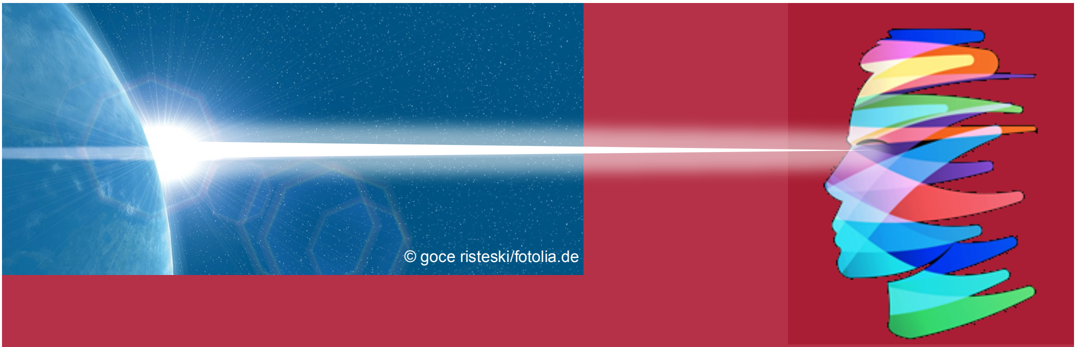

Colouring the Future - Summerschool

September, 22nd – 23rd 2016
University of Tuebingen

PROGRAM

EBERHARD KARLS UNIVERSITÄT TÜBINGEN

Medizinische Fakultät
Department für Augenheilkunde

Philosophische Fakultät
Institut für Medienwissenschaften

Funded by Zukunftskonzept Universität Tübingen

Hector Fellow Academy

Summerschool “Colouring the Future“

Program

22nd September

08.30 - 09.00		Registration
09.00 - 10.00		Welcome
Session 1:		**Colour perception and its neural foundations**
10.00 - 11.00	HS25	**KEYNOTE 1**: **Karl Gegenfurtner** **“Mechanisms of colour perception: From cones to cognition via constancy“**
11.00 - 11.30		Coffee break & Posters
11.30 - 12.00	HS23	**Andreas Bartels** “Colour in the Cortex“
12.00 - 12.30	HS23	**Bevil Conway** “How colour language reflects usefulness of colour“
12.30 - 13.30		Lunch break
13.30 - 14.00	HS22	**Stacey Aston** (Newcastle, UK) “The limits of human illumination discrimination ability“
14.00 - 14.30	HS22	**Christoph Witzel** (Gießen, Germany) “Colour constancy and the uncertainty of the sensory signal due to metamer mismatching“
14.30 - 15.00	HS22	**Discussion all participants**
15.00 - 15.30		Coffee break & Posters

Session 2:		**Biological significance of colour: Colour vision and communication in the animal kingdom**
15.30 - 16.00	HS24	**Thomas Euler** “Seeing with the eyes of mice“
16.00 - 16:30	HS24	**Kentaro Arikawa** “How do butterflies see flowers? Their eyes and colour vision“
16.30 - 17.00		Coffee break & Posters
17.00 - 18.00	HS25	**KEYNOTE 2**: **Almut Kelber** **“Colour vision in dim light“**
18.30 - 19.00	HS22	**Cynthia Tedore** (Lund, Sweden) “Using RGB displays to portray color realistic imagery to animal eyes”
19.00 - 19.30	HS22	**Peter Olsson** (Lund, Sweden) “Bird colour vision in different light environments and adaptive backgrounds”
19.30 - 20.00	HS 22	**Discussion all participants**

23rd September

Session 3:		**Colour preferences origins and models**
09.00 - 10.00	HS25	**KEYNOTE 3**: **Anna Franklin** **“Origins of colour preferences“**
10.00 - 10.30		Coffee break & Posters
10.30 - 11.30	HS23	**Robert Horres** “Traditional colours of Japan“
11.00 - 11.30	HS23	**Kazuhiko Yokosawa** “Ecological effects in cross-cultural differences on single colour preferences: The effect of symbolic/conceptual associations”
11.30 - 11.45		Coffee break & Posters

