colour, skin colour variation, and facial colour contrast were measured and employed to model the facial attractiveness of both Caucasian and Chinese faces. The results revealed the significant facial colour cues utilized by Caucasian and Chinese people for attractive judgements. In the Caucasian model, five selected predictors obtained by MLR were



used for the prediction of attractiveness with a predictive success (adj. R2) of 43.8%. Seven colour variables were selected from Chinese datasets for predicting Chinese facial attractiveness and the predictive success (adj. R2) was found as 55.6%. The methodology used in this study could serve as an important analytical tool for future facial attractiveness prediction.



WEDNESDAY JUNE 15 9:15 – 10:30

**Session B – Art: Inspiration & Materials**

**Kyoko Hidaka *Shibaura Institute of Technology***

**Yellow is the sound of a trumpet: An international survey on the association between color and sound and a comparison with color theory**

This study is an international survey of the tendency to associate colours with sound from the perspective of colour theory. However, the purpose of this study is to identify a colour-sound link that many individuals can relate to, rather than to investigate synesthesia's perceptual qualia. Since ancient times, there has been an idea that there is a link between colour and sound. According to Sir Isaac Newton's "Opticks" (1704), the rainbow's spectrum is divided by a musical scale.

Previous research has revealed that the colours and sounds that people identify with colours are quite consistent. Respondents were asked to fill out a questionnaire about the sounds they associate with different colours in either English or Japanese, and statistics were produced. According to Hashimoto et al., colour and sound stimuli are linked through hue, saturation, and lightness.

The scales and hues in the standard colour theory outlined in Collopy's paper (2009) were compared to the results of our survey. In terms of colour connections, Newton's E and G colours tended to be similar, whereas Field's C and G colours tended to be similar. We can obtain more consistent data by categorising the cohorts by gender, age, and favourite activities.

**Umut Eldem *Royal Conservatoire Antwerp & University of Antwerp***

**Multimodal and pseudo-synaesthetic systems in visual music composition: Applying color harmony to the musical process**

The application of ideas based on color and visual theory into the musical domain has gained more and more interest in the last century. With the advent of animation, coupled with the advancements of technology, there have been several techniques and concepts invented and used in the creation of audiovisual art. While many such theories exist in these disciplines, there has also been a lack of concepts that consolidate the mathematical correspondences of color and sound with the cognitive audiovisual experience. In this presentation, the composer Umut Eldem introduces his doctoral research of cognitive and synaesthetic correspondences in contemporary musical creation and practice. Through research on the experiences of musicians



with synaesthesia, as well as how non-synaesthetic people react to synaesthetic and pseudo-synaesthetic constructs, several cross-modal constants have been derived in both the creation and experience of audiovisual aesthetic information. This enables the creation of systems which can apply color and visual harmony into the emergent properties of music - not only singular notes, chords, and rhythms, but also the relationships between these musical parameters.

**Carrie Firman *Edgewood College***

**My thoughts appeared in the sky: A synesthete meets the aurora**

My synesthetic ability to perceive sound as abstract shapes with movement and colour on the dark canvas of my mind's eye has been the primary basis of my digital art and design practice. I spent two months in the Norwegian arctic, studying the scientific basis, cultural connections, and human experience of the Northern Lights. Along with an essay on these topics, I produced photographs and time lapses of the Northern Lights, which served as reference material for four digital art pieces. These motion graphics videos visually interpret clips of ambient instrumental music, chosen for their ability to trigger visuals with similarities to the aurora according to my sound-visual synesthetic experience.

Seeing the aurora's colour and movement, I was struck by a rare, specific state of awe and recognition, until then only felt when viewing artworks by synesthetes which related to my own experience. It is the only time nature has created such an encounter, and it was stronger than expected. This project has brought together art, design, music, science, history, and anthropology to explore the value of individuals and intersectional inquiry.

**Soo Kang *Chicago State University***

**The colour sensation in the art of Maria Tomasula**

Maria Tomasula (b. 1958), a prominent Mexican American painter and Professor of Art at the University of Notre Dame, has produced Neo-Baroque still life paintings over three decades. Her paintings are intriguing due to the unusual arrangement of flowers, fruits, insects, and inanimate objects, and highly attractive due to the application of sumptuous colours. The artist employed vibrant colours to sensationalize, but also to evoke a spiritual or invisible force in the images. She attributes this to the art works of the Catholic churches that she attended as a child. Her objectives of the usage of colours evolved as she adopted certain philosophical



views, particularly Spinoza's theory of immanence, Deleuze's account of sensation in relevance to colour and various concepts of material vitality, as addressed by the advocates of New Materialism. This paper explores the origin and influences on Tomasula's use of sensational colours that impart varied meanings to her still life paintings.

### **Romesh Kumar *Colorants Solutions USA, LLC***

#### **A history of Azo pigments – for color in all applications**

An important chemical bond existing in many organic pigments often used in paint applications, is called the “azo” chromophore. Johann Peter Griess discovered the first azo compound in 1858. His discovery subsequently resulted in the multi-billion-dollar industry we know today! The first synthetic azo pigments of commercial significance were manufactured over 100 years ago. Since that time, several different classes of azo pigments have been discovered and mass produced for use in all types of coatings including liquid (aqueous & non-aqueous), powder, automotive, industrial, road markings, and many other special applications. Even today, work goes on to develop azo pigments representing new unique chemical structures.

This paper will discuss the beginnings of azo chemistry. Different classes of azo pigments commonly used today in the worldwide coatings industry. Starting raw materials, pigment synthesis, processing, and finishing to be briefly covered. Examples of how chemical and physical differences of pigments can affect their overall performance properties in polymers will also be illustrated. Finally, some recent developments in azo pigment chemistry, and the current and future role of azo pigments in coating applications of plastics will be discussed.

WEDNESDAY JUNE 15 10:45 – 12:00

## Session A – Colour Science II

**Che Shen** *RIT*

**Co-authors:** Mark D. Fairchild, Robert Wanat

### Measuring display observer metamerism

Observer metamerism refers to a situation in which some observers with normal colour vision see two colours as identical while others see them appear mismatched. In recent years, some issues with metameric failure have been exacerbated by displays with more saturated primaries and narrower emission spectra. Classic trichromatic colorimetry cannot predict this effect because of the typical reliance on a single standard observer – a Colour Matching Function (CMF) averaged across the population. In this paper, we present a new experiment that uses unique hues as an intrinsic reference to measure the amount of metameric failure of a single display for real observers without comparisons to other reference displays.

**Ehsan Ullah** *Norwegian University of Science and Technology*

**Co-authors:** Gregory High, Phil Green

### Quantifying and evaluating color appearance models based on Helmholtz Kohlrausch Effect

The brightness sensation of a colour source depends in part on colour purity, and this colour appearance phenomenon is defined as the Helmholtz-Kohlrausch effect. With the recent advancement in HDR and WCG displays, greater brightness and contrast will make the Helmholtz-Kohlrausch effect more noticeable. An experiment using magnitude estimation was conducted to evaluate the Helmholtz-Kohlrausch effect. Twenty-one observers participated in the experiment and judged the brightness of the test colour samples in relation to achromatic samples. Saturated colour samples were judged by the observers with high brightness values as compared to less saturated colour samples with the same luminance, and a small deviation in observers' predictions of lightness was observed on chromatic backgrounds. The performance of several existing colour appearance models was investigated. The lightness values predicted by CAMs on all backgrounds were lower than perceptual lightness values returned by the observers. CAMs were quantitatively assessed based on CV statistics showing higher variations between predicted lightness values and the observers' perceptual lightness judgements. In addition to lightness, the chroma channels were also shifted in the case of CIECAM02, and CAM16. However, in chroma shift was minimal because of decorrelation between achromatic and chromatic components due to constant luminance.



**Abigayle Weymouth** *RIT*

**Co-author:** Michael J. Murdoch

### Perceived speed in transitions between neutral and chromatic illumination

Dynamic lighting is an integral part of our experience of illumination, both in daylight and increasingly in artificial lighting. Previous research has focused either on daylight or chromatic illumination, and most studies examined speeds near detection thresholds. This experiment investigated transitions between neutral and chromatic illumination to expand upon these findings. The perceived speed of lighting changes to and from the chromaticity of D65 in eight radial hue directions was measured in a two-interval forced choice task. The relative perceived speed, computed as the point of subjective equality (PSE), of transitions moving away from D65 differed by radial hue direction, indicating that CIELAB is temporally nonuniform. Results show that the yellow-blue opponent colour component contributes less to speed perception, in line with previous literature. The experiment did not yield PSEs for many transitions moving towards D65, likely because the comparison was too difficult, an improper range of speeds was studied, or both.

