DALTONIANA

NEWSLETTER
OF THE INTERNATIONAL RESEARCH GROUP ON COLOUR VISION DEFICIENCIES

April 1993 No 78

IRGCVD News

Revised membership fees

Membership fees have been held constant since 1990 despite continuously rising costs. Unfortunately, the modest reserves of the IRGCVD are now being eroded and the need to revise the fees has become unavoidable.

The new full membership fee is now UK£40 (US$65). The Associate membership (Student/Post-Doctoral/Retired) fee remains unchanged at UK£10 (US$15).

The full-membership fee includes the cost of the Symposium Proceedings and the negotiation of a bulk purchase with the publishers gives individual members a very substantial discount. For example, the Sydney Symposium Proceedings volume was obtained for members at 64% of the retail price.

Elections: Nominations for President and for General Secretary.

The terms of office for the President (A Roth) and the General Secretary (J D Moreland) will end in June, 1993 (all other members of the Directorial Committee will remain in post until 1995). Nominations for the posts of President and of General Secretary for the term 1993-1997 may be returned using the form appended to this issue. Both Prof Roth and Prof Moreland are eligible for re-election but members are advised that Prof Moreland is due to retire (at least, officially!) at Keele University in 1995.

Tübingen Symposium News

A provisional programme of 52 papers and 39 posters has been compiled for the symposium and three papers are scheduled for the workshop.

There are three invited lectures: The Construction of Colour by the Cerebral Cortex (S Zeki), Current and Future Applications of Chromatic Adaptation in Clinical Populations (J Pokorny) and Electrophysiology and Psychophysics of the Blue Cone (E Zrenner). Contributed papers will include the following topics: Molecular Genetics of Colour Vision (Motulsky), Blue Cone Morphology and Colour Specific Retinal Connections (Anhnelt), The Effects of Sub-Cortical and Cortical Damage on Volour Vision (Kullkowski) and Blue Cone Bipolar Cells of the Macaque Retina (Marshak).

Literature Survey

Impoverished stimulus input does not simulate the slowed visual kinetics of retinal damage. J R ISON, G P BOWEN and M DEL CERRO. Invest Ophthalmol Vis Sci, 1992, 33, 3114-3120.

In the rat with normal sight, the acoustic startle reflex to a sound burst is suppressed when the sound is preceded by a brief light pulse. This effect of light in the rat with retinal damage is reduced and peak suppression is seen at a greater delay. Both observations are expected consequences of the loss of visual sensitivity that should accompany photoreceptor loss. However, in an early stage of retinal damage, the peak of the suppressive effect is so delayed that at long lead times the light flash

is a more effective stimulus in the rat with the damaged retina than in the normal rat. Two experiments tested the hypothesis that this crossing over of the two groups is a secondary consequence of a nonspecific loss of visual sensitivity in the visually impaired rat. If the hypothesis is correct, reductions in the intensity or duration of the light flash and the degree of dark adaptation should model the effect in normal rats. The overall amount of reflex suppression was diminished with these manipulations, but none diminished the temporal development of reflex suppression to a degree sufficient to produce the paradoxical cross-over effect characteristic of retinal damage. These data indicate that decrements in the speed of visual processing are not secondary to the changes in sensitivity that accompany retinal damage, but should be viewed as a separate and independent form of visual impairment.

Mid-frequency loss of foveal flicker sensitivity in early stages of age-related maculopathy. M J MAYER, S J SPIEGLER, B WARD, A GLUCS and C B Y KIM. Invest Ophthalmol Vis Sci, 1992, 33, 3136-3142.

Temporal contrast sensitivity in eyes at risk for exudative age-related maculopathy (ARM) was compared to that in age-matched healthy older eyes. The test stimulus was a foveally viewed, flickering, long-wavelength 2.8° diameter circle in an equiluminant (photopic) surround. Retinal illuminance and decision criterion differences were experimentally controlled. Eyes in the healthy and ARM-risk groups had 20/30 or better Snellen acuity and intraocular pressure of less than 22 mmHg. Nevertheless, the ARM-risk patients were less sensitive to flicker contrast, especially for mid-temporal frequencies. This suggests that flicker sensitivity may be useful in identifying patients at risk for exudative ARM. In addition, comparison with other research reveals a paradox: Mid-temporal frequency sensitivity losses may be attributable primarily to a "high temporal frequency" mechanism.

