DALTONIANA

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The bulletin of the International Colour Vision Society

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Daltoniana on the web

Welcome to the 11th 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.

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Message from the General Secretary - 05/02/02

The inter-meeting years for our society always seem to pose a problem. There is less interest in the society and there seems, perhaps, to be less activity of interest going on. There is more going on than meets the eye, however. For example, there is considerable activity related to the editing

of the next proceedings. These will be published by Oxford University Press and we expect to be able to submit the final versions of all accepted manuscripts to the publisher soon. Also, the next meeting is being organized by Steve Buck and Semir Deeb for 2003 in Seattle. We expect to have a preliminary announcement concerning this meeting in the next edition of the newsletter. The Verriest Committee, chaired by Barry Lee this term, goes into action about a year and a half before the bi-annual meeting in order to give sufficient time to receive and consider all nominations. A preliminary announcement for calls for nominations for the Verriest Medal can be found in this newsletter. Finally and most importantly, we have traditionally had a problem collecting dues in off-meeting years. The solution proposed by our Treasurer Ted Sharpe resolved this problem last time by offering a discount for investing in a two year membership. We continue this policy. Note the membership information in this issue and do re-join for the next two years.

There is a disturbing trend in evidence lately. As a group our interests cut a large swathe through science, ranging over physics, physiology, psychology and anthropology. Thus, we traditionally participate in meetings and organizations of great diversity, covering optics, imaging, ophthalmology, psychology and neuroscience, to name a few. Our society is the home in which we can find all of these things related to our primary interest, color, but we are constantly infused with new life blood from the ideas and findings obtained through interaction with other fields. Only within our own organization are we not minority members of other groups. This is equally true of our brethren more generally interested in vision and visual perception. Thus, it is with some sadness and much alarm that I see the vision community's contribution to two large organizations, OSA and ARVO, withering away. There is a long history of vision in both organizations, where vision even though a minority member, played an important role and vision research was, as well, richly nourished from the cutting-edge advances in related physical and medical fields. For both groups, a large satellite meeting has emerged that instead of complementing the main meeting has simply sucked away its members. I think that we all recognize that there are too many meetings, and that even within a single meeting, one can only absorb so much data, listen to just so many talks, read just so many posters. So it is understandable when given the options of one meeting with all of one's colleagues and friends at a pleasant and nostalgic site versus an enormous congress within which most people don't care about your field, what the most probable choice will be. I would urge you all to fight against the attrition of participation in ARVO and OSA and to convince your colleagues of the same. The danger in the long run is of isolation. Vision research risks becoming a community talking only to itself. To put the issue in perspective, consider what a color vision meeting would be if we were to cut links to molecular genetics, to physiology and anatomy of the retina and to models of retinal pathology. It is typically a losing battle convincing someone to forego short-term pleasures for long-term gains which is why I implore you to consider the intellectual consequences for your science. Consider, as well, the consequences for the breadth of training of your students.

Next Symposium

Friday, July 11, through Tuesday July 15, 2003. The venue will the beautiful University of Washington campus in the heart of Seattle.

Verriest Medal, 2003

We are inviting nominations for the award of the Verriest Medal for 2003.
The Verriest Medal is bestowed by the International Colour Vision Society (ICVS) to honour long-term contributions to the knowledge of colour vision. The Medal was established in 1991 in memory of Dr. Guy Verriest, and is presented at the ICVS biannual Symposia. Previous recipients have been Harry Sperling (1991), Marrion Marré (1993), Vivianne Smith and Joel Pokorny (1995), Jack Moreland (1997), John Krauskopf (1999) and Donald MacLeod (2001). Candidates need not have been active in the affairs of the ICVS but they must be either current or former ICVS (or IRGCVD) members. Candidates previously proposed for the award will be twice renominated in the next award cycle.
Submitted materials should include a letter of nomination and, if possible, the candidates's curriculum vitae. Please take the time to consider and to nominate a worthy candidate for this honour.
Address to whom nominations should be submitted before September 30th 2002:
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Membership

We will shortly be requesting membership dues for 2002 and 2003. The most important change is that payment will now only be in **Euros**. As before we are collecting for two years: Regular/new members are required to pay 100 € (students/retired 25 €), by the **15th of July 2002** and **120** Euros **thereafter.** Membership request forms will be posted to those who were members for 2000/2001.
It is of utmost importance that we encourage especially younger researchers in the field of colour vision to participate in our society. At the moment, less than 8% of our members are students. As a special incentive, student members from now on will also automatically receive a copy of the Conference Proceedings. We ask all members to inform their students and other interested colleagues about the International Colour Vision Society. We hope that membership forms will soon be available as downloads from out web-page. In the meantime, information about ICVS membership can be obtained from Anne Kurtenbach (e-mail: anne.kurtenbach@uni-tuebinge.de)

The International Colour Vision Society
MEMBERSHIP 2002/2003

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Website news

The good news is that the Macintosh G4 is proving 100% stable. The bad news is that we have had to wait until 14th May for the software to run multiple home pages so that you still need to use http://orlab.optom.unsw.edu.au/icvs without the trailing /. I have also just changed over from Adobe Pagemill to Macromedia Dreamweaver for website authoring. I will be learning and practising by redesigning the ICVS page.