**Qinyuan Li** *University of Leeds*

**Co-authors:** Kaida Xiao, Ningtao Mao, Michael Pointer

### Visual judgment of the tactile properties of fabrics by altering colours

This paper presents the results of experiments to evaluate the human perception of visual-tactile properties: flexible-stiff, smooth-rough, and soft-firm of both images of flattened fabrics and draped fabrics on the professional BenQ display. The aim of the study was to evaluate the differences of the perception between the different shapes of the fabrics, i.e., flattened or draped. 128 fabric images representing different shapes (flattened and draped fabrics), four different fabric materials and 16 fabric colours, were used in this study. Their visual-tactile properties were accessed by human subjects using psychophysical experiment. The results showed that the difference of the perception of these properties between images of flattened fabrics and draped fabrics was huge, except for smoothness and roughness on Fabric 1 and Fabric 2. More colours showed significant effects on human responses of smoothness, roughness, softness, and firmness on images of draped fabrics than flattened fabrics, while the perception of flexibility and stiffness was not significantly affected by colours.



WEDNESDAY JUNE 15 16:15 – 17:30

Session A – Colour Science III

**Tanzima Habib** *Norwegian University of Science and Technology*

**Co-authors:** Phil Green, Peter Nussbaum

### **A weighted goodness-of-fit metric for comparison of spectra**

Spectral estimation methods are being increasingly used to create spectral data for colour reproduction applications. Therefore, a good spectral matching metric is required that can minimize colour differences, metamerism as well as errors in the spectral domain. A goodness-of-fit metric is proposed that applies weights to different metrics based on selected criteria and combines them to a single value to assess the fit between two spectra. Acknowledging that for different applications the individual criteria may be more or less relevant, we propose the components of this metric are weighted according to their relative importance in a given application.

**Olivia Kuzio** *RIT*

**Co-author:** Susan Farnand

### **Simulating the effect of camera and lens choice for color accurate spectral imaging of cultural heritage materials**

Spectral sensitivity measurements from a set of 43 different professional level consumer cameras were used to assess the effects of factors including brand, model, lens, and internal IR filter removal on the simulated colour accuracy of these cameras when used in a practical spectral imaging approach involving the collection of six spectral channels under two optimized lighting conditions. The findings offer insight into the robustness of the two-light method to such variables, suggesting that two-light spectral imaging using multichannel tunable LEDs is a reliable means of introducing practical, highly colour accurate spectral imaging into cultural heritage studio photography workflows, regardless of the camera equipment used to carry out imaging.



**Ruili He** *University of Leeds*

**Co-authors:** Kaida Xiao, Michael Pointer, Manuel Melgosa, Yoav Bressler

### **An investigation on visual colour difference of 3D printed objects**

With the rapid development of colour 3D printing technologies, the colour measurement and colour-difference evaluation on 3D printed objects requires further studies and advanced techniques to achieve faithful colour appearance reproduction of 3D objects. This study aimed to investigate visual colour difference of 3D objects from lightness, chroma and hue attributes, based on 42 pairs of 3D printed spherical samples with predominant lightness/chroma/hue differences ( $DL^*$  (or  $DC^*_{ab,10}$  or  $DH^*_{ab,10}$ ) /  $DE^*_{ab} \geq 0.85$ ). A psychophysical experiment with the gray scale method was conducted to collect visual colour difference data assessed by observers. It was found that it is generally easier to assess lightness and hue differences of 3D spherical objects but not chroma differences, and the results indicated that the parametric factors related to lightness, chroma and hue-differences in colour-difference formulas should be optimized specifically for 3D objects.

**Hao Xie** *RIT*

**Co-author:** Mark D. Fairchild

### **The Luther condition for all: Evaluating colorimetric camera design for personalized color imaging**

The Luther condition has been a guideline for colorimetric camera design. However, the standard observer only represents an average observer without considering the inter-observer variability. Thus, there is still potential observer-camera metamerism between a camera colorimetric to the standard observer and an actual observer that has different CMFs. In this work, 1000 sets of CMFs were used to evaluate the RIT camera sensitivity dataset that includes 28 representative cameras. In general, it is found that the camera performances averaged across the individual observers can be predicted from the standard observer. However, the ranking by the standard observer would not be approved by some individuals; therefore, a camera less colorimetric to the standard observer can be more colorimetric to an individual observer. And two cameras that are similarly colorimetric to the standard observer can have different levels of variation for the whole population. Furthermore, when the individual observer's CMFs are unknown, the typical colour characterization using the standard observer may likely cause higher mismatches between the camera and the individual observer. This work provides theoretical insights for personalized colour imaging, where from camera to display, colour can be consistently captured and rendered for any individual observer.



**David Briggs** *National Art School, Sydney*

**Psychophysical Colour**

The CIE International Lighting Vocabulary (ILV) defines the word “colour” in two distinct senses, “perceived” colour and “psychophysical” (i.e., colorimetric) colour. Colorimetric specification of lights and objects can be a source of confusion in the broader colour community, and many find the concept of colorimetric or psychophysical “colour” to be suspect or even nonsensical. This paper reviews the connections between colour stimuli, colour perceptions, and colorimetric specifications, leading to consideration of the ontology of colour implicit in the two CIE definitions. In defining two senses of the word “colour” the CIE ILV expresses a pluralist ontology that acknowledges that we may wish to use the word “colour” either for our perceptions of colour or for the perceivable properties of lights and objects that these perceptions are based on. A colorimetric specification of a light identifies a class of spectral distributions that share a common overall balance at the level of their long-, middle-, and short-wavelength components as detected by the human visual system, resulting in a common disposition to evoke a perceived colour. A colorimetric specification of an object identifies for practical purposes a class of spectral reflectances having a common disposition to evoke a perceived object colour in daylight.

THURSDAY JUNE 16 08:30 – 09:45

## Session A – Colour Science IV

**Kyosuke Ota** *Chiba University*

**Co-authors:** Midori Tanaka, Takahiko Horiuchi

### Preliminary evidence for the effect of circadian rhythms on color perception

Intrinsically photosensitive retinal ganglion cells (ipRGCs) affect the pupillary light reflex and regulation of circadian rhythms. ipRGCs have also recently been shown to affect visual perception, especially brightness perception, and reports are gradually accumulating to affect colour perception. The purpose of this study was to verify the effects of ipRGCs on colour perception through the repeated performance of colour matching on the same display screen at different times of day. We performed colour matching a total of 290 times over a period of nine months. The color matching results showed that central vision exhibited lower color discrimination ability than peripheral vision. Furthermore, significance tests revealed that the colour perception characteristics between central and peripheral vision differed between day and night, indicating that M1 ipRGCs, which affect non-image-forming functions, and non-M1 ipRGCs, which affect image-forming functions, may interactively affect colour perception.

**Qiang Xu** *Zhejiang University*

**Co-author:** Ming Ronnier Luo

### A parametric colour difference study on the physical size effect

It has been a long debate whether a colour difference or colour appearance model can only be used under either 2° or 10° standard colorimetric observer. The hypothesis is that the difference caused by the Field of View (FoV) or physical size to be small. This experiment was intended to provide scientific evidence on size effect. 280 sample pairs having CIELAB colour difference of 4 were selected around 5 CIE recommended colour centers, with no division line between two colours in a pair. Each pair was assessed at 4 FoVs, 2°, 4°, 10° and 20°. The results were also used to test the effects of different colour matching functions (CMFs) and 3 colour-difference formulae, CIELAB, CIEDE2000 and CAM16-UCS. It was found that CIE 1964, CIE 2006-10° slightly outperformed CIE 1931, CIE 2006-2° and 2006-4°CMFs. Also, all combinations of formulae and CMFs gave better performance for visual data having larger FoV. Finally, CAM16-UCS and CIEDE2000 perform better than CIELAB formula.



**Yuki Ohira** *Chiba University*

**Co-authors:** Kazuki Nagasawa, Shoji Yamamoto, Ikumi Hirose, Yuki Ohira, Wataru Arai, Kunio Hakkaku, Chawan Koopipat, Keita Hirai, Norimichi Tsumura

### **3D printed human skin appearance with a multilayered spatial distribution of pigment components**

In this paper, we propose a pipeline that reproduces human skin using an inkjet 3D printer by obtaining the spatial concentration distribution of pigments from an image of human skin taken by an RGB camera. The pigment concentration distributions were obtained from the skin image using a method for separating skin pigment components with independent component analysis. This method can extract the melanin and hemoglobin components, which are the main pigments that make up skin tone. We used inkjet 3D printers to fabricate the skin model because these printers are suitable for creating multilayered structures. In our proposed method, the melanin and haemoglobin layers are created as separate layers and arranged in a multilayered structure to reproduce human skin, which has a multilayered structure consisting of an epidermis with melanin pigment and a dermis with haemoglobin pigment. Subjective evaluation showed that the skin reproduced by our method was superior to that produced using conventional printing.

