JANUARY VISION MEETING - THE COLOUR GROUP UK – WEDNESDAY 8 JANUARY 2020

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Maria Olkkonen & Toni Saarela

Object surfaces vary in terms different features, such as diffuse reflectance (color), and specular reflectance (gloss). These surface features or "cues" may be used by the visual system to discriminate and identify objects, but little is known about the mechanisms of cue integration in surface material perception. We used psychophysics and fMRI to study the integration of color and gloss cues for classifying fruit-like objects as unripe or ripe. We found that observers were behaviorally near-optimal in integrating color and gloss cues for ripeness estimates, and that large parts of the ventral visual cortex represented color and gloss jointly. Although neural integration was present broadly from early to late visual cortex, only later visual areas showed a robust relationship to behavioral integration.

Tushar Chauhan

Despite robust behavioural and psychophysical evidence, the question remains as to whether unique hues have a distinct and discernible neural signature. Here, we adopt a classification-based approach to address this problem using electroencephalographic (EEG) recordings. Through spatio-temporal decoding we show that EEG responses carry robust information about isoluminant unique hues within a 100-300 ms window from stimulus onset. This information is present during both passive viewing and in an active task in which colour is task-irrelevant but only for unique rather than non-unique hues. Our findings provide the first hard evidence demonstrating robust responses to perceptually opponent unique hues in the human brain.

Paul Martin :

The lecture will summarise evidence for distinct pathways in the retina and sub-cortical visual system that carry visual signals supporting blue-yellow and red-green axes of colour vision. These pathways emerge at the first level of visual processing in the retina, and are carried to the brain by multiple types of retinal output neurones (ganglion cells). At the first point of interaction with brain pathways, in the dorsal thalamus, there is anatomical and functional segregation of blue-yellow and red-green colour vision pathways. The consequences and evolutionary significance of this segregation will be discussed.

Rik M. Spieringhs: Time course of chromatic adaptation under dynamic lighting

"Chromatic adaptation is an extensively studied concept. However, less is known about the time course of chromatic adaptation under gradually-changing lighting. Two experiments were carried out to quantify the time course of chromatic adaptation under dynamic lighting. In the first experiment, a step change in lighting chromaticity was used. The time course of adaptation was well described by the Rinner and Gegenfurtner slow adaptation exponential model, and the adaptation state after saturation differed between observers. In the second experiment, chromatic adaptation was measured in response to two different speeds of lighting chromaticity transitions. An adjusted exponential model was able to fit the observed time course of adaptation for both lighting transition speeds. "

Fiona Rowe

Stroke can have serious detrimental effects on the visual system and cortical processing including eye movement disorders, visual field impairment, low vision and perceptual and cognitive difficulties. While many visual disabilities are easily recognised and diagnosed, other, more subtle, defects remain harder to diagnose with important implications. Research data will be presented aimed at exploring the visual consequences of stroke. Information will be provided as to the incidence and prevalence of visual impairment, the types of visual impairment that occur in relation to low vision, eye movement disorders, visual field loss and perceptual deficits and the impact of visual impairment. A brief review of visual rehabilitation options will be outlined along with issues relating to vision screening and access to eye care for this specific population.

Christoph Witzel

Different colour appearance spaces produce utterly different estimates of saturation and it remains an open question how to assess the perceptual dimension of saturation. Many empirical measurements of perceived saturation relied on the observers' concepts of saturation. However, it is quite a task to explain to a colour-innocent layperson what saturation is supposed to be. In one study, we observed that ratings of saturation fundamentally changed due to small modifications of instructions, highlighting the elusiveness of the observers' concept of saturation. One way to measure perceived saturation independent of concepts is to assess the number of discriminable steps away from grey in terms of discrimination thresholds. This approach reveals fundamental differences in saturation across hue. Yet, this approach seems not to be equivalent with subjective saturation, i.e. the subjective appearance of saturation. We measured subjective saturation through a matching procedure that does not rely on a concept of saturation. Although this approach captures differences of subjective saturation across hue rather well, it systematically underestimates the magnitude of those differences. A model that estimates signal and measurement noise is needed. Other dimensions of subjective appearance, such as lightness and gloss, might appear to be comparatively harmless because observers' seem to naturally understand what perceptual dimension the experimenter refers to. Yet, the considerations about subjective saturation also apply to other problems of subjective appearance within and beyond colour.

Alejandro Parraga

Computer Vision is a fast-paced branch of Computer Engineering focused on solving practical problems. For the most part it has only superficially relied on vision sciences to do so. Here we show some examples where a deeper knowledge of colour visual perception can improve over existing computational solutions and models in the hope of deepening the relationship between these two disciplines.

Christine Fernandez-Maloigne

The notion of appearance grows in importance since the last decade (colour appearance model, material appearance…). In the same time, one of the first notion in image processing come back at the top of the challenge in Vision and image analysis: the notion of texture or non-uniformity. If the definition of texture was straightforward for grey-level image analysis, the extension to the colour is more complex inducing to consider the spatial and colour variations in a joint probability.

In the *s-CIECAM* model, the texture is considered as spectral power density but in a marginal approach in *CIEXYZ*, where the XYZ channels are not orthogonal inducing bias. In an opposite way, cooccurrences are close from the Julesz formulation for a human discrimination of texture but the extension in colour domain is not straightforward and efficient. All these approaches are showing the necessity of vector adaptation in right colour spaces, taking care about the inter-channels orthogonality. We will show how to develop texture/features in a vector way in the frequency domain and in the spatial domain. These topic address also the question of the adapted gratings to assess fully the human ability to characterize colour textures, and some new notion as the naturalness aspect.

Christopher Tyler and Joshua Solomon

One model of human colour processing attributes the appearance of extended colour fields to a process of filling-in from colour edges, where one colour transitions to another. Some form of colour filling-in must underlie the colour induction percept known as the Watercolour Effect, but this effect is too weak to account for the vivid appearance of extended colour fields in natural images. Observation of natural images reduced to their pure colour edges, or their colour edges combined with the pure luminance information, leads to the conclusion that colour filling-in makes only a minimal contribution to the appearance of extended colour regions in natural images.

Conversely, viewing purely chromatic images with maximally graded ('edgeless') transitions in stabilized vision by means of afterimages show that coloured afterimages look fully colourful even as they fade. Further explorations of the colour gamut in afterimages show that their colour gamut does not match the colour gamut for direct viewing unless nonlinear luminance transformations are taken into account. Doing so to equate the perceptual linearity of the direct percept and the complementary colour afterimage suggests that human colour perception is best characterized by six, rather than the standard four, unique hues.