DALTONIANA

- number 92 - June, 1999

The bulletin of the International Colour Vision Society

Edited by Stephen Dain

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Daltoniana on the web

Welcome to the fourth edition of the web based **Daltoniana**. This edition will be transmitted by email and mailed to members from locations in North America, Europe and Australasia.

Contents

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General Secretary's report

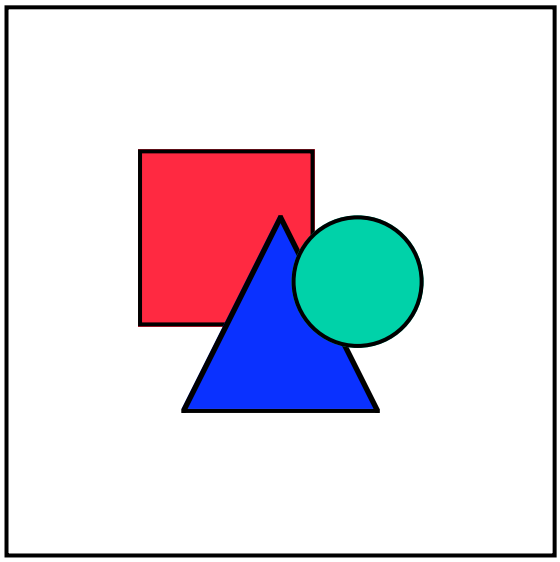
I am pleased to inform you that the proceedings of the Gottingen meeting will be published as a supplemental issue of Color Research & Application. The guest editors will be C. R. Cavonius, Barry

Lee, Joel Pokorny and myself.

The organizers of the meeting have received about 100 abstracts, which bodes well for the health of the society. I think with our name change we are reaching a greater number of color vision scientists. The publication in CR&A should help in the same direction. Like the Vision Research proceedings, however, this will not represent a permanent venue. Publishing in journals is 'cher' and we need to consider whether we can find a permanent form or not for our forum.

This will be our 15th meeting but the second under the banner of our new name. We should probably consider renaming our proceedings as well since 'Colour Vision Deficiencies' suggests a more limited subject matter than is included within. A simple suggestion is Proceedings of the ICVS, but if you have a more succinct and pithy title, I would like to hear your suggestions.

Next Symposium



See previous Daltoniana for full details of venue

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Programme

The Proceedings of the International Colour Vision Society

will be published as a Supplement in Color Research & Application

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Manuscripts should be written in English and submitted at the meeting or to one of the Proceedings Editors by August 16, 1999. There is no assurance that manuscripts received after this date will appear in the Proceedings.

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1. King VM, Armstrong DM, Apps R, Trott JR. Numerical aspects of pontine, lateral reticular, and inferior olivary projections to two paravermal cortical zones of the cat cerebellum. J Comp Neurol 1998;390:537-551.

2. Voet D, Voet JG. Biochemistry. New York: John Wiley & Sons; 1990. 1223 p.

3. Gilmor ML, Rouse ST, Heilman CJ, Nash NR, Levey AI. Receptor fusion proteins and analysis. In: Ariano MA, editor. Receptor localization. New York: Wiley-Liss; 1988. p 75-90.

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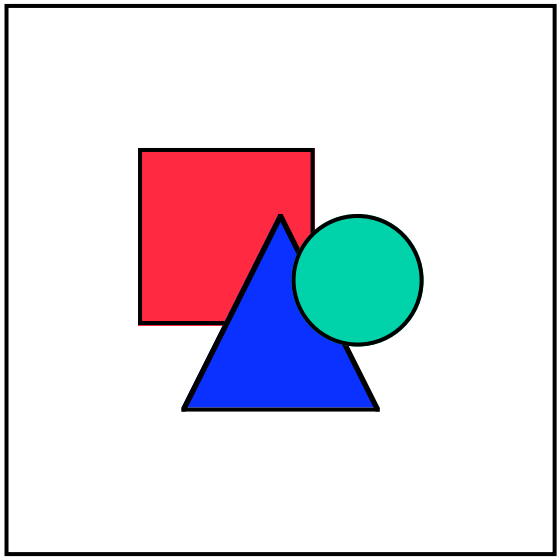
Looking forward to seeing you in Göttingen,