Foveal flicker sensitivity discriminates ARM-risk from healthy eyes. M J MAYER, S J SPEIGLER, B WARD, A GLUCS and C B Y KIM. Invest Ophthalmol Vis Sci, 1992, 33, 3143-3149.

The "good" eyes of 13 patients with monocular exudative ARM were compared with age-matched healthy eyes of 19 subjects. Membership in the two study groups was based upon careful clinical evaluation of the tested eye as well as upon status of the fellow eye. We asked whether temporal contrast sensitivity for a long-wavelength, low spatial frequency stimulus can be used to identify the group in which a given eye belongs. Using step-wise discriminant analysis, we found that the ARM-risk and healthy eyes could be classified with 78% accuracy on the basis of foveal flicker sensitivity at two temporal frequencies - 14 and 10 Hz (in order of estimated weight).

Preliminary evaluation of flicker sensitivity as a predictive test for exudative age-related maculopathy. M J MAYER, S J SPIEGLER, B WARD, A GLUCS and C B Y KIM. Invest Ophthalmol Vis Sci, 1992, 33, 3150-3155.

Flicker contrast sensitivity was tested in the "good" eyes of 13 patients with monocular exudative age-related maculopathy (ARM). The stimulus was a foveal, long-wavelength, low spatial frequency 2.8° circle in an equiluminant (photopic) surround. Two of these ARM-risk eyes have since developed exudative ARM. Compared to healthy age-matched eyes, the two eyes that developed exudative ARM had significantly lower sensitivity at 10-40 Hz up to 9 mo before exudative symptoms appeared. The implications of these results regarding the time-course of ARM and the predictive value of foveal contrast sensitivity testing are considered. Based upon data and theoretical considerations, the authors speculate that sensitivity loss between 10 and 40 Hz is a good predictor of which eyes will develop exudative ARM. This proposal will be tested by new data from current as well as new ARM-risk subjects.

Morphologic comparisons between rhodopsin-mediated and short-wavelength classes of retinal light damage. L M RAPP and S C SMITH. Invest Ophthalmol Vis Sci, 1992, 33, 3367-3377.

The histologic manifestations of rhodopsin-mediated versus short-wavelength classes of retinal phototoxicity were compared after spectral exposures of the albino rat retina. Animals were exposed to wave-bands of light centered at the peak of rhodopsin absorbance (green, 500 nm) or in the ultraviolet A (UVA; 360 nm). Intensity-damage curves generated for each wave-band indicated that UVA light was 50-80 times more effective than green light at causing photoreceptor cell losses.

Examination of early ultrastructural changes in rod inner segments, outer segments, and retinal pigment epithelium revealed a remarkable degree of similarity between UVA and green light-induced damage. Furthermore, the two classes of damage were indistinguishable in terms of post-exposure recovery from threshold damage and regional distribution of photoreceptor cell loss along the vertical meridian. The finding of essentially identical histologic manifestations for the two classes of damage raises the possibility that they share a common biochemical etiology or pathway of cell destruction.

Blood-retinal barrier dysfunction at the pigment epithelium induced by blue light. B J PUTTING, R C V J ZWEYPFENNING, G F J M VRENSEN, J A OOSTERHUIS and J A VAN BEST. Invest Ophthalmol Vis Sci, 1992, 33, 3385-3393.

