CREATE: Developing a European Exchange in the Application of Colour

by Carinna Parraman and Alessandro Rizzi

> Since colour is a sensation unrelated to anything else, it is essentially impossible to give a meaningful definition. (Nassau, 1998)
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> Colour perception is one of the fundamental ways by which we find out about the things around us. (Judd and Wyszecki, 1975)
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> Each newcomer to the mysteries of colour science must pass through a series of conceptual insights. (Mollon, 2003)
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> In our daily lives colour images surround us in print, television, computer displays, photographs and movies. Whilst these colour images are taken for granted by a majority of readers and viewers, their production engages an entire industry of scientists, engineers, and practitioners. (Sharma, 2003)
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> In visual perception a color is almost never seen as it really is – as it physically is. This fact makes color the most relative medium in art. (Albers, 1971)
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> Colour is uncontainable. It effortlessly reveals the limits of language and evades our best attempts to impose a rational order on it... To work with colour is to become acutely aware of the insufficiency of language and theory – which is both disturbing and pleasurable. (Batchelor, 2000)

These introductory quotations from scientists and artists reveals how colour is one the most far-ranging, engaging, enduring, yet problematic, of subjects to consider. How, for example, can we or do we identify, name, categorise, mix or print colour? Colour is not static; colour perception is affected by the environment, neighbouring colour, and the surface quality or texture of the coloured object. Therefore, because colour is ever changing, then our ability to create a standard, to define or categorise colour is likewise problematic. Though developments in science and technology in the last century have considerably contributed to an improvement in colour standards, we still have not attained accurate definitions in colour science and colour reproduction. A balance is required between the new contribution to knowledge, developments in technology and limits of knowledge: advancements in developing technology and knowledge need to keep apace.

In March 2000 a summit of the European Council of Heads of State and Government held in Lisbon highlighted the urgent need to address the brain drain from Europe. Economists explained that the EU countries were consistently underachieving and failed to match the growth rate of those in the US. The European Council set out a 10-year strategy to make the EU the world's most dynamic and competitive knowledge-based economy. This of course will take time to develop. It is hoped that we have moved away from C P Snow's 1959 definition of the arts and sciences as being 'two cultures', but one could also suggest that the two cultures remain disparate and some researchers are resistant to a possible dilution of knowledge. Competition for research funding has increased since then, causing research institutes to seek capital from other sources and to rethink strategies for their financial future, sustainability

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and growth. Likewise, a greater impetus has evolved for scientists, technologists and artists to develop a clearer understanding and dialogue about how colour is perceived and applied for the development of new ideas in art, design and technology.

In 2004, based on discussions relating to digital technologies and the changing situation in the field of colour in art and design and science, Carinna Parraman, senior research fellow in digital colour at the Centre for Fine Print Research (University of the West of England, UK) and Alessandro Rizzi, assistant professor in graphics imaging and colour research (Università degli Studi di Milano, Italy) began working on the development of a pan-European network in colour. The idea was to bring together European colour groups so that experts from the arts and sciences could exchange and disseminate knowledge through specialist conferences to be hosted in a range of participating countries.

The aim of CREATE (Colour Research for European Advanced Technology Employment) was to develop an international cross-disciplinary community within the areas of the arts, commerce, science and technology that could exchange both practical and theoretical knowledge. By comparing existing models the group could foster novel ideas, and by using the Internet could share these ideas with an audience of scientists and artists that reached beyond the core CREATE group.

In 2006, in collaboration with six other institutes, University of Pannonia (Hungary), Université de Reims Champagne-Ardenne (France), Universitat Autonoma de Barcelona (Spain), University of Leeds and University of Ulster (UK), and Gjøvik University College (Norway), the group CREATE was awarded funding of half a million euros from the European Union Framework 6 Marie Curie Conferences and Training Courses (SCF) to facilitate knowledge sharing amongst researchers, colour experts and industry. By 2010, the group will have undertaken their last event in Norway and therefore will be able to contribute to the Lisbon agenda.