Yours sincerely,



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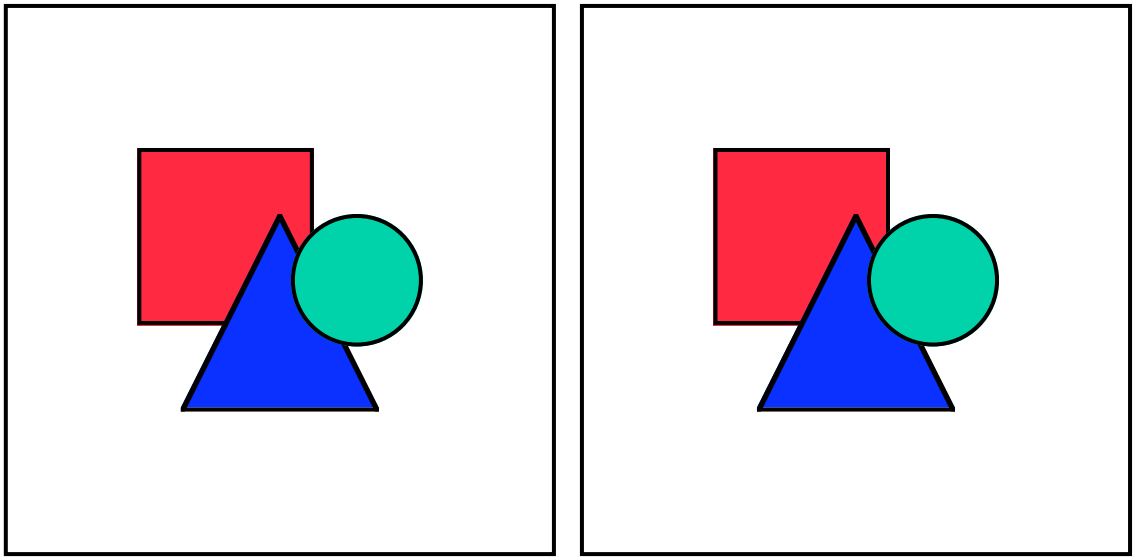

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The mailed version of the February 1999 Daltoniana has a list of members attached. This was not been made accessible from the web to minimise the possibility of inappropriate use. It is available to committee members only as a password protected file.
Please send email addresses for inclusion in the Membership List to any of

General Secretary Ken Knoblauch

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Daltoniana Editor	Stephen Dain

You could also include a personal website, if you have one, and we could start a list of those.

Abstracts of colour vision papers. Compiled by Joel Pokorny

MOLECULAR GENETICS

Hayashi, T., A. G. Motulsky and S.S. Deeb (1999). "Position of a 'green-red' hybrid gene in the visual pigment array determines colour-vision phenotype." Nat Genet 22:90-93.

The X-linked red- and green-pigment genes are arranged in a head-to-tail tandem array. The colour-vision defect of deuteranomaly (in 5% of males of European descent) is associated with a 5'-green-red-3' visual- pigment hybrid gene,which may also exist in males with normal colour vision. To explain why males with a normal red, a normal green and a green-red hybrid gene may have either normal or deutan colour vision,we hypothesized that only the first two genes are expressed and deuteranomaly results only if the green-red hybrid gene occupies the second position and is expressed preferentially over normal green- pigment genes occupying more distal positions. We used long-range PCR amplification and studied 10 deutan males (8 deuteranomalous and 2 deuteranopic) with 3 visual pigment genes (red, green and green-red hybrid) to investigate whether position of the hybrid gene in the array determined gene expression. The green-red hybrid gene was always at the second position (and the first position was always occupied by the red gene). Conversely, in two men with red, green and green-red hybrid genes and normal colour vision, the hybrid gene occupied the third position.When pigment gene mRNA expression was assessed in post-mortem retinae of three men with the red, green and green-red genotype, the green-red hybrid gene was expressed only when located in the second position. We conclude that the green-red hybrid gene will only cause deutan defects when it occupies the second position of the pigment gene array.

Jacobs, G. H., J. C. Fenwick, J. B. Calderone, and S. S. Deeb (1999)."Human cone pigment expressed in transgenic mice yields altered vision." JNeurosci 19: 3258-3265.

Genetically driven alterations in the complement of retinal photopigments are fundamental steps in the evolution of vision. We sought to determine how a newly added photopigment might impact vision by studying a transgenic mouse that expresses a human cone photopigment. Electroretinogram (ERG) measurements indicate that the added pigment works well, significantly changing spectral sensitivity without deleteriously affecting the operation of the native cone pigments. Visual capacities of the transgenic mice were established in behavioral tests. The new pigment was found to provide a significant expansion of the spectral range over which mice can perceive light, thus underlining the immediate utility of acquiring a new photopigment. The transgenic mouse also has the receptor basis for a novel color vision capacity, but tests show that potential was not realized. This failure likely reflects limitations in the organizational arrangement of the mouse retina.

Winick, J. D., M. L. Blundell, B. L. Galke, A. A. Salam, S. M. Leal, and M.Karayiorgou (1999). "Homozygosity Mapping of the Achromatopsia Locus in the Pingelapese." Am J Hum Genet 64: 1679-1685.