Exposure to low-intensity white light can induce dysfunction of the blood-retinal barrier (BRB) at the retinal pigment epithelium (RPE). To determine whether the shorter wavelengths within white light are responsible for this dysfunction, rabbit retinas were exposed to blue light (400-520 nm) or yellow light (510-740 nm). The permeability of the BRB, a parameter for the integrity of the barrier, was quantified with vitreous fluorophotometry. Morphologically, the barrier at the RPE was visualized on light and electron microscopy using horseradish peroxidase (HRP) as a tracer. Seventeen pigmented rabbits were exposed to blue light and 11 were exposed to yellow light. Vitreous fluorescein leakage increased with the exposure energy according to a power function (correlation coefficient >0.79). The threshold energy for an increase in BRB permeability was 50 J/cm^2 (0.014 W/cm^2 for 1 hr) after blue and 1600 J/cm^2 after yellow light. HRP tracing demonstrated that after blue light exposure, a significant fluorescein leakage on fluorophotometry corresponded to the presence of HRP in the RPE cells and in the subretinal space. After yellow light exposures of <3700 J/cm^2 and in rabbits with no significant fluorescein leakage, the HRP was limited to the choroidal capillaries and Bruch's membrane. These results demonstrate that the blue component of white light causes dysfunction of the BRB at the RPE 30 times more effectively than the longer wavelength fraction of white light. As a result, a blue light blocking filter should be used in ocular surgery on humans when an operating microscope is being used (light power 0.1-0.9 W/cm^2).

Grating, vernier, and letter acuity in retinitis pigmentosa. K R ALEXANDER, D J DERLACKI, G A FISHMAN and J P SZLYK. Invest Ophthalmol Vis Sci, 1992, 33, 3400-3406.

Grating, vernier, and letter acuities were compared in 25 patients with retinitis pigmentosa (RP), whose Snellen visual acuities were better than 20/40, to address the mechanism of visual acuity loss. For these patients with RP, all three types of visual acuity were reduced to an equivalent degree from those of a control group of 10 age-similar, visually normal subjects. The findings indicate that the visual acuity losses of these subjects with RP did not result from cone spatial undersampling (due, for example, to a random loss of foveal cones), from cone sampling irregularities (due to random alterations in foveal cone position), or from a selective loss of sensitivity to high spatial frequencies (as might result from changes in media transmission characteristics or a gain reduction in high spatial frequency mechanisms). In addition, previous studies have indicated that acuity losses in such patients with RP do not result from reductions in the quantum-catching ability of foveal cones. The most likely explanation for the equivalent losses in all three acuity types in these patients with RP appears to be an alteration in foveal spatial scale, consistent with a generalized increase in foveal intercone spacing.

X-linked retinitis pigmentosa: functional phenotype of an RP2 genotype. S G JACOBSON, A J ROMAN, A V CIDECIYAN, M G ROBEY, T IWATA and G INANA. Invest Ophthalmol Vis Sci, 1992, 33, 3481-3492.

Rod- and cone-mediated function was studied with psychophysics and electroretinography in members of an X-linked retinitis pigmentosa pedigree with the RP2 genotype. An asymptomatic hemizygote with an early stage of the disease had cone dysfunction in the mid-periphery and an abnormal cone electroretinogram (ERG); rod function was normal. Hemizygotes with more advanced disease had cone and rod dysfunction in the mid-peripheral retina and cone dysfunction in the far periphery; cone and rod ERGs were abnormal. At very advanced stages, there was an absolute mid-peripheral scotoma and marked cone and rod dysfunction in the far peripheral and central retina. Cone and rod ERGs were severely abnormal or not detectable. Heterozygotes showed tapetal-like reflexes, patches of pigmentary retinopathy, and a range of functional findings from no detectable

abnormalities to moderate levels of retinal dysfunction. There were regions of normal function adjacent to dysfunctional patches that had greater cone than rod sensitivity losses or comparable cone and rod losses. The results suggest that the phenotype of this RP2 genotype of X-linked retinitis pigmentosa, unlike other forms of retinitis pigmentosa, is first expressed as a cone photoreceptor system dysfunction, and as the disease progresses, both rod and cone systems are involved.

Flicker perimetry resists retinal image degradation. B J LACHENMAYR and M GLEISSNER. Invest Ophthalmol Vis Sci, 1992, 33, 3539-3542.