**Ming Ronnier Luo** *Zhejiang University*

**Co-authors:** Mingkai Cao, Yan Lu, Kaida Xiao

### **Cross-cultural influence of preferred memory colours on mobile display devices**

An experiment was carried out to study memory colours across 106 observers from 5 ethnic groups on mobile displays. The threshold psychophysical method was used, and each observer was asked to make a forced choice decision between like and dislike for the image assessed. Twenty-four familiar objects were investigated and each memory colour was defined by their colour centre and 50% preference acceptance ellipsoid in CIELAB space. The results were analysed in terms of observer variations, inter-comparison individual objects and observer groups between different objects. Some systematic variations are reported.



**He Yuanyuan** *Chiba University*

**Co-authors:** Yuanyuan He, Hiromi Sato, Yoko Mizokami

## **Comparison of brightness perception of facial skin with differences of skin color**

Reddish skin appeared brighter than yellowish skin when both had the same lightness for Japanese observers (Yoshikawa et al., 2012). Nevertheless, Thai, Korean, Chinese, or European observers showed opposite or inconsistent tendencies (He et al., 2021). There are some possible reasons for this difference, such as the observer's ethnicity and living environment as well as the judgement criterion or the definition of brightness. Here, we investigate how the definition of brightness and judgement criteria influence facial brightness evaluation. We conducted experiments with two criteria, "appearance match" and "brightness match." We also tested two types of scale images for judgments: face and uniform patch. The results of the two criteria showed a similar trend, suggesting the little influence of brightness definition. The results for the face scale image showed a similar tendency as the previous studies, but not for the uniform colour scale. This may imply that the observer matched different areas on the face when using the uniform scale (i.e., Japanese observers tended to gaze at the eyes and cheeks). We need further investigation on the fixation area of observers in different regions or countries. Our results suggest the influence of stimuli and evaluation criteria on facial brightness judgement.

THURSDAY JUNE 16 10:45 – 12:00

## Session A – Colour in Health & Design

**Lou Ricome** *Architectural School of Lyon*

**Co-author:** Chantal Dugave

### Colour and care in space

This research paper allows us to look into the actions of our relationship with space in the particular environment of the hospital. Beyond the creation of space, our focus is on colour and the way it sets space in motion, both physical and imaginary. As an architecture student, I had the opportunity to do two internships. The first one was with the architect Emmanuelle Moureaux in Japan, where I understood how colour can transform and interact with space. This experience led me to a second internship, this one in research of architecture. I worked with Laure Mayoud in the “Femme Mère Enfant” hospital. The particularity of this psychologist is that she treats with “cultural prescriptions”. My project for this internship therefore aimed to create a tool that children could handle and that would make them play and interact with space and colour. As such, my hypothesis poses questions regarding the effects of colour on healing and care.

**Estelle Guerry** *Université de Toulouse*

### Color-design applied to the elderly's nutrition: a public health issue

In a general context of population ageing, we question the therapeutic scope of the concept of “gourmet colour”. The colour then becomes a major health ally when taking meals for elderly. Indeed, taste comes first by sight. A multisensory search for gourmet colours helped identify appetizing and stimulating chromatic combinations, summoning the sensory memory attached to tastes. We associate research on the textures and more precisely the use of the modified textures, adapted to the swallowing disorder. The colour makes possible a restitution and a rediscovery of the flavours, often denatured by the aspect of these textures. This new chromatic composition makes it possible to question in particular the codes of the gastronomy and the collective catering in favour of an innovative, stimulating and gourmet culinary experience which can be declined for the daily meals. Thanks to this meeting, combining colour research and textures, we seek to promote a therapeutic diet that awakens the senses, restores the desire and experience of taste in elderly. Thus, this concept of “gourmet colour” becomes a key element for a harmonious ageing and factor of good health.



**Cat Pattie *Newcastle University***

**Co-authors:** Harpreet Dlay, Sinéad Mullally, Gabriele Jordan

**Development of a questionnaire to assess the impact of congenital colour vision deficiencies on education.**

Technological advances over recent decades have heralded a new era for education in which colour is omnipresent in the classroom: in textbooks, worksheets, smartboards, laptops, tablets and learning applications. Despite this, little research has been conducted on the impact of this change on the educational experiences and outcomes of colour vision deficient (CVD) students. Here, following a qualitative study of childhood impacts of CVD, we develop and validate a questionnaire measuring the impacts of CVD, focusing on education. CVD participants reported significantly more difficulties than control participants in total and across all impact subscales: Education (15 items), Social (5 items), Emotions (13 items) and Day-to-Day (9 items), demonstrating construct validity and providing evidence that CVD has a substantial adverse effect on affected individuals. This calls into question the status quo of CVD, characterised by a lack of universal screening and guidance on how to make educational materials accessible to the CVD learner. The questionnaire can be used alongside robust diagnostic tools for CVD, allowing investigation of the effect of CVD type and severity, and to understand the impacts of the increasing reliance on colour on CVD students across a range of educational contexts.

**Elizabeth Neswald *Brock University***

**The Colours of Diabetes: Colorimetry, Chemical Indicators and Colour Standardization in Diabetic Sugar Measurement in the Twentieth Century**

For most of the 20th century, the diagnosis and management of diabetes were inseparably tied to colour. This paper discusses colour as a tool of measurement in diabetic glucose analysis in the late 19th and early 20th centuries, in the period before polarimetry and automatic monitoring became routine. With the development of chemical indicators for glucose analysis, colours became central for diabetes diagnosis. From the 1920s onward, insulin therapy required frequent and precise sugar monitoring, with testing responsibility shifting from physician to patient. Colour scales of various kinds allowed non-specialists to interpret test results, but materialising colour in these standards posed further challenges, including accessibility, colour accuracy, representativeness, and how to assess the effects of substrate. These difficulties were shared with other fields that used colorimetric



methods and colour comparisons for measurement, analysis, and communication. Taking diabetic glucose analysis as a case study provides insights into historical discussions on the uses, limits, and challenges of colour as a measurement tool.

**Yulia A. Griber** *Smolensk State University*

**Co-author:** Galina V. Paramei

### Colour naming of post-COVID participants hints to “darkening” of perceived colour

We investigated colour naming in individuals who have recovered from COVID-19. Data was collected from native Russian speakers in an online experiment (<http://colournaming.com>). An unconstrained colour-naming method was employed. The dataset included responses of 201 participants (147 women) aged between 19–65 years ( $M = 33.4 \pm 13.2$ ), who had had coronavirus infection and the confirmed medical diagnosis. The data was compared with data collected pre-pandemic (2018–2019) from 2,457 respondents (1,402 women) aged between 16–98 years (henceforth termed “healthy”). For intergroup comparisons, we estimated frequency of Russian basic colour terms ( $N=12$ ), frequent non-basic colour terms, and achromatic modifiers, as well as the number of words in colour descriptors and colour-naming patterns. In post-COVID respondents, we found an increase in ‘brown’-naming, along with an increase of frequency of achromatic modifiers. These naming pattern changes provide indirect evidence that colour vision of these respondents has been affected by coronavirus. If confirmed in a psychophysical examination of colour vision, the two phenomena might be indicative of an affected processing of spatial luminance contrast in post-COVID individuals.

THURSDAY JUNE 16 10:45 – 12:00

## Session B – Colour in Aesthetics & Culture

**Ivan Magrin-Chagnolleau** *CNRS*

### A phenomenological approach to color theory and aesthetics

This paper proposes to investigate colour theory and aesthetics from a phenomenological point of view, that is, from the point of view of the lived experience. Two angles of study are suggested: one is from the point of view of the artist creating a piece, the other is from the point of view of the audience receiving the work. In each case, it is possible to interrogate the lived experience in order to find some cues about the aesthetic components that contribute to this lived experience, in particular as they relate to colour. A tool, the explicitation interview, is proposed as a means to conduct such an investigation.

**Lavina Bhaskar** *National Institute of Fashion Technology*

**Co-author:** Dimple Bahl

### The story of colour in traditional Indian folk media and art

The narrative of traditional Indian folk media and art is elaborated in its brightly coloured / hued visual language. One cannot think of India or its folk formats in absence of colour. Colour is symbolic, is a derivative of subcontinent culture and has a story to tell. This research paper explores the art of storytelling through use of colours in Traditional Indian Folk Media and Art.