Achromatopsia, or total color blindness (also referred to as "rod monochromacy"), is a severe retinal disorder characterized clinically by an inability to distinguish colors, impaired visual acuity in daylight,photophobia, and nystagmus. Inherited as an autosomal recessive trait, achromatopsia is rare in the general population (1:20,000-1:50,000). Among the Pingelapese people of the Eastern Caroline Islands, however, the disorder occurs at an extremely high frequency, as recounted in Oliver Sacks's popular book The Island of the Colorblind: 4%-10% of this island population have the disorder and approximately 30%carry the gene. This extraordinary enrichment of the disease allele most likely resulted from a sharp reduction in population in the late 18th century, in the aftermath of a typhoon and subsequent geographic and cultural isolation. To obtain insights into the genetic basis of

achromatopsia, as well as into the genetic history of this region of Micronesia, a genome wide search for linkage was performed in three Pingelapese kindreds with achromatopsia. A two-step search was used with a DNA pooling strategy,followed by genotyping of individual family members. Genetic markers that displayed a shift toward homozygosity in the affected DNA pool were used to genotype individual members of the kindreds, and an achromatopsia locus was identified on 8q21-q22. A maximal multipoint LOD score of 9.5 was observed with marker D8S1707. Homozygosity was seen for three adjacent markers (D8S275, D8S1119, and D8S1707), whereas recombination was observed with the flanking markers D8S1757 and D8S270, defining the outer boundaries of the disease-gene locus that spans a distance of 6.5cM.

ANATOMY AND PHYSIOLOGY

Roorda, A. and D. R. Williams(1999). "The arrangement of the three cone classes in the living human eye." Nature 397: 520-522.

Human colour vision depends on three classes of receptor, the short- (S),medium- (M), and long- (L) wavelength-sensitive cones. These cone classes are interleaved in a single mosaic so that, at each point in the retina,only a single class of cone samples the retinal image. As a consequence, observers with normal trichromatic colour vision are necessarily colour blind on a local spatial scale. The limits this places on vision depend on the relative numbers and arrangement of cones. Although the topography of human S cones is known, the human L- and M-cone sub mosaics have resisted analysis. Adaptive optics, a technique used to overcome blur in ground-based telescopes, can also overcome blur in the eye, allowing the sharpest images ever taken of the living retina. Here we combine adaptive optics and retinal densitometry to obtain what are, to our knowledge, the first images of the arrangement of S, M and L cones in the living human eye. The proportion of L to M cones is strikingly different in two male subjects, each of whom has normal colour vision. The mosaics of both subjects have large patches in which either M or L cones are missing. This arrangement reduces the eye's ability to recover colour variations of high spatial frequency in the environment but may improve the recovery of luminance variations of high spatial frequency.

Chao, L. L. and A. Martin (1999). "Cortical regions associated with perceiving, naming, and knowing about colors." J Cogn Neurosci 11:25-35.

Positron emission tomography (PET) was used to investigate whether retrieving information about a specific object attribute requires reactivation of brain areas that mediate perception of that attribute. During separate PET scans, subjects passively viewed colored and equiluminant gray-scale Mondrians, named colored and achromatic objects,named the color of colored objects, and generated color names associated with achromatic objects. Color perception was associated with activations in the lingual and fusiform gyri of the occipital lobes, consistent with previous neuroimaging and human lesion studies. Retrieving information about object color (generating color names for achromatic objects relative to naming achromatic objects)activated the left inferior temporal, left frontal, and left posterior parietal cortices, replicating previous findings from this laboratory. When subjects generated color names for achromatic objects relative to the low-level baseline of viewing gray-scale Mondrians, additional activations in the left fusiform/lateral occipital region were detected. However, these activations were lateral to the occipital regions associated with color perception and identical to occipital regions activated when subjects simply named achromatic objects relative to the same low-level baseline. This suggests that the occipital activations associated with retrieving color information were due to the perception of object form rather than to the top-down influence of brain areas that mediate color perception. Taken together, these results indicate that retrieving previously acquired information about an object's typical color does not require reactivation of brain regions that subserve color perception.

PSYCHOPHYSICS

Kraft, J. M. and J. S. Werner(1999). "Aging and the saturation of colors. 1. Colorimetric purity discrimination." J Opt Soc Am A 16: 223-230.

Colorimetric purity (Pc) discrimination functions were measured for 21 color-normal observers (11 younger and 10 older observers with mean ages of 30 and 74 years,respectively). On each two-alternative-forced- choice trial, observers saw two flashes of light, a broadband white light [CIE(x, y) = (0.33, 0.35)]and a mixture of broadband and monochromatic light (420-680 nm). The observer's task was to choose the flash that had a chromatic component. Foveally viewed, circular, 1.2 degrees-diameter stimuli were presented as 1.5-s flashes with 3-s inter stimulus intervals in Maxwellian view. Stimuli [250 trolands (td) and 10 td] were equated on the basis of individual heterochromatic flicker photometry functions. Measured Pc discrimination sensitivity was lower in the older group than in the younger group at both light levels, and the performance difference between the age groups was approximately constant across the spectrum. The difference between discrimination at 10 and 250 td was relatively small for the younger group but larger for the older group, indicating a selective performance decrement for older observers at low light levels.The data were modelled as a sum of differential responses from S-cone and L/M- cone chromatic channels. The model and the data indicate similar age- related losses of sensitivity in the two channels, perhaps secondary to receptorial sensitivity losses.