The influence of refractive defocus and artificial media opacities on perimetric thresholds in automated light-sense and flicker perimetry was investigated in 20 eyes of 20 normal subjects. Thresholds were determined at 13 locations in the central visual field up to 25°. Refractive defocus was induced by blurring with glasses of +1, +2, +3, +6 and +9 diopters spherical. Three diffusers were used as artificial media opacities, causing a mean reduction of visual acuity to 0.46, 0.08 and 0.02. Blurring of the retinal image by a small defocus or by slight artificial media opacities causes a measurable reduction of light-difference sensitivity. Mean sensitivity (MS) and defocus are related logarithmically (log (MS)/defocus, $r=-0.9297$; $P<0.0001$). The correlation between MS and the luminance factor I_{15}, characterizing the artificial media opacities, is linear (MS/I_{15}, $r=-0.9736$; $P<0.0001$). Flicker fusion frequency resists retinal image degradation much better. Mean flicker frequency (MF) and defocus are related logarithmically (log(MF)/defocus, $r=-0.4960$; $P<0.0001$). The correlation between MF and I_{15} is nonlinear (MF/$[I_{15}]^2$, $r=0.8693$; $P<0.0001$). The results of the present study show that perimetric methods that use temporal threshold criteria, such as flicker fusion frequency, should be more suitable than methods that use static criteria for detecting neuronal damage in the presence of factors that disturb retinal image quality.

Assessing the reliability, discriminative ability, and validity of disability glare tests. D B ELLIOTT and M A BULLIMORE. Invest Ophthalmol Vis Sci, 1993, 34, 108-119.

Pupose: *To gather information regarding the reliability, discriminative ability, and validity of disability glare tests.*
Methods: *The following glare tests were evaluated: the Miller-Nadler, Vistech MCT8000, Berkeley, van den Berg Straylightmeter, and the Brightness Acuity Tester used with the Pelli-Robson and Regan charts. Three test evaluation criteria were used: (1) repeatability - comparing test scores on two visits; (2) discriminative ability - the tests' ability to differentiate between young and old subjects and between old normal and cataract subjects; (3) validity - comparing cataract test scores with the reference standard of the van den Berg Straylightmeter. Three subject groups were evaluated: young normals ($n = 24$, mean age 24.3 ± 3.3yr), older normals ($n = 22$, mean age 66.0 ± 6.2 yr), and early cataract ($n = 33$, mean age 70.6 ± 8.1 yr).*
Results and Conclusions: *Data indicate that contrast sensitivity or low contrast acuity measured in the presence of glare are superior to disability glare scores in assessing cataract patients with normal neural function. Under glare conditions, contrast sensitivity and low contrast acuity scores from the Pelli-Robson, Regan, and Berkeley tests provide similarly reliable, discriminative, and valid measures of visual assessment in cataract. The Miller-Nadler glare tester poorly detects and measures subtle changes in the ocular media, such as early cataract, because of its large step sizes at low contrast thresholds. The poor reliability of the Vistech MCT8000 limits its usefulness. The study suggests that unless good chart design and psychophysics are used, the geometry and intensity of the glare source are of little importance.*

Quantitating nuclear opacification in color Scheimpflug photographs. P M KHU and T KASHIWAGI. Invest Ophthalmol Vis Sci, 1993, 34, 130-136.

Purpose: *To test the validity of the color component subtraction method, a new objective technique of measuring nuclear cataract, and to correlate the tangent values of the different degrees of nuclear opacities to their corresponding subjective nuclear cataract grading using the Lens Opacities Classification System II and to another objective method of measuring nuclear cataract.*
Methods: *Densitometries for red, green, and blue colors of the color Scheimpflug image were conducted simultaneously along the anteroposterior axis of the lens nucleus. The three color curves were subtracted from each other, giving rise to three subtracted curves: blue-red, green-blue, and red-green. This technique was applied to 99 color Scheimpflug photographs taken in 99 eyes of 51*

NOMINATION FORM

(please write in capitals or type)

I nominate the following members, with their agreement,

..... as President

..... as General Secretary

for the term 1993-1997.

Name .....

Signed..... Date .....