This paper through an extensive review of existing literature, more than a decade long ethnographic studies throughout various parts of India (and specifically in the state of Rajasthan conducted in past by the authors), and through semi-structured interviews with folk artists and scholars; aims to understand why a particular colour is used in the visual storytelling, where does that colour originate from, and what does a particular colour means? This research studies folk formats only from the province of Rajasthan. And finds commonalities of visual narratives in folk paintings of Phad, in the attire of performative arts like, Kathputli (puppetry) and Khyal (folk theatre), etc. And to conclude, take out a colour palette to give a visual definition to Traditional Indian Folk Media and Art.



## **Nusa Maal *Pacifica Graduate Institute***

### **The persistence of a personal palette**

This paper draws from patterns and processes learned from my synesthesia, and decades of work with individuals as a strategic coach.

Four areas of usage have emerged over the years in which a natural palette whose coherent use inwardly and outwardly provides support to one's sense of wholeness and lends strength to self-expression in the world. One restorative use is also included. These personal palette uses include:

1. Inner Biome
2. Personal Visual Harmonies
3. Personal Brand Coherence
4. Transitional Colorspace

These reflective disciplines reference inner, physical and socially representational dimensions that are anchored by color. Clarifying each of these otherwise invisible ineffable domains mindfully, respectfully, and coherently creates a stabilizing inner platform for people to work inwardly with growing sense of restorative interiority, as well as outwardly in ways that feel strengthening for their alignment from the inside-out.

## **Osuanji Essel *University of Education, Winneba***

### **Decolonising skin-lightening practices in selected Ghanaian universities**

This study explored the phenomenon of skin lightening practices using descriptive case study of qualitative research to make meaning of the lived experiences of skin lightening student-practitioners drawn from four universities in Ghana. It explored the views of skin lightening student-practitioners on their own practices and the motivation behind their quest. A sample size of sixteen (16) respondents drawn from four (4) universities in the metropolitan and municipal centres of Ghana namely, Takoradi, Cape Coast, Accra and Winneba was used for the study with the help of critical case sampling technique under purposive sampling. Skin lightening or whiting pills, injections, creams, and oils are the major forms University female students used to change the looks of their skin regardless of the health hazards. The study also revealed that female university students resort to skin-lightening treatments to appear attractive to males; due to peer influence; Eurocentric aesthetic standards emulation; and influences from social media. The African Studies departments, institutes and centres in the Universities should consider including courses in their curricula that would contribute to decolonizing the skin lightening practices to restore pride of being Black and for that matter, African.



THURSDAY JUNE 16 15:30 – 16:15

**Session A – Colour in the Landscape**

**Tania Fuentes** *NSCAD University*

**Colours of the land**

Colours of the land is a project that will refer to how we experience and connect with nature through colour, using Kejimikujik National Park as the case study.

The land has multiple stories to tell: the story of its predecessors, the stories of the hundreds of families that visit the park every day, and the story of its non-human inhabitants. When we enter a space, colour has a huge impact on how we perceive that space, how we connect to it, and the kind of memories and personal stories we build around it. Our colour experience in a place is unique. Depending on the moment of the day, the season, and other environmental elements such as clouds, water, vegetation, and human presence, one-of-a-kind palettes are created. These palettes shape our experience and cause physiological and physical reactions. In addition, we interpret these stimuli based on our background, memories, and previous experiences.

**Yulia Kovanova** *The University of Edinburgh*

**Chroma calls: Place attunement through colour intra-action in sculpture**

The paper discusses the public sculptural installation Chroma Calls presented along the Forth and Clyde Canal in Scotland, to consider how contemporary art practice can help initiate and develop attunement to a place by introducing colour through sculpture. It proposes the idea of 'intra-action of colour', drawing on the concepts of Josef Albers' interaction and Karen Barad's intra-action, to approach colour in more entangled and embodied terms and to bring forth invisible natural processes: from the presence of specific colours in a place, to the different ways of sensing colour, and associated ethical considerations. The author develops the concept of 'acclimatising', derived from 'acclimatising', the process of becoming more accustomed or adjusted to new conditions or circumstances. 'Acclimatising' describes the process of gradual attunement towards a place through colour. Ultimately, the paper suggests that colour can be used as an entryway into a more entangled and responsible sharing of places with humans and nonhumans, with art practice offering a platform for merging a range of disciplines to develop awareness of our environment, with its myriad other participants.



**Zena O'Connor** *Design Research Associates, Colour Collective Sydney*

**Co-author:** Hamidreza Sheibani

**Environmental color mapping in an historic UNESCO Heritage context:  
Uramanat, Iran**

Colour plays a key role in environmental assessment. In this context, environmental colour contributes to judgements about environmental aesthetics, visual amenity, and congruity. Lynch suggests that environmental color also contributes to Imageability, a term he coined to refer to the qualities inherent in a specific environment that gives it a high probability of evoking a strong image in any given observer.

Using a case study approach, the aim of this research was to use environmental colour mapping to investigate architectural and contextual colour in Sherkan, a village located in the Uramanat region of Iran. This region has recently been listed as an important cultural site on the UNESCO World Heritage List. In this region, locally sourced construction materials often feature in the built environment, and this has contributed to a high degree of visual compatibility with the natural environment.

Key outcomes from this study found patterns of colour similarity as well as colour difference in the colours of the built environment and the village context. It is suggested that patterns of colour similarity (at the macro scale) in tandem with colour differences (at the micro scale) specific to Sherkan village have a positive impact on environmental assessment and evaluation overall.



# Poster Presentation Abstracts



**Yuka Akuzawa** *Tokyo University of Science*

**Co-authors:** Chuanyi Liu, Yuki Oe, Yukie Miura, Nozomu Yoshizawa, Naoko Shinohara, Marie Nakaso, Koichi Kaiho

### **Comparative study of the psychological effects of the spectral distribution of daylight and LEDs in office spaces**

The purpose of this study is to clarify whether it is possible to obtain the same psychological and physiological effects as daylight by reproducing it with LEDs. In this paper, we focused on the spectral distribution among the elements of daylight. The experiments were conducted in a controlled experimental space imitating an office space, and psychological evaluations of the daylight were compared with that of LEDs which has different spectral distribution and the same correlated colour temperature (hereinafter called “CCT”) and illuminance as daylight. As a result of the experiments, there is no difference in psychological evaluation if the chromaticity is close even if the spectral distribution is different, and the effect of the difference in chromaticity between the light sources is more likely to appear in the low illuminance condition. Therefore, when reproducing daylight by LEDs, it would be necessary to consider the chromaticity in addition to the CCT and illuminance.

**Enkela Alimadhi** *Bilkent University*

### **Color choice in providing a restorative interior space: A pilot study?**

The main aim of this study is to explore colour choice and eventually, patterns for a restorative classroom. To do so, ten interior design students, trained on the colour application are asked to choose and “allocate” colour in a classroom to provide restorative scenarios and other students (n=13) rated the environments by using the Perceived Restorative Scale, Personal Reactions, and Aesthetic Judgements. Users’ ratings of restorative classrooms are compared with each other to determine which colour choice enhances restorativeness.

As a result, the blue-green interior hues were the most proposed, followed by yellow, and orange. In addition, the first scenario which is a monochromatic colour scheme composed of (RGB: 113, 133, 144), (RGB: 186,186,186), and (RGB: 147, 157,149) shows high score ratings when compared to other scenarios in terms of restorativeness and personal reactions. From a broad perspective, the study, which is a phase of undergoing research, is rather explorative research to contribute further to the knowledge gathered about indoor restorativeness.



**Francis Ankyiah *University of Education, Winneba***

### Intermediate and tertiary pigment colours: Mathematically ‘why’ they can’t be the ‘same’

Colour exists as visual, mathematics, logic, and language, defining life and living in fluidity. Within this fluidity dwells intermediate and tertiary pigment colours making their understanding and difference very difficult for its identity and separation in concept and visual property. This paper approaches these differential difficulties in both ideas, optical properties, and mathematics to show the differences between these two-colour concepts. The study concludes that in applying mathematical expansion and factorization, three pigment colours should be obtained as the equation’s results to justify the third position concerning ‘tertiary’.

**Kévin Bideaux *Labratoire d’Etudes de Genre et de Sexualité (UMR8238)***

### Pink marketing: How does it work? Why is it (still) working?

Gender marketing takes advantage of gender research, modifying some products to respond the allegedly specific needs of women. The aim is to double profits by offering two gendered versions of the same product. Pink is then massively used to particularise a product “for girls/women”, which has often been criticised by feminist researchers and activists as sexist. The intent here is to explain how and why such a marketing strategy persists, even though it is in decline. Through gender studies, the article will first show how the gendered use of pink in marketing manages to construct a “feminine mode of consumption”, referring to Christian Derbaix and Pierre Gregory’s model of the “doors of persuasion” to show how the colour pink can activate different levers likely to modify the attitudes and behaviour of female consumers. The article will then consider Jean Baudrillard’s semiological approach to consumption in order to explain female consumers’ adherence to this “pink marketing”. Finally, using the concept of “extended-self” developed by Russel W. Belk, it will show how the consumption of these “feminine products” allows consumers to prove their belonging to the category of “women”, while reinforcing their feeling of “being a woman”.