The objective for the four year project was to coordinate a series of themed conferences and training courses that would bring together research communities to share, discuss, and teach, and that built on the particular expertise of each of the participating institutes. Rizzi and Parraman designed the courses to form a series of interrelated but differently themed events that tackled issues on colour. These courses were written to include both practical workshops and theoretical lectures and included invited keynote speakers, experts, practical courses and presentations of work in progress from researchers who are in the early stages of their careers. Ideas were presented through papers, poster presentations, workshops, publications and the CREATE website. The objectives of the training course were:

- To enable early-stage researchers to gain experience through practical and theoretical workshops
- To increase their breadth of knowledge through the introduction of alternative or complementary fields of research in areas such as archiving, industry, conservation and fine art
- To provide mentoring and expert advice for the career development of the researchers
- To develop collaborative research between researchers, SMEs and institutes
- To exchange and disseminate knowledge through interdisciplinary conferences
- To enable the members to not only develop links outside their own research centres but to create an international and cross-disciplinary dialogue
- To facilitate the dissemination of cutting-edge research to the artistic, commercial and industrial sector and improve economic growth through new collaboration and knowledge transfer

- To establish and improve cooperation in research and training between research institutes.
- To foster and develop a multidisciplinary group of top level expertise in the field of colour.

The event programme was initiated by the first three-day CREATE conference in Bristol on the 18 September 2007, and was coordinated by Carinna Parraman and Alison Davis of the Centre for Fine Print Research (CPFR), University of the West of England. More than 80 colour delegates from over 20 countries attended. It was hoped that the Bristol event would set the pace and format for the subsequent training events. There was such a clear enthusiasm, energy and motivation from the experts, committee members and delegates for the project to succeed, that these hopes have been realised, and places for subsequent events have been oversubscribed.

The theme of the first training course in France in February 2008, focused on human aspects of colour, and presented colour from a social, anthropological and psychological point of view. As well as lectures on human vision, colour in insects, colour in gastronomy, art, design, and education, the course enabled researchers to gain experience through a combination of practical and theoretical workshops. These workshops included multispectral imaging tools for painting analysis, the use of Matlab for computing perceived images (where texture meets colour), a multimedia Internet-based installation, and differences between colour mixing of pigments and what appears on screen. Fifty delegates attended from 17 different countries, and included a mixture of researchers who had attended the first conference, and some new to the CREATE network. This second event provided an opportunity to showcase new collaborative research projects between researchers who had met at the first event, and had been working independently on joint research projects since then. It is anticipated that more collaborations will continue to develop and increase in number, and demonstrate the opportunities that CREATE events provide to participants in developing links outside of their own research areas.

As we are about to embark on the second and third training courses, it is hoped that as the programme of events continue, the students will become the teachers, as in this field, everyone has the opportunity to learn from one another. The continuing vision for the events are to maintain the momentum beyond the time frame of the EU funding; that as researchers from different fields come together new opportunities will arise for new research projects.

With grateful acknowledgement to the Society of Dyers and Colourists, who are publishing a selection of the papers from the previous two events from Bristol and France, it is our pleasure to be editing this special issue of *Colour: Design & Design Creativity*.

The papers included in this mid-term special issue of CREATE demonstrates the real crosslinks between art and science: what is known by scientists and what is used by artists.

The intention of bringing together two different fields of research could be considered as so far flung that no meaningful results could be possibly achieved. However, as demonstrated in the following papers, the bringing together of these ‘two cultures’ is necessary for a deeper understanding of how image quality, colour management and colour reproduction can be improved from the perspective of a wider understanding of the arts and sciences. In this instance, scientists have taken their clues from paintings and drawings made by artists, where artists have sought to map their perception of colour and luminance through the use of materials such as paint and ink. Artists, when engaged in the process of making paintings and drawings, do not necessarily intend to reproduce nature exactly on canvas and paper, but present a representation of colour appearance and colour relationship. The clues provided by

many artists provide a better understanding of the relationship between what is real and what is perceived.

Majed Chambah presents the artist's issue of the subjective qualities of image quality. The quality of an image is difficult to quantify. Chambah sets about determining how image quality can be defined from the point of view of the scientist. Reiner Eschbach, from the point of view of colour management and colour reproduction, begins from the visual system and highlights areas that can and cannot be undertaken scientifically. Alessandro Rizzi, from his interest in the visual system, points out the limits and the functionalities of colour matching functions when applied in a visual context.