11.45 - 13.15	HS25	**KEYNOTE 4: Kirsten Thompson** **“Disney animation and the wonderful world of colour” and Karl-Miescher Film Award**
13.15 - 14.15		Lunch break
14.15 - 14.45	HS22	**Chris Racey, Chris Bird, Anna Franklin** (Sussex, UK) “The neural correlates of colour preference”
14.45 - 15.15	HS22	**Alice Skelton, Jenny Boston, Anna Franklin** (Sussex, UK) “The relationship of infants’ response to colour and colour preference”
15.15 - 15.45	HS22	**Discussion all participants**
15.45 - 16.00		Coffee break & Posters

Session 4: Display and effect of colour in art, film and animation

16.00 - 16.30	HS22	**Erwin Feyersinger** (Tübingen, Germany) “The use of colour in animated data visualizations”
16.30 - 17.00	HS22	**Andreas Karge** (Stuttgart, Germany) “Applying Open Film Tools - a Spectral Data Based Approach for a Movie Camera Colour Characterization”
17.00 - 17.15	HS22	**Discussion all participants**
17.15 - 17.30		Coffee break & Posters
17.30 - 18.30	HS 25	**KEYNOTE 5**: **Anya Hurlbert** **“The colour of paintings in a contemporary light“**
18.30 - 19.00	HS 25	**Hector Fellow Academy Speakers Award**
		Goodbye

Abstracts

Summerschool

The limits of human illumination discrimination ability

Stacey Aston
Institute of Neuroscience, Newcastle, UK

Anya Hurlbert
Institute of Neuroscience, Newcastle, UK

Abstract

Colour constancy is the phenomenon by which the human visual system keeps the colours of objects stable despite changes in the incident illumination. The definition of colour constancy implies that if an observer is able to perceive differences in a scene under two different illuminations, then the observer has not remained colour constant. Consequently, illumination discrimination thresholds provide a measure of colour constancy, with worse discrimination (or higher thresholds) implying better constancy and vice-versa. This method of probing colour constancy previously revealed that constancy is best for “bluer” daylight illumination changes, suggesting the human visual system has evolved to keep object colours stable under naturally changing illuminations. However, there is large variability in individual patterns of illumination discrimination thresholds. In this talk, data will be presented from a cohort of participants ($n = 39$) who completed the illumination discrimination task alongside several other colour perception tests (such as a chromatic contrast detection task) in our attempt to identify factors that mediate these individual differences and hence limit human illumination discrimination ability. These data reveal that illumination discrimination ability is limited by age with older participants producing higher thresholds (correlation between mean threshold and age: $r = 0.54$, $p < 0.001$). Moreover, the data show that chromatic contrast detection thresholds do not fully predict the results, supporting the use of the illumination discrimination task as a measure of colour constancy.

Acknowledgements: This work is supported by Wellcome Trust (102562/Z/13/Z) to SA and EU FP7 (HI-LED; 619912) to AH.

Color constancy and the uncertainty of the sensory signal due to metamer mismatching

Christoph Witzel

Allgemeine Psychologie, Justus-Liebig-Universität, Gießen.

Abstract

Color constancy is the ability to recognize the color of an object (or more generally of a surface) under different illuminations. Without color constancy, surface color as a perceptual attribute would not be meaningful in the visual environment, where illumination changes all the time. Nevertheless, it is not obvious how color constancy is possible in the light of metamer mismatching. Surfaces that produce exactly the same sensory color signal under one illumination (metamerism), may produce utterly different sensory signals under another illumination (metamer mismatching). Here we show that this phenomenon explains to a large extent the variation of color constancy across different colors. For this purpose, color constancy was measured for different colors in an asymmetric matching task with photorealistic images. Color constancy performance was strongly correlated to the size of metamer mismatch volumes, which describe the uncertainty of the sensory signal due to metamer mismatching for a given color. The higher the uncertainty of the sensory signal, the lower observers' color constancy. At the same time, sensory singularities, color categories, and cone ratios did not affect color constancy. The present findings do not only provide considerable insight into the determinants of color constancy, they also show that metamer mismatch volumes must be taken into account when investigating color as a perceptual property of objects and surfaces.