**Mengyuan Chen** *University of Leeds*

**Co-Authors:** Stephen Westland, Caroline Hemingra

### The effect of colour temperature of morning light exposure on wellbeing

This study investigated the effect of correlated colour temperature (CCT: 2500k, 5000k, 8500k, 18000k, 500lx) on healthy adults (N=16) exposed to light for one hour in the morning based on three measures. PANAS was used to assess mood, KSS was used to assess alertness, and the tympanic temperature was also recorded. There was evidence that the CCT affected tympanic temperature, with lower temperatures being induced by higher CCT in general. The KSS data was consistent with other related studies in that higher CCTs resulted in increased alertness and the lowest CCT (2500K) resulted in decreased alertness compared to the baseline condition (3500K). The CCTs were found to differentially affect positive and negative emotions measured using PANAS. The 8500K condition, in particular, induced an increase in positive emotions and a decrease in negative emotions. Overall, we find some evidence that exposure to light (500 lux) in the early morning could positively affect the well-being of healthy adults. The study raises questions about the suitability of low CCT (e.g., 2500K) in homes and offices.

**Hortense De La Codre** *Université Bordeaux Montaigne*

**Co-authors:** P. Bertrand, L. Servant, R. Chapoulie, P. Mora, A. Mounier

### The impact of colours fading on our sense of 18th century tapestries

When one approaches the subject of 18th-century colours, the common thought is immediately oriented towards pastel or even dull colours. Tapestries from this period are no exception to the rule. However, current research shows that the dyes of the time were bright and contrasting.

This study proposes to show how it is possible to recover a hypothesis on the original colours of tapestries from different chemical or numerical analysis techniques. An experimental setup was installed in the laboratory to study the degradation of reference samples. The analyses and our reflections on the colours were applied to a tapestry kept at the Cité Internationale de la Tapisserie in Aubusson. Indeed, the Grande Verdure aux Armes du Comte de Brühl is a high-quality piece called “Grand teint”, dyed and woven from the materials identified as the most solid in the 18th century. The lining of the reverse side of this object has been removed for restoration, giving us an excellent opportunity to study it from both sides (the side exposed to light and the side protected by the lining). The digital restitution of the colours of this



tapestry calls into question the vision that we had until then of the colours of the 18th century and the aesthetic choices made despite the rapid degradation of certain dyes present on the tapestry.

**Alfonso De Lucas Tron *Universidad Nacional Autonoma de Mexico***

### **Aerial perspective: Alteration of color due to the interposition of air**

Leonardo da Vinci observed that colours at a distance undergo significant changes in an effect that he denominated aerial perspective (AP). Similarly, in his Notebooks, he mentioned that there are three types of perspective: linear; colour, and disappearance. Considering that his proposal is exceptionally correct in terms of the optics of colour at a distance, and that there is little information on the theme, his observation has been taken up again with a current view of physics and perception. With the purpose of establishing the manner in which colour alters AP, the thesis assumed that the air, in spite of its transparency, affects colour at a distance in three fundamental aspects: in its diminution; its disappearance, and its modification, depending on the air mass separating the object from the observer. This is an effect that, although perceived by landscape painters, eludes commonplace persons in comprising a perceptual activity that, for the purpose of this study, has been termed constancy of aerial perspective. This essay has as its objective to render an approximation of the optics of aerial perspective under a hypothetical focus of five planes at a distance and to expose why constancy of the aerial perspective limits the vision of colour in exteriors.

**Hui Fan *Zhejiang University***

**Co-authors:** Candong He, Tingwei Huang, Ming Ronnier Luo

### **A new method for measuring the spectral sensitivities of a camera**

In this study a new method of estimating the spectral sensitivities of a camera based on a multi-channel LED cube was introduced. This method required the measurement of the camera responses and the spectral power distribution of each LED channel. The estimated spectral sensitivities were comparable to the results calibrated by a monochromator. The accuracy was verified by capturing a colour chart in a LED viewing cabinet. The results showed the proposed method to be effective to estimate the spectral sensitivities of the camera.



**CC Hart *The International Association of Synaesthetes, Artists, and Scientists***

**Fifty shades of grayscale: Orthopedic structures as perceived by a manual therapist with synaesthesia**

Congenital synaesthesia is an inherited trait in which stimulation of one sensory or cognitive pathway leads to involuntary experiences in a second sensory or cognitive pathway. Grapheme->colour synaesthesia is a trait by which a synesthete perceives individual graphemes as colored. Lexeme->colour synaesthesia is the experience of perceiving entire words in colour. In this context, letters, digits, and lexemes are the inducers of synaesthesia, and the colour is the concurrent. Research into cross-sensory perception documents instances of the immediate transfer of synaesthesia to a novel inducer, for example the transfer a synaesthete's colour for the Roman alphabet grapheme "R" to the Cyrillic alphabet grapheme "Я", despite the graphic differences between the two letters. Anecdotal evidence from synaesthetes suggests that various systems of order including sequences, hierarchies, maps, etc. can serve as the novel inducer fostering a colour concurrent. "Fifty Shades of Grayscale: orthopaedic structures as perceived by a manual therapist with synaesthesia" explores the transference of grapheme->colour and lexeme->colour synaesthesia onto novel inducers: anatomical structures and orthopaedic fractures as revealed through medical imaging. Using grayscale radiographs printed to canvas, I apply mixed media to reveal injuries, anatomical landmarks, and pathologies as I see them in vivid hues through my synaesthetic perception.

**Johanna Hedenskog *University of Edinburgh***

**Grey City: Queering chromatic architecture**

The legacy of modernism has left contemporary architectural practice with a prevailing chromophobia, which limits the expression of diverse identities in the built environment. This paper originates from a stance that colour can be used as a queer architectural device, and outlines how modernism sought to erase queer colour and promoted the controlled use of 'architectural' colour. It argues that the written and designed work of Le Corbusier actively contributed to this, using his defacement of Eileen Gray's E.1027 as an example of the modernist erasure of queer colour. The concept of queer colour is then explained with reference to drag culture. The discussion is consolidated by linking back to the built environment, using David Batchelor's theory of chromophobia. This argument is concluded with the understanding that the modernist suppression of queer colour directly relates to the monotony of contemporary architectural practice, and that a greater appreciation for aesthetic diversity would be of great benefit to cities and their inhabitants.



**Sunghyun Kang** *Iowa State University*

**Co-authors:** Andrea Quam, Nora Ladjahasan, Carol Faber

### Color preference, perception, and its flavors: Focus on a snack package

A product's packaging is an important vehicle to convey product information and branding at the point of purchase. Especially in food packaging, colour is one of the critical elements in how people perceive these products and can affect the decision-making process. This study investigates colour preference and its flavour and perception of healthier colours on five colours used in the market. Four questions were used to identify colour preference when selecting an item to eat in snack food packages; the perception of snack flavours associated with the chosen colour; the perception of healthier colours; and whether favourite colours impact the colour preference for consumption among adults. The package samples were designed with computer-generated packages as a research method, and the survey was distributed to a Midwest university online. Approximately 800 people participated in the survey. Red was the colour most preferred to eat, green is selected as the healthiest colour to eat, and blue was selected as the overall favourite colour.

**Lin Jinyi** *Zhejiang University*

**Co-authors:** Keyu Shi, Timwei Huang, Ming Ronnier Luo

### Colour modelling on a virtual display system – LEDSimulator

Based on a computer system for supply chain management, named LEDSimulator, introduced in the previous two AIC conferences [1,2], some refinements, including hardware and software, in system colorimetric accuracy were made. And a series of tests were conducted to show the system performance enhancement.

**Ichiro Katayama** *Kindai University*

**Co-authors:** Sachiko Noguchi, Rumiko Takata, Kaori Segawa

### Improvement of color feelings prediction formulas for the estimation of color combination feelings of “Kimono”

We examined the applicability of colour feelings prediction formulas to the estimation of colour combination feelings of “kimono.” As a result, colour feelings prediction formulas were found effective in estimating “contrast,” “floridness,” “warmth,” and “pleasantness,” but the estimation accuracy of “contrast” and “pleasantness” was lower than that of “floridness” and “warmth.” Thus, this study



aimed to derive colour feelings prediction formulas that are more suitable for estimating colour combination feelings of “kimono” by conducting a new evaluation experiment. To improve the colour feelings prediction formulas for “contrast” and “pleasantness,” we conducted multiple regression analyses using the evaluation results of “contrast” and “pleasantness” obtained in the present experiment as objective variables. We applied the improved formulas to the evaluation results in the previous study and calculated the correlation coefficients between the estimation and evaluation values. Statistical tests indicated that the population correlation coefficients of “contrast” and “pleasantness” were significantly higher after the improvement, and the effect of the improvement was confirmed.