John McCann's paper bridges the art and science of colour. He analyses the the work of early photographers and the characteristics of some of the Old Master paintings, discussing ways to create a luminance that was pleasing to the eye. The art of painting can be seen as an intelligent way to introduce luminance and colour distribution in a way that is completely different to reality but is similar to our human vision remaps reality.

Carinna Parraman, from the point of view of an artist working in the field of colour management, presents how artists and scientists have investigated the optical properties of the juxtaposition of colour.

Alain Tremeau's paper deals with perception, but introduces the very interesting issue that human vision will take into account visual art.

Further details about CREATE can be found on the group's website at www.create.uwe.ac.uk.

Presentations from Previous CREATE Events

Event 1, Bristol, UK (2007)

Image Reproduction – An Oxymoron?, by Reiner Eschbach (Xerox Corporation, USA)

The Interaction of Art, Technology and Consumers in Picture Making, by John McCann (McCann Imaging, USA)

When computers look at art: Rigorous analysis of color, lighting and form in master paintings, by David G Stork (Ricoh Innovations and Stanford University, USA)

Models of Colour Vision for Image Processing, by Sabine Süsstrunk (Ecole Polytechnique Fédérale de Lausanne, Switzerland)

Perception of Colour and Image Quality of Films Projected in Cinema or Displayed on TV Screens, by Alain Trémeau (Laboratoire LIGIV Université Jean Monnet, France)

The Many Misspellings of Fuchsia, by Nathan Moroney (Hewlett Packard, USA)

Assessment of Image Difference and Image Quality, by Stephen Westland (School of Design, University of Leeds, UK)

Colour Rendering: Open Questions and Possible Solutions, by János Schanda (University of Veszprém, Hungary)

Reference-free Image Quality Evaluation for Photographs and Digital Film Restoration, by Majed Chambah (Université de Reims Champagne-Ardenne, France)

Light Stability of Colorants in Museum Collections: Are We Still in the Dark Ages?, by Joyce Townsend

The Biological Basis of Colour Preference, by Anya Hurlbert

Human Visual Perception and Spatial Models of Colour, by Alessandro Rizzi (Università Degli Studi Di Milano, Italy)

The Practical Realities and Daily Disappointments of Colour!, by Michael Crain and Angela Brown (Cranfield Colours Ltd, UK)

Colour in Flux, by Carinna Parraman (CFPR, University of Western England, UK)

Event 2, Charleville-Mézières, France (2008)

Responses of Retinal Ganglion Cells to Natural Images, by Norberto M Grzywacz (University of Southern California, USA) Keynote address.

Computing Perceived Images: When Texture Meets Colour, by Maria Vanrell (Universitat Autònoma de Barcelona, Spain)

Introduction to Colorimetry: The CIE System, by János Schanda (University of Pannonia, Hungary)

Colour in Image and Video Processing: Most Recent Trends and Future Research Directions, Alain Trémeau (Université de Saint-Etienne, France)

Open Problems in Perceptual Imaging: Searching: A Link Between Neuroscience Findings and Imaging, by Alessandro Rizzi (Università Degli Studi Di Milano, Italy)

Digital Art: Couleur Réseau, by Fred Forest (Université de Nice Sophia Antipolis, France)

The Relationship Between Design and Technology, by Stephen Westland (School of Design, University of Leeds, UK)

The Analysis of Colours in Artworks: Methodological Issues, by Georges Roque (Centre National de Recherche Scientifique, France)

Crafted and Digital Colour in Textiles and Fashion, by Trish Belford (School of Art and Design, Belfast)

Colour and Gastronomy, by Juan Valverde (Agro Paris Tech, France)

Art and Imaging: Multispectral Imaging Tools for Painting Analysis, by Philippe Colantoni (Centre de Recherche et de Restauration des Musées, France)

Mixing and Describing Colour, by Carinna Parraman (University of West England)

Body–Number–Colour: Light Phenomena of Eye-Ocean, Real Time 3D Computer Graphics Images, by Anne Sarah Le Meur (Pantheon-Sorbonne, France)

Da Vinci's Mona Lisa Analysis with Today's Technologies, by Christian Lahanier (Centre de Recherche et de Restauration des Musées, France)

Physical Colours in Insects: Origin, Role in Life and Art, by Serge Berthier (Institut des Nanosciences de Paris)

New Imaging Technologies, by Harry Oldfield (Oldfield Systems Ltd, UK)