Acknowledgements:
This talk was supported by the grant "Cardinal Mechanisms of Perception" No SFB TRR 135 from the Deutsche Forschungsgemeinschaft and the empirical work was financed by ERC Advanced Grant "FEEL", number 323674.

Using RGB displays to portray color realistic imagery to animal eyes

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Sönke Johnsen
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Abstract

RGB displays effectively simulate millions of colors in the eyes of humans by modulating the relative amount of light emitted by three differently colored juxtaposed lights (red, green, and blue). The relationship between the ratio of red, green, and blue light and the perceptual experience of that light has been well defined by psychophysical experiments in humans, but is unknown in animals. The perceptual experience of an animal looking at an RGB display of imagery designed for humans is likely to poorly represent an animal's experience of the same stimulus in the real world. This is due, in part, to the fact that many animals have different numbers of photoreceptor classes than humans do, and that their photoreceptor classes have peak sensitivities centered over different parts of the ultraviolet and visible spectrum. However, it is sometimes possible to generate videos that accurately mimic natural stimuli in the eyes of another animal, even if that animal's sensitivity extends into the ultraviolet portion of the spectrum. How independently each RGB phosphor stimulates each of an animal's photoreceptor classes determines the range of colors that can be simulated for that animal. What is required to determine optimal color rendering for another animal is a device capable of measuring absolute or relative quanta of light across the portion of the spectrum visible to the animal (i.e. a spectrometer), and data on the spectral sensitivities of the animal's photoreceptor classes. In this paper, we outline how to use such equipment and information to generate video stimuli that mimic, as closely as possible, an animal's color perceptual experience of real-world objects.

Bird colour vision in different light environments and adaptive backgrounds

Peter Olsson
Lund University: Department of Biology, Lund, Sweden

Almut Kelber
Lund University: Department of Biology, Lund, Sweden

Abstract

Birds use colour to guide many biologically important behaviours, such as foraging and mate choice. Colour perception in birds is mediated by four different types of cone photoreceptors. Additionally, type of cone photoreceptor has a specific type of oil droplets that act as intracellular long pass spectral filters, narrowing the spectral sensitivity function of each cone type. These adaptations suggest that birds may have an amazing ability to discriminate colours in bright light and good colour constancy, the ability to maintain similar colour perception despite changes in the spectral content of the illumination. However, they also suggest birds may lose colour vision at much brighter light than e.g. humans. We have performed several behavioural experiments which show that, contrary to our expectations, chickens are not noticeably better than humans at discriminating similar colours, suggesting a relatively higher level of visual noise in birds that limits colour discrimination performance. The intensity threshold of colour discrimination is affected by the colour contrast between and brightness of the colours they are discriminating, and the lowest intensity threshold we have measured correspond to around bright moonlight levels. To maintain colour discrimination at these intensity levels, the visual system of chickens are likely using temporal and spatial summation mechanisms. Additionally, we find that chickens are indeed colour constant and they can remain colour constant in the light environments they are likely to experience in the wild.

Acknowledgements: Human Frontiers Science Program and the Swedish Research Council.