Stephen Dain

Abstracts of color vision papers. Compiled by Joel Pokorny

WELL-KNOWN AND NEWLY DISCOVERED PHOTORECEPTOR SYSTEMS

Masland, R. H. (2001). "The fundamental plan of the retina." Nature Neuroscience 4: 877-886.
The retina, like many other central nervous system structures, contains a huge diversity of neuronal types. Mammalian retinas contain approximately 55 distinct cell types, each with a different function. The census of cell types is nearing completion, as the development of quantitative methods makes it possible to be reasonably confident that few additional types exist. Although much remains to be learned, the fundamental structural principles are now becoming clear. They give a bottom-up view of the strategies used in the retina's processing of visual information and suggest new questions for physiological experiments and modeling.

Hattar, S., H. W. Liao, M. Takao, et al. (2002). "Melanopsin-containing retinal ganglion cells: architecture, projections, and intrinsic photosensitivity." Science 295: 1065-1070.
The primary circadian pacemaker, in the suprachiasmatic nucleus (SCN) of the mammalian brain, is photoentrained by light signals from the eyes through the retinohypothalamic tract. Retinal rod and cone cells are not required for photoentrainment. Recent evidence suggests that the entraining photoreceptors are retinal ganglion cells (RGCs) that project to the SCN. The visual pigment for this photoreceptor may be melanopsin, an opsin-like protein whose coding messenger RNA is found in a subset of mammalian RGCs. By cloning rat melanopsin and generating specific antibodies, we show that melanopsin is present in cell bodies, dendrites, and proximal axonal segments of a subset of rat RGCs. In mice heterozygous for tau-lacZ targeted to the melanopsin gene locus, beta-galactosidase-positive RGC axons projected to the SCN and other brain nuclei involved in circadian photoentrainment or the pupillary light reflex. Rat RGCs that exhibited intrinsic photosensitivity invariably expressed melanopsin. Hence, melanopsin is most likely the visual pigment of phototransducing RGCs that set the circadian clock and initiate other non-image-forming visual functions.

Berson, D. M., F. A. Dunn and M. Takao (2002). "Phototransduction by retinal ganglion cells that set the circadian clock." Science 295: 1070-1073.
Light synchronizes mammalian circadian rhythms with environmental time by modulating retinal input to the circadian pacemaker-the suprachiasmatic nucleus (SCN) of the hypothalamus. Such photic entrainment requires neither rods nor cones, the only known retinal photoreceptors. Here, we show that retinal ganglion cells innervating the SCN are intrinsically photosensitive. Unlike other ganglion cells, they depolarized in response to light even when all synaptic input from rods and cones was blocked. The sensitivity, spectral tuning, and slow kinetics of this light response matched those of the photic entrainment mechanism, suggesting that these ganglion cells may be the primary photoreceptors for this system.

RODS AND CONES

Bloomfield, S. A. and R. F. Dacheux (2001). "Rod vision: pathways and processing in the mammalian retina." Progress in Retinal and Eye Research **20**: 351-384.
Bipolar cells in the mammalian retina are postsynaptic to either rod or cone photoreceptors, thereby segregating their respective signals into parallel vertical streams. In contrast to the cone pathways, only one type of rod bipolar cell exists, apparently limiting the routes available for the propagation of rod signals. However, due to numerous interactions between the rod and cone

circuitry, there is now strong evidence for the existence of up to three different pathways for the transmission of scotopic visual information. Here we survey work over the last decade or so that have defined the structure and function of the interneurons subserving the rod pathways in the mammalian retina. We have focused on: (1) the synaptic ultrastructure of the interneurons; (2) their light-evoked physiologies; (3) localization of specific transmitter receptor subtypes; (4) plasticity of gap junctions related to changes in adaptational state; and (5) the functional implications of the existence of multiple rod pathways. Special emphasis has been placed on defining the circuits underlying the different response components of the AII amacrine cell, a central element in the transmission of scotopic signals.