**Agata Kwiatkowska-Lubańska *Academy of Fine Arts in Krakow***

**The symbolism of colour for Gen Z; Visual communication through images and hashtags**

Sociologists have identified Generation Z as a group of people born after 1996 who do not know a world without digital devices and virtual communication platforms. Equipped with phones, they document their lives on an ongoing basis, taking photos and sharing them on social networking sites.

The paper is intended to present the results of an experiment conducted with second-year undergraduate students of the Faculty of Design at the Academy of Fine Arts in Krakow, in the winter semester of the academic year 2021/2022, as part of the colour fundamentals course. The aim was to find out to what extent colours have a semantic value for them, used in interpersonal communication, and how the visual message is complemented by the verbal message.

For 2 weeks, students were assigned the task of looking for the particular primary colour - red, yellow, blue or green - in their surroundings. They documented the examples they found by taking photos with a smartphone or camera and then posted them on a specially prepared profile on Instagram, complementing them with hashtags of their choice. Within each colour, a set of hashtags was created that were used to create basic categories of meaning attributed to the analysed colours.



**Peihua Lai** *University of Leeds*

**Co-author:** Stephen Westland

### Pixel-based colour image object detection in fashion

An image-to-image Generative Adversarial Network was trained to classify each pixel of an input fashion image according to 5 categories of objects. A total of 1600 images were used as training images and a correctly labelled image was generated manually for each of these training images to use as target output for the network. The network was trained for 100 epochs, and this took approximately 200 hours of computation time. Some evidence was produced to show that the trained network was able to generalise by correctly classifying the pixels of images that were not used during the training process. The application of such a network was demonstrated in terms of automatically generating colour palettes that represent garments in an image. This work provides a route to accurately generate colour palettes that represent garments from a huge number of images, and this may be a useful tool in colour forecasting processes which are increasingly using large numbers of fashion-related images as inspiration.

**Pia Lopez-Izquierdo** *Universidad Politécnica de Madrid*

### Inhabiting the Art

The aim of this paper is to present a conceptual strategy related to the use of colour in architecture, and its practical application. When we speak about “Inhabiting the Art”, we talk about an approach that depicts the passage from the two-dimensionality of the canvas to what Le Corbusier called the “La promenade architecturale”, the experience of space in three dimensions over time.

This journey starts from a new concept of colour that the philosopher Gilles Deleuze (2007) describes as the “Pictorial Diagram”, which emerges on the way to abstraction in art. Theo Van Doesburg, one of the members of the neoplasticist movement, initiates this approach in architecture; from its first steps of the Café Aubette to the “Maison Particulière” models, he develops a true manifesto of “Inhabiting Art”. We create a reading tool to be able to “read the unwritten” and the multitude of factors that intervene in its decoding, which we named the Neoplasticist Tabulae. Ultimately we performed an intervention in the ceilings of the halls of the Universidad Politécnica de Madrid. Based on the painting “House in Gandansk” by the German expressionist Enrich Heckel from the Thyssen-Bornemisza collection, we carried out the intervention “The Expressionist Ceilings at the ETSEM”. Finally, we define the “Expressionist keyboards”, as a range of beautiful colors extracted from the world of art that can be used in any architectural project.



**Kanoko Makino** *Tokyo University of Science*

**Co-authors:** Haruno Tsuda, Yuki Oe, Kaoruko Kitamura, Nozomu Yosizawa

### **Intra-observer differences in the perceived colour of colorimetry using tablet devices**

To measure the perceived colour of architecture, it is preferable to use an easy-to-carry device. Therefore, in the previous research by Tsuda et al., a method for measuring the perceived colour using a tablet device was proposed. In that study, the inter-observer differences by the colour measurement method in architecture using a tablet device has been examined, whereas intra-observer differences were not confirmed. The purpose of this study is to conduct an experiment to verify the degree of intra-observer differences by letting one observer measure the perceived colour for the same conditions multiple times. We conducted the experiment under the same conditions of correlated colour temperature (CCT) for ambient lighting, display, and spotlighting, all of which had small inter-observer differences in the experiment of Tsuda et al. As a result, the intra-observer differences were smaller under the conditions at CCT of 6500K than those of 3000K. Thus, we concluded that the colour measurement method using the tablet device is suitable under daylight with a high colour temperature.

**Zachary Manning** *Amsterdam University of Applied Sciences*

**Co-authors:** Aljoscha Gleser, Miriam Loos, Robin Tepe, Irene Maldini

### **Emotional association of colours through participants' delineation of their present state of mind paired with specific color tones**

How would you visualise your present emotional state at this very moment? How would you describe that emotional state? How we're feeling in a moment can be very nuanced. Any individual may have layers of emotion. The intensity may vary. Our research sought to find a correlation of the emotional state of mind to singular colour representation. Fifty-seven individuals were surveyed to rate how energised or calm, pleasant or unpleasant they felt, and identify up to three emotions they were experiencing at the time of the survey. Lastly, they were asked to choose a single colour from a colour picker.



**Yukie Miura** *Tokyo University of Science*

**Co-authors:** Yuka Akuzawa, Tatsunori Suzuki, Yuki Oe

### **Psychological effects of white- and coloured-LED lighting for older people**

The purpose of this study is to clarify physiological and psychological stress of white and primary colour lights on older people. In this paper, firstly, we examined the psychological effects on the light colours with the older subjects. In the evaluation items relating the impressions of the lighting environment, the white lights have been significantly more positive evaluations than the red light. Secondly, we confirmed the evaluations among the lighting conditions for each age group using the results of our previous study. For the greater part of the evaluation items, the differences between light colours in the young were not found in the older subjects. One reason for this can be reduction in colour discrimination ability with ageing. Thirdly, the comparison of the evaluative tendencies between age groups showed that the evaluations of “eye strain” and “anxiety” for the red and the blue light on the older subjects have been more negative than on the younger subjects.

**Jimena Vanina Odetti** *Instituto Tecnológico Mario Molina Campus Puerto Vallarta*

**Co-authors:** Alberto Reyes Gonzalez, Andres Enrique Reyes Gonzalez, Fernando Daniel Valdez Olmos

### **The study of color in cities as a component of urban cultural constructions**

The study of the phenomenon of colour in the city is proposed as an element of experience and urban cultural construction. This work starts from the studies of urban colour. It is proposed a link between the methodologies of analysis of tangible colour with the studies of urban anthropology and urban imaginaries, to relate the objective and the subjective of colour in the city, from reality and the cultural construction of the protagonists of it. The approach to the study of colour in this article starts from the objective and the subjective and is related to the study of the colours of the city from the material and immaterial perspective. From here, the relationships between the subjective aspects of colour that come from images, experiences, or visual stimuli and the perceived material reality are considered. This materiality of objective colour becomes the starting point for the study of subjective colours as a product of the urban cultural construction of a city. The proposed methodology is developed from the generation of objective colour palettes, which include the analysis of the colours of the urban image, made up of the facades, the urban furniture, and the landscape context, as a particular setting for each city, to the study of the subjective chromatic perceptions, also expressed in palettes that reveal the urban cultural constructions developed by the inhabitants, visitors, migrants, etc. depending on the cultural dynamics of each city.



**Kazim Hilmi Or *Private Office of Ophthalmology***

**Medical, illumination, and geographic issues at circumpolar areas may cause changes in colour perception**

Polar T3 syndrome is a change in thyroid hormone T3 related to prolonged residence in polar circles. Polar T3 syndrome may also include colour vision perception changes. In some areas of the world colours green and blue are perceived in a similar way so the perception is called or expressed under the term “grue”. Grue is seen also in polar circle areas. There are also studies showing that there are clinically measurable colour perception differences in Norway when a comparison is made between the inhabitants living inside and outside the polar circle. Colour perception changes are experienced also in prolonged day and night times. At the pole areas of the world daylight is there for 6 months uninterrupted followed by a night of 6 months uninterrupted. Night vision changes colour perception. In addition, artificial illumination is needed for normal illumination and to overcome the biologic clock changes at the polar night. Night vision changes also have an effect on colour perception. On the other hand, there are no high incidences in depression found in Iceland as expected due to long night episodes. So, in the polar regions of the world medical, illumination, and geographic issues and changes may cause colour perception changes.