The neural correlates of colour preference

Chris Racey[1,2], Chris Bird[1] & Anna Franklin[1,2]
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Abstract

Colour preferences tend to vary considerably across individuals (Palmer, Schloss, & Sammartino, 2013). In spite of this, systematic patterns of colour preference have been observed at a group level, for example, on average bluish colours are liked and dark yellows are disliked (Hurlbert & Ling, 2007; Taylor & Franklin, 2013). There are several theories of colour preference: colour preferences have been summarised in terms of the cone-opponent mechanisms of colour vision (Hurlbert & Ling, 2007); related to colour-object associations and their valences (Palmer and Schloss, 2010); and linked to ease of colour naming (Álvaro, Moreira, Lillo, & Franklin, 2015). The present study uses functional Magnetic Resonance Imaging (fMRI) to investigate the neural correlates of colour preference and to shed further light on why some colours are preferred more than others. We use an event-related fMRI design to measure participants' BOLD response to a set of 29 colours from the Berkeley Colour Project (Palmer & Schloss, 2010) during both passive viewing of the colours and explicit rating of colour preference. In order to test specific hypotheses about the origin of colour preference, participants also complete tasks which localise the brain regions associated with: i) colour discrimination; ii) colour naming; iii) object perception; as well as all early retinotopic visual regions. Analyses correlate the BOLD response to each colour during passive viewing and explicit rating of colour preference with BOLD in the localised brain regions. A whole-brain analysis is also conducted. The regions of the brain where correlations are found are used to make inferences about the mechanisms underlying colour preference. The findings are also related to broader theory on the neural basis of aesthetics.

Acknowledgement:
This project is funded by a European Research Council Grant (project CATEGORIES, ref 203685) to AF.

The relationship of infants' response to colour and colour preference

Alice Skelton[1,2], Jenny Bosten[1] & Anna Franklin[1,2]

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Abstract

From birth, infants are able to discriminate between chromatic and achromatic stimuli (Adams & Courage, 1998) with colour vision developing greatly over the initial post-natal months (Brown & Lindsey, 2013). This results in infants having adult-like chromatic channels by at least 4 months of age, with chromatic discrimination continuing to develop post infancy (Knoblauch, Vital-Durand, & Barbur, 2001). Infants are also known to look longer at some colours than others, and some have proposed that infant looking times at different hues follow the same pattern as adult's aesthetic preferences for colour (e.g., Bornstein, 1975). Here, we consider this hypothesis and review studies of infant colour vision to determine whether there is converging evidence that infants do look longer at colours adults prefer. We find that the evidence is mixed, but we also present new data which does find a significant relationship between infant looking time and adult colour preference when hues are maximally saturated. We consider whether variation in infant looking times across hues reflects an aesthetic response in infants, or whether it simply reflects variation in visual salience. We also present a new study which aims to more fully characterise infants' response to colour by measuring infants' discrimination thresholds for different hues. The findings are discussed in relation to contemporary theories of the origin of colour preference, and in relation to the development of colour vision.

Acknowledgement:
This project is funded by a European Research Council Grant (project CATEGORIES, ref 203685) to AF.

The Use of Color in Animated Data Visualizations

Erwin Feyersinger

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Abstract

In this paper, I will discuss the use of color in combination with movement in animated data visualizations. Just as colors and shapes are often used redundantly in visualizations, colors can be combined with movements in a similar way. One of the shared functions of color and movement is to increase the salience of significant elements. A combination of changing colors and movement can make these elements even more conspicuous. A dot, for examples, that pops up by growing and shrinking draws more attention when its saturation changes in unison with the movement. However, movement and color can also have quite differing functions in visualizations, allowing for a variety of non-redundant combinations. I will show the wide range and complexity of these combinations by closely analyzing several well-known examples of dynamic visualizations.

Applying Open Film Tools - a Spectral Data Based Approach for a Movie Camera Colour Characterization

Andreas Karge

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Hochschule der Medien, Stuttgart

Abstract

The Open Film Tools of Stuttgart Media University are a toolset aimed for a spectral data based colour characterization in movie and TV productions. It considers the spectral characteristics of the three important components in a scene: the lighting, the objects and the camera. The toolset consists of three parts: a database of commonly used cine lighting, a low cost hardware design to estimate the spectral response of cameras, and a software for calculating standardized camera colour profiles using the spectral characteristics of the scene. These profiles can be applied to create a device independent colour representation from camera specific movie data. Open Film Tools is an open source toolset for cinematographers and camera technicians, which provides a standardized colour correction.