Sun, H., J. Pokorny and V. C. Smith (2001). "Rod-cone interaction assessed in inferred postreceptoral pathways." Journal of Vision 1(http://journalofvision.org/1/1/5, DOI 10.1167/1.1.5): 42-54.
Interactions between receptor-isolating rod and long (L)- or middle (M)-wavelength-sensitive cone modulations at 2 Hz and 10 Hz were analyzed in terms of underlying inferred magnocellular (MC) and parvocellular (PC) postreceptoral pathways. Stimuli originated from a colorimeter with 4 primaries in both the center and surround fields. The first experiment employed a phase paradigm in which the thresholds for mixed rod and cone modulations were measured as a function of relative phase. The amplitudes of the rod and cone modulations, equated in threshold units, were varied in tandem. In the second experiment, thresholds for mixed rod and cone modulations were measured as a function of the ratio of the rod and cone modulation amplitudes for 2 fixed phase offsets. Both experiments yielded similar interpretations of rod and L- (or M-) cone interactions. At 1 and 10 troland (td), rod and L- (or M-) cone interactions varied depending on the postreceptoral pathways underlying the detection. When cone thresholds were mediated by the inferred MC pathway, rod and cone thresholds showed almost linear summation. When cone thresholds were mediated by the inferred PC pathway, rod and cone thresholds showed probability summation. Assuming that signals within the same pathway follow linear summation, and signals traveling in different pathways follow probability summation, we concluded that the rod thresholds were mediated by the inferred MC pathway for both the 2-Hz and 10-Hz conditions.

Shapiro, A. G. (2002). "Cone-specific mediation of rod sensitivity in trichromatic observers." Investigative Ophthalmology and Visual Science 43: 898-905.
PURPOSE: The slope of the rod threshold versus the illuminance (TVI) function changes with the wavelength of the background light. This study was conducted to determine whether the changes in slope are due to the stimulation of specific cone classes. METHODS: An eight-channel optical system was used to generate lights that differed in cone and rod photoreceptor illuminance. Rod flicker TVI functions were measured in normal trichromatic observers at mesopic light levels. The independent variables were (1) the relative contribution of the short (S)- and long (L)- wavelength cones to the background light (i.e., the background lights varied along S-only and L-only lines), and (2) the temporal frequency of the flickering lights (4, 7.5, and 15 Hz). RESULTS: The 4-Hz rod flicker TVI function had a slope of 0.87 when measured near W (MacLeod-Boynton chromaticity of 0.66, 1.0). At 4 and 7.5 Hz, an increase in the relative L-cone illuminance steepened the slope of the rod-only TVI curve, but an increase in the relative S-cone illuminance had no effect. The slope of the 7.5-Hz TVI function decreased at higher illuminance levels. At 15 Hz, the thresholds could be measured over only a limited range.

CONCLUSIONS: The L-cone system contributes to the desensitization of the rod system at mesopic light levels, whereas, in the range of lights used in these experiments, the S-cone system apparently does not. The possibility that S-cone stimulation desensitizes the response to rod signals at higher levels of S-cone illumination cannot be eliminated.

TIME AND MOTION STUDIES

Beaudot, W. H. and K. T. Mullen (2001). "Processing time of contour integration: the role of colour, contrast, and curvature." Perception 30: 833-853.

We investigated the temporal properties of the red - green, blue- yellow, and luminance mechanisms in a contour-integration task which required the linking of orientation across space to detect a 'path'. Reaction times were obtained for simple detection of the stimulus regardless of the presence of a path, and for path detection measured by a yes/no procedure with path and no-path stimuli randomly presented. Additional processing times for contour integration were calculated as the difference between reaction times for simple stimulus detection and path detection, and were measured as a function of stimulus contrast for straight and curved paths. We found that processing time shows effects not apparent in choice reaction-time measurements. (i) Processing time for curved paths is longer than for straight paths. (ii) For straight paths, the achromatic mechanism is faster than the two chromatic ones, with no difference between the red-green and blue- yellow mechanisms. For curved paths there is no difference in processing time between mechanisms. (iii) The extra processing time required to detect curved compared to straight paths is longest for the achromatic mechanism, and similar for the red - green and blue-yellow mechanisms. (iv) Detection of the absence of a path requires at least 50 ms of additional time independently of chromaticity, contrast, and path curvature. The significance of these differences and similarities between postreceptoral mechanisms is discussed.

Jimenez, J. R., J. M. Medina, D. Jimenez, et al. (2002). "Binocular summation of chromatic changes as measured by visual reaction time." Perception and Psychophysics 64: 140-147.

We determined visual reaction times to monocular and binocular changes in the luminance of isochromatic stimuli and to monocular and binocular changes in the color of isoluminant stimuli. Two isoluminant color changes were tested: chromatic variations along the red-green axis of Boynton's (1986) two-stage color vision model and chromatic variations along the yellow-blue axis of the same model. The results indicate a greater degree of binocular summation for luminance change than for color change. This result was largely independent of the motor component of reaction time.

Thiele, A., K. R. Dobkins and T. D. Albright (2001). "Neural correlates of chromatic motion perception." Neuron 32: 351-358.