**Qianqian Pan *University of Leeds***

**Co-authors:** Stephen Westland, Farah Naz

**Towards the number of discernible skin colours**

A set of 1500 measurements of skin colour were obtained and used to estimate the gamut volume of skin colour. Three methods were used to estimate the number of discernible colours that were defined within the colour gamut. The grid method, sphere method and dodecahedra methods revealed estimates of 6547, 9258 and 9084-18748 colours respectively. The study concludes that there are approximately 10000 discernible skin colours. However, the work is very dependent upon whether the original data used were themselves representative of human skin colour. In addition, the work was carried out in CIELAB colour space which is not perceptually uniform.



**Ana Paula Pinheiro** *Lisbon School of Architecture*

**Co-author:** Rui Barreiros Duarte

### **Color, materiality, and authenticity: The Cathedral of Portalegre rehabilitation**

The goal of this article is to relate the colour and the materiality to the authenticity arising from the methods employed in the work. The restoration of the cathedral of Portalegre was done in such a way as to avoid further building degradation, to give the building an updated infrastructure, improve the space of worship, and restore the altarpieces and chapel paintings that embody a rich and unique historic heritage dating back to the sixteenth century. Both in the project plan and in the works, fundamental importance was given to materiality, the way light played off the colours, and the materials. The whole project and works respected the principles of cultural heritage. The key concepts employed were reversibility of the interventions, above all the use of whitewashing to cover up paintings, for economic reasons; versatility to allow future restoration work to reveal these paintings; simplicity, which is present in the whole philosophy of the project and the moderation of resources used; sustainability, from the way the program was conceived and implemented.

**Amirah Qashqari** *Queen's University Belfast*

### **The effect of colors and textures of interior materials on the thermal comfort of libraries in hot and humid climates**

To provide a comfortable place for readers and researchers and to attract visitors to the library, it must be taken into consideration with equal importance both the appropriate temperature to preserve the library's materials and people's thermal comfort. This study aims to develop thermal comfort in libraries by using the colours and textures of materials inside the library to improve thermal comfort, maintain the appropriate temperature to preserve books. This study also aims to understand the effect of colour on the visual and psychological perception of heat to enable the development of design approaches in response to these findings. The methodologies used in the research compare the materials used in global libraries in different regions, temperature measurements, and interviews with library users. The results showed that colours and materials are selected in libraries regardless of the climatic zone's thermal comfort requirements. The temperature of the library is too cold, it affects the comfort of users, while warm colours give the physical feeling of warmth.



**Nallely Rangel *Autonomous Metropolitan University Xochimilco***

**Reconstructing a history of color in Mexican women's fashion 1900-1910**

To reconstruct a history of women's clothing in Mexico from 1900 to 1910, based on the periodical publications of the time, a history of colors can be unraveled. Each historical context has framed specifications in color & design. For this investigation, we start from the last year of the 19th century, emphasizing in each garment their textile design, trends, silhouettes, cuts, materials, textures, and volumes. First, it starts from the raw material. In other words, the types of fibers used were mostly due to natural fibers. Secondly, the manual and industrial processes for the coloring of manufactured textile materials will be analysed. In the same way, the finishes and final details addressed. As a third section, the representation and distribution of women's clothing designs emphasize prices providing a color palette that reflects the preference of the female public, their social, economic, and cultural position. Therefore, it is possible to contribute to understanding the designs of a specific decade in Mexico, without omitting the influence it received from Europe. It seeks to provide a conceptual solution to can be use by clothing design students interested in looking at the history of color, through the looks and chromatic traces preserved in archives.

**Fateme Shakourirad *University of Tehran***

**Co-author:** Maryam Khalili

**Sensing colors through smart lighting based on multisensory experience of poetry**

As the hierarchy of living needs has increased, people are looking for products that not only meet their needs but also create positive experiences for them. In a multi-sensory design approach, the designer intentionally considers the role of every sensory modality. Intangible sources like poetry can also be a source of design inspiration. With the emergence of modern lifestyles, although there are still signs of poetry in people's lives, compared to the past, poetry has moved away from everyday life. A renaissance for old poetry is needed because these poems are full of human concepts that should not be forgotten. The aim of this study is to design a multisensory experience around Hafez's poetry and explore the role of sensing colored lights related to his poems that evoke positive emotions. The design thinking method includes the literature studies, holding generative sessions, making the product simulation, and testing it using the "prEmo" method. The results showed that the use of colored lights could significantly increase the expression of positive emotions in users. As a result, engaging the user's different senses in interacting with a product based on poetry can enrich the experience.



**Keyu Shi Zhejiang University**

**Co-author:** Ming Ronnier Luo

### **Colour matching experiments on LEDMax technology**

A visual colorimeter based on two spectral tunable LED systems was constructed to perform a colour matching experiment between two side-by-side semi-circular stimuli. The visual colorimeter was based upon 18 LED channels whose centre wavelengths ranged from 400 to 700 nm. A series of tests were conducted to evaluate the system performance on stability and consistency for both sides. Finally, colour matching experiments performed by normal vision observers were performed on this apparatus. Eleven different primary sets were selected as the primaries of the field of view to be matched, while the primaries of the reference field of view always remained the same. Five normal vision observers conducted a colour matching experiment. Each observer performed 11 colour matches for 5 times in the experiment. The results were used to reveal the inter- and intra- observer variations. In total, 55 colour matches were obtained. The collected data were analysed from matching error, inter- and intra-observer variation.

**Xinye Shi Zhejiang University**

### **CIECAM16 performance in high dynamic range based on a new corresponding color data set**

The purpose of this study is to produce a visual dataset under a wide range of luminance conditions. The results can be used to verify colour models such as CAM16-UCS, which is the latest colour appearance model based uniform colour space. It was developed using the colour patch samples under standard dynamic range conditions. A colour matching experiment under high dynamic range was conducted to obtain the corresponding colours between patches in an illumination box and a display. The results were used to verify the model. Six illuminance levels (15, 100, 1000, 3160, 10000, 32000 lx) and 13 test colour samples were used in the experiment. Ten observers were asked to adjust the colour patches on the display to match the colour patches in an illumination box. The results showed that the chroma and hue angle between the two fields are pretty similar in the CAM16-UCS a'b' plane. However, a clear trend was discerned in J'C' plane, for which the lightness (J') of real patches predicted by CAM16-UCS were invariant at different illuminance levels, while the J' values of visual results on display showed great difference between different illuminance levels.



**Neha Singh** *National Institute of Fashion Technology, New Delhi*

## Stories of Color Symbolism and its Significance in Indian Weddings

Traditional cultural practices in society have not faded away in the face of modernization; rather, they have been magnified, transitioned, and revived within the society's affluent strata. Weddings are one of the few rituals that people from all over the world share. A wedding is the most important event in a person's life in every society. Wedding ceremonies are events when two mostly unknown people come together (especially in India) to initiate a chapter in their lives.

Wedding traditions and customs differ greatly depending on culture, religion, and region. Even in a diverse country like India, where more than a billion people are united by around 1600 spoken languages and over 9 religions, spread across 28 culturally different states, there is this commonality, the unison of two souls known as marriage and the ceremony known as Wedding. The wedding ceremony is one of the most elaborate events in any Indian family, sometimes lasting several months or even days, making it the most memorable moment of one's life.

Religion is the most important tool for understanding a group's or society's way of life and cultural system, as well as an individual's global or universal perspective. Different cultures and religions assign different meanings to different colours. Certain colours that are significant in one religion may not have the same significance in another. Colour can be a powerful visual element that acts as a code, providing a deeper level of meaning to those who can decipher the signs.

This paper focuses on the significance of colours in Indian wedding ceremony rituals, depicting the variation of colour usage as we move across various regions of this vast country, and also provides insight into how the concept and significance of colours changes across religions and regions. Furthermore, the paper discusses how colours play an important role in various sub-ceremonies within a wedding ceremony.

**Pedro Felipe** *Pinho Souza UNICAMP*

## My own color system: An educational approach

The creation of a personal and particular colour system as a learning and self-knowledge tool is the main purpose of this text and the dissemination of this work of art in progress. Thinking of a colour system that will meet all industrial needs, cultural demands, utilitarian, symbolic or any other issues that may exist is utopian. This is not to say that organising and systematising colours is not an interesting and challenging



approach for anyone at any historical moment. By analysing the emergence of different colour systems throughout history, it was possible to perceive changes consistent with each moment and situation of the societies and individuals involved in the use of these systems. Today's society values buying and selling, a society that consumes colour systems mainly for industrial and commercial purposes. Seeking a counterpoint to the teaching of colour that tries to get rid of this premise, we propose a work of art that seeks to create its own system of colour, personal and particular, in order to create a new educational approach to the theme.

