

Book review

***Color Vision: Perspectives from Different Disciplines*, Edited by W.G.K. Backhaus, R. Kliegl and J.S. Werner, Walter de Gruyter, Berlin, New York, 1998. xi + 342 pp.; Hardcover US\$89.95, paperback \$49.95**

This useful book is based on an international and interdisciplinary symposium that took place at the Einstein Forum in Potsdam, Germany, in 1996. Its 18 chapters by a total of 30 authors are grouped in four sections. Its first section on Colour Vision in Art and Science consists of a single chapter by John Werner who, using Claude Monet's paintings as an anchor, takes the reader on a richly illustrated and colourful guided tour on the use of colour by impressionist painters, the history of colour science and the fundamentals of human colour perception, including the changes that occur with ageing. The next section, Physiology and Neuroethology, begins with a chapter by Werner Backhaus on flow diagram accounts of the human and the honeybee colour vision mechanisms. The remarkable issue is that, although the species are phyletically and structurally so different, the two species display several convergences at the processing mechanism level. This is so despite the fact that bees, by being ultraviolet-sensitive and red-blind, have a spectral sensitivity range that is shifted overall, relative to that of humans. However, the author has packed a lot of information into a short chapter, and readers need to gather all their wits to follow his partly intricate text. Barry Lee's succinct and excellent chapter explains well the functioning of the retinal circuitry of the macaque monkey by which the Young-Helmholtz trichromacy that characterises

their receptive processes is re-mapped into the Hering opponency that typifies their perceptual processing. Jan Kremers and co-authors deal rather technically with the question of whether and how rods contribute to colour coding in geniculate neuron of marmosets, and what role they may play in human dichromats. Marmosets are characterised by a sex-linked genetic dimorphism whereby all males are dichromats but females can be either dichromats or trichromats. But, as if that situation were not complex enough, this is further complicated by a superposed allelic polymorphism. Maureen and Jay Neitz suitably follow up with a more general chapter on the moleculo-genetic bases of colour vision and its variations in humans. Among other things, they consider the situation that some females seem to be genetically provided with four different cone photopigments (the two X chromosomes giving rise to two different long-wave absorbing pigments) but still are trichromats rather than tetrachromats. Presumably the follow-up neural circuitry does not keep apart the input from the two types of long-wave receptive cones. In humans the possibilities of a neurophysiological analysis of colour vision are very limited indeed. Walter Paul and colleagues demonstrate what can be done and discuss what may be possible with the transcranial evoked potential method. A negative polarity component with a 87 ms latency seems to best reflect the chromatic composition of visual stimuli over the primary visual V1 cortex. A component with a 160 ms latency may be reflecting the colour processing in the V4 cortical area. Petra Stoerig reports the interesting fact that certain brain damaged patients may lack a con-

scious perception of colour but may nevertheless be capable of behavioural detection and discrimination of chromatic stimuli. However, their competencies therein appear to lack certain qualities that conscious colour seers command. For those interested in the evolution of consciousness, would the colour behaviour of macaques correspond to the performance of humans who only respond to colour rather than those who are also colour-conscious? In her nice chapter Christa Neumeyer makes it amply clear that the colour vision of humans, about which we are so impressed, is a rather unsophisticated affair. Goldfish are decidedly tetrachromatic, turtles in all probability too, although they have to do with only three cone pigments. Like reptiles and birds, they have coloured cone oil-droplets that act as low-pass light-frequency filters that cleverly provide an extra colour mechanism. The colour vision of birds is unfortunately not treated: it may be even fancier by being perhaps pentachromatic (Varela et al., 1993). With birds, the issue has acquired a kind of practical interest because, in much perceptual-cognitive work with pigeons, the question arises whether what they see on trichromatic slide and monitor pictures bears much relation to the way they see the real objects that these are purported to represent (Cuthill and Bennett, 1993). Colour vision is, or better colour visions are the product of genetic mutations and natural selection. Peter Kevan and Werner Backhaus consider ecological demands as the sources of selection and plausibly sketch the probable evolutionary history of colour vision.

The third section deals with the Philosophy and Psychology of colour vision. Vicki Volbrecht and Reinhold Kliegl deal with the sensation of blackness in a wide-ranging review that, while informative in some respects, harks back a bit too often to the pseudo-riddle of the visibility of nothingness. Clyde Hardin briefly reviews colour names and colour classes and stresses their essential independence from linguistic cultures. The reviewers were left wondering whether colour naming may be more closely related to the statistics of the narrow band colour neurone of the V4 cortex than the properties of broad band colour neuron of the primary visual cortex. Rainer Mausfeld's

rather difficult chapter deals with how the colour of objects and the colour of illumination are largely compensatorily perceived. He argues that the trick resides in the fact that the cues for the colouration of either are separately processed by the visual system. Michael Zamura treats the effect that the perceived colour contrast of a stimulus patch is influenced by the colour contrast of its neighbourhood and accommodates his findings within a more comprehensive flow diagram model of vision. Hans Irtel briefly and straightforwardly examines how binocular brightness differences are integrated into one percept. Kenneth Knoblauch provides a review as well as a summary of his own research on infant colour vision and concludes that at 4 weeks of age the mechanisms of trichromacy are fully established. A section on Colour Metrics and Applications follows. Horst Scheibner's chapter is a rather technical description of the colour space of human deuteranops but which, comfortably, does not spring any surprises on the reader. Janos Schanda describes the continuing efforts of the Commission Internationale de l'Éclairage to improve the standards of human colorimetry. Perhaps they should also proceed to produce a standardised algorithmic-causal model of human colour vision. If such existed, the reading of a book like the present one could be simpler. Klaus Richter describes a sophisticated and universal computer program package for the production of colour graphics useful for research and illustration. It was apparently used to produce many of the figures that adorn the present book.

Indeed, the fact that this fund of informative and colourful illustrations can help one much with the teaching of a colour vision course is one reason for recommending this well produced and not too pricey book. It is of course the case, as nearly always with symposia volumes, that its chapters are of varying didactic quality and demand varying levels of previous expertise. But because it makes an effort to present a really wide-ranging cross-section of current research and theory, it is an unusually thought-provoking and thus worthwhile book on colour vision.

References

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