A variety of psychophysical and neurophysiological studies suggest that chromatic motion perception in the primate brain may be performed outside the classical motion processing pathway. We addressed this provocative proposal directly by assessing the sensitivity of neurons in motion area MT to moving colored stimuli while simultaneously determining perceptual sensitivity in nonhuman primate observers. The results of these studies demonstrate a strong correspondence between neuronal and perceptual measures. Our findings testify that area MT is indeed a principal component of the neuronal substrate for color-based motion processing.

COLOR TESTING

McKendrick, A. M., G. A. Cioffi and C. A. Johnson (2002). "Short-wavelength sensitivity deficits in patients with migraine." Archives of Ophthalmology 120: 154-161.
OBJECTIVE: To examine short-wavelength sensitivity in patients with migraine using short-wavelength automated perimetry (SWAP) and Stiles 2- color increment threshold procedures. METHODS: Twenty-five subjects with migraine with (n = 11) and without (n = 14) aura and 20 age- matched headache-free subjects underwent testing. All subjects underwent standard automated perimetry (SAP) and SWAP (using a Humphrey field analyzer; 24-2 presentation pattern). In 2 migraine patients (one with and another without aura), the 2-color increment threshold procedure was used to determine whether sensitivity losses were specific to short-wavelength sensitivity pathways or a generalized loss to multiple pathways. RESULTS: No statistically significant differences between migraine patients and controls were found for mean deviation (MD) or pattern-standard deviation (PSD) for SAP. However, for SWAP, MD and PSD were worse for the migraine group (P =.04). Twelve migraine patients had more than 4 locations with sensitivity worse than the 5% probability level (reference value). Increment threshold determinations in the 2 selected migraine patients indicated a selectively greater loss for short-wavelength sensitivity mechanisms. CONCLUSIONS: Approximately 50% of subjects with migraine (with or without aura) demonstrate SWAP sensitivity losses, at times between migraine events. These findings, in conjunction with previous results for SAP and flicker perimetry, suggest that migraine patients should be excluded from normative databases of visual function, and warrant further investigations of the relationship between migraine and glaucoma.

Poon, W. K., G. L. Ong, L. G. Ripley, et al. (2001). "Chromatic contrast thresholds as a prognostic test for visual improvement after macular hole surgery: color vision and macular hole surgery outcome." Retina 21: 619-266.
PURPOSE: To evaluate the relationship between preoperative chromatic contrast thresholds, postoperative visual acuities (VA), and visual improvement after macular hole surgery. METHODS: A consecutive series of patients with Stage II to IV macular holes was studied before macular hole surgery. Preoperative chromatic contrast thresholds, VA, and reading acuity were analyzed in relation to the postoperative visual function. The chromatic contrast thresholds were measured using a computerized cathode ray tube-based system along red-green and tritan confusion axes. RESULTS: Preoperative and postoperative chromatic contrast thresholds were elevated significantly in affected eyes (P 0.001). Preoperative VA showed a strong correlation with postoperative VA (r = 0.66, P 0.001) but a weak correlation with visual improvement (r = -0.33, P = 0.03). Red-green contrast threshold correlated strongly with both the distance visual improvement (r = -0.77, P 0.001) and reading visual improvement (r = -0.61, P 0.001). Tritan contrast threshold, however, showed a slightly weaker correlation (distance: r = -0.63, P 0.001; reading: r = -0.47, P 0.005). CONCLUSIONS: These results suggest that chromatic contrast thresholds, especially the red- green contrast threshold, represent a better prognostic guide for visual improvement after macular hole surgery than VA measurement.

Lang, A. and G. W. Good (2001). "Color discrimination in heterozygous deutan carriers." Optometry and Visual Science 78: 584-588.
PURPOSE: The color discrimination abilities of heterozygous deutan female carriers were measured using color mixture thresholds and compared with those of suspected nonheterozygous normal subjects. METHODS: Eight test subjects and 26 control subjects were run on a computer-controlled color test (color mixture thresholds) that presented 1 degree diameter spots

on a color television monitor for 1/60 of a second. A QUEST procedure was used to determine visual thresholds for spots varying in brightness and/or color. Individual data points were graphed on an X/Y plot and fitted with an ellipse. The major and minor diameters of the ellipse represent the color and brightness thresholds, respectively. RESULTS: The mean axis angle of the ellipse for the heterozygous carriers did not differ from that for the controls (15.75 degrees vs. 14.93 degrees, $p = 0.428$, Mann-Whitney test). The carriers did show, however, a larger mean major axis length (68.79 vs. 46.78, $p = 0.0218$, Mann-Whitney test). Additionally, the length-to-width ratios for the carriers were higher than the controls (9.34 vs. 6.80, $p = 0.0403$, Mann-Whitney test). CONCLUSIONS: Deutan- carriers do show reduced color purity discrimination as measured using color mixture thresholds compared with nonheterozygous, color vision normals.