**Anna Stamm *Indiana University Bloomington***

### **Not so black & white: Colors in early cinema**

Cinema from the first half of the twentieth century is often thought to be in monochrome; this is false. As previous and current scholarship in early cinema has shown, a significant proportion of films were colored in some way (Gunning, 1989; Cherchi-Usai, 1996; Yumibe, 2012). This scholarship has been concerned with tracing the production of, audience reception to, and cultural motivators for filmic colours. What has been less addressed are the ways in which colour functions as a site of meaning in this early period of cinema. By analysing the production context and visual content in *Hell's Angels* (1931), this paper builds on past research to explore three functions of filmic colour in early cinema: indexical, narrative, and affective. Colours in films today take on similar functions, prompting further questions of our relationship to colours and their meaning.

**Aditya Tandra *National Taiwan University of Science and Technology***

**Co-authors:** Li-Chen Ou, Hsin-Yen Liao, Julianne Agatha Tan

### **The effect of bar soap color on customer perception based on expected functionalities**

Very few studies have been made regarding consumer perception towards actual product colour. In this research, bar soap was selected as the object of interest since it is seen as the most common cleaning agent in human lives. The main objective was finding associations between different colours of soaps and the expected functionality in curing specific skin concerns. Measurement of CIELAB colour parameters for twenty-one soaps was conducted inside a viewing cabinet before an online questionnaire was distributed. 121 observers participated and were asked their



views about the expected benefits of those soaps only by their colours - moisturising, anti-bacterial, nourishing, refreshing, or whitening. It was observed that specific hues, along with different levels of brightness and chroma gave different expectations regarding soap functionality, notably pale pastel colours for moisturising and nourishing skin, relatively dark colours for anti-bacterial, vivid blues to refresh skin and white for whitening effect. Unfortunately, inconsistency in viewing experience among observers whilst filling the questionnaire largely contributed to experimental errors in our study. Nevertheless, it is hoped that these findings may provide useful guidelines for related design practices.

**Terri Tomlinson** *Terri Tomlinson Makeup Training Academy*

### **Color theory and creating conversations about the color of us**

There is a decisive lack of framework and commonality when talking about the color of skin. The reason for this is because we have for too long used racial identity as a way to describe the color of us. People are not described by the actual color of their skin, they are described with words like “black” and “white”. Color Theory and the principles of color when expressed in neutral, give us an inclusive framework to discuss skin color without the bias of racial identity. When I created The Flesh Tone Color Wheel® I inadvertently made 2 powerful discoveries. The first was that all skin is neutralized color. We are simply brown. The second was that when teaching color theory in neutral, with The Flesh Tone Color Wheel®, I found a way to talk about the color of us without needing race identifying language.

**Teresa Uchman** *University of Silesia*

### **Colour-naming: Intercultural connotations and multisensory colour contexts based on the names of wall paints**

This paper attempts to present cultural similarities and differences in the metatextual elements – Dulux “let’s colour” and Dulux “VALENTINE” names of wall paints in three different languages. The main research questions concern the intercultural and intra-cultural associations in naming paint colours in different European cultures: Polish, English, and French. The paper examines qualitative analysis with a method of the linguistic image of the world in contrastive studies. The discussion is based on the names of hues appearing in basic colour categories: red, blue, green, and yellow. The research explored the colour naming systems and categorised them in eight subsystems. The subject of colour naming reveals cultural and sense



associations. The research proves some universal strategies in colour naming and highlights unique cultural aspects of creating terms.

**Eric Zeigler** *University of Toledo*

**Co-author:** Aaron M. Ellison

### **Color for all organisms: Landscapes outside the human visible spectrum**

A more nuanced and empathetic understanding of the lives and intrinsic values of nonhuman species may be achieved by learning how to see the world through their eyes. Humans already use technology to sense “colours” outside those we can perceive and use them in scientific and commercial applications. We propose to use images created with these technologies to “see” and understand the world from the standpoint of nonhuman organisms. By transforming spectral wavelengths perceived by nonhuman visual systems into coordinate systems that we can see, we can create images that help us enter into the nonhuman world and develop empathy and compassion for its myriad inhabitants. The differing tonal values, contrast ranges, and objects revealed in our images support more complex narratives about nonhuman organisms and their interactions with one another and their environments. Seeing the world through their eyes also opens a window for us to use to see them for themselves, not just as resources for us to exploit. Finally, we expect that a detailed analysis of the aesthetic properties of images representing wavelengths and colours outside of the human visible spectrum will lead us to an expanded colour theory and new directions in art and ecology.



# AIC Study Groups

WEDNESDAY JUNE 15 10:45 –12:00

## Study Group for Environmental Colour Design (SG ECD)

**Chair: Verena M. Schindler**

### The Future of Environmental Colour Design: The Conscious and the Unconscious

The theme of this ECD meeting, which will be held during the AIC 2022 “Sensing Colour” in Toronto, is the future of environmental colour design with a special focus on the conscious and the unconscious. Conscious environmental colour design is a mental process based on rational thoughts and colour concepts designed for interior spaces or exterior environments such as cities, villages, public and semi-public urban spaces, and architecture. Colour practice based on the conscious awareness of a site at a given time participates actively to the physical application of colour in a real-world context. The unconscious mind, however, reveals the emotional and atmospheric quality of a space. Unconscious colour impacts people’s perception and feelings, and evokes moods, atmospheres, ambiances, memories, and affective ties to a place. The transition between the conscious and the unconscious can be dichotomous or gradual. These kinds of explorations can lead to new theoretical and methodological approaches relevant to the future of environmental colour design.

#### **Presenters:**

1. **Verena M. Schindler**: Introduction
2. **Galyna McLellan** (Brisbane, Australia): The controversy of monochromatic architecture in multicultural subtropical contexts
3. **Fiona McLachlan** (Edinburgh, Scotland): Colour explorations: On becoming conscious
4. **Clino Trini Castelli** (Milan, Italy): Toronto RGB Interior
5. **Lynnette Postuma** (Toronto, Canada): A Living Canvas
6. **Changying Xiang, Barbara Szybinska Matusiak** (Trondheim, Norway): Colour preference study for façade-integrated photovoltaic design
7. **Kazim Hilmi Or** (Hamburg, Germany): Proposals for interior architectural colour design for ophthalmological low vision patients
8. **Pía López-Izquierdo Botín** (Madrid, Spain): Freud’s preconscious and conscious and the process of communicative and emotional colour skills
9. **Cath Carver** (London, United Kingdom): Colour As A Portal
10. **Ralf Weber** (Dresden, Germany): Unconscious and conscious colour in architectural design
11. **Q&A**



THURSDAY JUNE 16 08:30 – 9:45

## Study Group for Colour Education (SG CE)

**Chairs: Maggie Maggio & Robert Hirschler**

### Update: Joint ISCC/AIC Colour Literacy Project: Testing a Bottom-Up & Top-Down Approach to Colour Education

The Colour Literacy Project is an educational initiative of the Inter-Society Colour Council (ISCC) of the United States and the International Colour Association (AIC). Approved as a four-year joint project in January of 2020, the Colour Literacy Project is currently testing prototype resources for teaching 21st century colour at both elementary schools and universities.

- 8:30 Introduction: **Robert Hirschler**
- 8:40 Bottom Up: **Maggie Maggio** will report on the results of the first round of curriculum testing with the teachers at St. Teresa's Primary School in Manchester, England.
- 9:00 Top Down: **Luanne Stovall** will report on the new Colour Literacy Forum, an international platform to align university-level colour education with state-of-the art design curricula.
- 9:20 Bottom Up + Top Down: **Huang Qian** from Hunan University will report on the project titled: 'Research and practice of primary school space color optimization based on color literacy education, China.'

The presentation includes information on the current situation and development opportunities for colour literacy education involving the university students and children at Dongmaojie Primary School in Changsha City, China.



WEDNESDAY JUNE 15 16:15 – 17:00

**Chair: Verena M. Schindler**

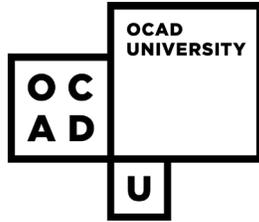
**Special Session: New Books on Colour Session B**

The special session on books includes short oral presentations on books on colour or related topics, published in the last three years (2022, 2021, 2020, last half of 2019).

Book Presenters:

1. **Cliño Trini Castelli:** No-Form 2020: 10 racconti oltre il design (2019)
2. **Fiona McLachlan:** Colour Beyond the Surface: Art in Architecture (2022)
3. **Paula Csillag:** Communication with Colors (2021)
4. **Kyoko Hidaka:** Color Categorization (2021)
5. **Eva Fay:** Shillito Design School: Australian Colour Education in the 70's (2021)

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L-R: Vien Cheung, Robin Kingsburgh, Ilene Sova, Doreen Balabanoff

