COLOUR ASSESSMENT LIMITS IN HEALTH AND EMPLOYMENT

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John L Barbur

Centre for Applied Vision Research
School of Health Sciences
City, University of London
London, UK.
avot@city.ac.uk
https://researchcentres.city.ac.uk/applied-vision/avot

BRIEF ABSTRACT

Colour conveys useful information about the spectral composition of the light and the reflectance properties of objects. It is only one of many attributes of vision that enable us to process and interpret complex information in the visual world, effortlessly and almost instantaneously.

Colour signals yield significant advantages in many visual tasks and in some occupations, the normal processing and correct interpretation of colour signals is also safety-critical. Subjects with congenital colour deficiency and those with diseases of the eye or systemic diseases such as diabetes exhibit either anomalous or even complete absence of red/green and / or yellow/blue colour vision. The accurate assessment of colour vision is therefore important, both in occupations as well as in the clinic, when high sensitivity and specificity are essential requirements.

The visual system makes use of several signals to construct the best representation of the visual world, based on the spatiotemporal and chromatic properties of the retinal image. The complex algorithms involved produce a faithful representation of the visual world with rare exceptions, when ambiguities result in visual illusions.

Because of the multiple signals involved in the representation of any coloured object, conventional colour assessment tests fail to isolate uniquely either red/green or yellow/blue colour signals, and also do not eliminate all the cues an applicant can use to carry out the task. Detailed analysis of current colour assessment protocols used in visually demanding and safety critical occupations reveals large variability, compromised safety and highlights the often inconsistent and unjust outcomes.

A new approach to colour assessment that overcomes these problems will be described. In addition, experiments designed to reveal the limits of red/green and yellow/blue colour discrimination one can achieve in human vision will be presented.

JOHN BARBUR BSc, ARCS, MSc, DIC, PhD
City, University of London

BRIEF TRACK RECORD

John Barbur is Professor of Optics & Visual Science and Director of the Applied Vision Research Laboratory at City, University London. He combines fundamental vision science with applied and clinical research, which underpins a long record of research achievement and wider impact. Work on camouflage for the Royal Signals and Radar Establishment led to insights into the processing of luminance and colour signals that have important applications in colour vision assessment. New research instrumentation and measurement techniques have

led to new methods for investigating mesopic vision, instrumentation for pupillometry, eye movements, visual search, spatial and chromatic vision, and also understanding the effects of scattered light in the eye. John's P_SCAN system makes binocular measurements of pupil size and eye movements, and has been used throughout the world for two decades. New components of the pupil response that link directly to alertness and attention and require the processing of specific stimulus attributes such as colour or motion in central areas of the visual cortex have been discovered with the P_SCAN system.

As a Fulbright Scholar, John worked as a Visiting Professor at the Center for Visual Science at the University of Rochester, N.Y. This work led to studies of mesopic vision supported by DTI (scales for the mesopic range), the EU (Mesopic Optimization of Visual Efficiency) and the DfT (medical aspects of fitness to drive). This was followed by EPSRC grants on "*Minimizing Glare in Lighting Installations*" and "*Mesopic Optimization of Residential Street Lighting*"

Work with the UK Civil Aviation Authority and the Federal Aviation Administration (USA) led to new pass/fail colour limits for aviation, which are used internationally. As a result, 35% of all applicants with congenital colour deficiency are now classed as safe to fly. The new Colour Assessment and Diagnosis (CAD), the rod/cone sensitivity, the Acuity-*Plus* and other Advanced Vision and Optometric Tests (AVOT) have found applications within ophthalmology and visually demanding occupations, with over 200 current users worldwide. In 2005, the significant award to Barbur and colleagues for laboratory refurbishment from the Wellcome Trust & the University established the Henry Wellcome Laboratories for Vision Sciences at City University of University, which is now internationally recognized as a leading centre in colour vision research.