Kraft, J. M. and J. S. Werner (1999). "Aging and the saturation of colors.2. Scaling of color appearance." J Opt Soc Am A 16: 231-235.

Saturation of two sets of stimuli was scaled by 21 color-normal observers (ten younger and 11 older observers, mean ages: 30 and 73 years).Circular fields,1.2 degrees in diameter, were presented in Maxwellian view as 1.5-s flashes with 3-s inter stimulus intervals. Stimuli were mixtures of broadband light[CIE(x, y) = (0.35, 0.39), 200 trolands (td)] and monochromatic light(420-700 nm, 50 td). Monochromatic lights were equated by the 1978 2 degrees fundamental observer's luminosity function in one set of stimuli [J. J. Vos, Color Res. Appl. 3, 125 (1978)and by each observer's heterochromatic flicker photometry function in the other set of stimuli. Comparing the two age groups reveals no sizable differences in saturation for either set of stimuli, neither supporting nor refuting neural compensation forage- related increases in ocular media density (OMD). Examining short-wavelength saturation as a continuous function of estimated OMD reveals a more complicated pattern of results,however, suggesting substantial compensation over a certain range of OMD values but incomplete compensation for observers with the highest OMD values.

CLINICAL STUDIES AND TESTING

Birch, J. and S. J. Dain (1999)."Performance of red-green color deficient subjects on the Farnsworth Lantern (FALANT)." Aviat Space Environ Med 70: 62-67.

BACKGROUND: The Farnsworth Lantern (Falant) is an occupational color vision test intended to identify people with significant red-green color deficiency who are unable to name aviation, marine or railway signal lights correctly. The colors shown are white, green and red selected to be within protan and deutan isochromatic zones.HYPOTHESIS: The Falant grades the severity of color deficiency and identifies subjects with different types of deficiency. METHOD: 270 color deficiency subjects(diagnosed with the Neitz anomaloscope) were examined. A subset of 108 subjects also completed the Farnsworth D15 and the Farnsworth-Munsell 100 hue test. RESULTS: All dichromats and 75% of anomalous trichromats failed the Falant. The mean error score of dichromats was greater than that anomalous trichromats, but errors were made in a similar number of qualitative color naming categories. The range of Falant error scores was continuous with no debarkation between the criteria

for pass and fail. It was not possible to identify anomalous trichromats likely to pass the Falant from the size of the anomaloscope matching range or from the results of Farnsworth-Munsell tests. CONCLUSIONS: People with severe red-green color deficiency fail the Falant, but neither the type nor the severity of color deficiency can be determined either from the qualitative results or from the error score.

TOXICITIES

Erb, C., T. Nicaeus, M. Adler, J.Isensee, E. Zrenner, and H.J. Thiel (1999). "Colour vision disturbances in chronic smokers" Graefes Arch Clin Exp Ophthalmol 237: 377-380.

PURPOSE: The aim of the present study was to test the influence of smoking on colour perception. SUBJECTS AND METHODS: At the University Eye Hospital Tubingen, 76 generally healthy smokers with inconspicuous ophthalmological findings (visual acuity, refraction, intraocular pressure, morphology) were examined by the cap-sorting test, Roth 28- hue desaturated. Group 1 was comprised of smokers (n = 20; M 9, F 11; mean age 28.1+/-10.3 years) with a smoking consumption of less than one packet of cigarettes per day(8.4+/-5.3 cigarettes/day) for 9.1+/-8.3 years. Group 2 consisted of smokers (n = 32; M 22, F 10; mean age 28.6+/-9.7 years) with a smoking consumption of one or more than one packet per day (30+/-8.4 cigarettes/ day) for 9.5+/-8.3 years. Generally healthy and ophthalmologically normal non-smokers served as a control group (n = 76; M 41, F 35; mean age 30+/-9 years).RESULTS: The average error score of the control group was (median +/- mean absolute deviation) 42+/-18. Group 1 showed no difference to the control group (51+/-27; P = 0.42). On the other hand, group 2 had a significantly higher error score than the control group (102+/-45; P0.0001). CONCLUSION: Otherwise healthy smokers with a cigarette consumption of less than 20 cigarettes per day do not show any disturbances in colour vision. Smokers who consume more than 20 cigarettes per day may suffer colour vision defects as a result.