Please return completed forms to:

Professor J D Moreland
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patients with varying degrees of nuclear opacities. Using linear regression analysis, the regression coefficient obtained, called tangent value (TV), represents the degree of nuclear opacification.
Results: *Higher tangent value indicated greater nuclear opacification and was associated with higher correlation coefficient. This was seen graphically as an increased steepness in the slope of the subtracted curve. Good correlation existed between the subjective nuclear opacity grading and the objective tangent value. When the tangent values were correlated to the mean density of the three original color curves, good correlation was present in red and green, but only fair for blue, where maximum light scattering occurs.*
Conclusion: *These results support the validity of color component subtraction technique in measuring nuclear cataract. This technique provides quantitative measures of nuclear opacification, has good reproducibility, and is useful for monitoring nuclear cataract longitudinally.*

Foveal cone involvement in retinitis pigmentosa progression assessed through flash-on-flash parameters. G DAGNELIE and R W MASSOF. Invest Ophthalmol Vis Sci, 1993, 34, 231-242.

Purpose: *To compare psychophysical Naka-Rushton parameters in retinitis pigmentosa (RP) patients and healthy controls using a flash-on-flash increment threshold paradigm, and to measure changes of these parameters with RP progression.*
Methods: *Sixty-six RP patients and 10 normal subjects were tested, and their maximum response (Rmax), half-saturation intensity (σ), and slope (n) parameters were estimated.*
Results/Conclusions: *R_{max} in RP patients is decreased significantly with respect to the range in normal controls and continues to decrease (0.024 log units/yr) with disease progression. The distribution of σ in RP patients differs from that in normal subjects, showing lower values in general, but no progression. Small differences in parameter distributions among genetic or pathophysiologic RP subcategorizations were found, but these do not fulfil stricter statistical criteria required for multiple comparisons. Measurement noise, inherent in the flash-on-flash paradigm, exerts considerable influence on the quality of the data, as was demonstrated through repeated measures and a Monte Carlo simulation.*

Foveal cone involvement in retinitis pigmentosa progression assessed through psychophysical impulse response parameters. G DAGNELIE and R W MASSOF. Invest Ophthalmol Vis Sci, 1993, 34, 243-255.

Purpose: *To compare psychophysical impulse response parameters in retinitis pigmentosa (RP) patients and healthy controls using a temporal contrast sensitivity threshold paradigm, and to measure changes in these parameters with RP progression.*
Methods: *Sixty-six RP patients and 10 healthy control subjects were tested, and the amplitude and timing parameters of the psychophysical impulse response function were computed through time-domain transformation under assumption of minimum-phase properties.*
Results/Conclusions: *The initial rise time of the impulse response, t_s, was significantly lengthened in RP patients compared to controls, as was the fall time from peak to trough, $t_{p\text{-}t}$. The log peak-to-trough amplitude, log R, was significantly reduced. With disease progression, all impulse response parameters continued to move away from the normal range. Only minor distinctions according to RP pathophysiologic subtype or mode of inheritance were found, supporting the hypothesis of a common course of the secondary retinal degeneration across different RP subcategories.*

Aging studies on normal lens using the Scheimpflug slit-lamp camera. K KASHIMA, B L TRUS, M UNSER, P A EDWARDS and M B DATILES. Invest Ophthalmol Vis Sci, 1993, 34, 263-269.

Purpose: *To study the changes in density and thickness in normal lenses related to aging, and to study changes in anterior chamber depth related to aging.*
Methods: *Eighty nine normal volunteers (ages 9-80 yr) were examined and their eyes were photographed to obtain Scheimpflug photographs. The images were digitized and linear densitometry was performed, dividing the lens into five areas: posterior capsular (area 1), posterior cortical (area 2), nuclear (area 3), anterior cortical (area 4), and anterior capsular (area 5). Total lens thickness and anterior chamber depth were similarly measured for 90 normal eyes from the densitometry profiles. These were correlated with age.*
Results: *There was a strong positive correlation between increasing age and the density in all lens*

areas (area 2: r = 0.805; P < 0.0001; area 3: r = 0.836, P < 0.0001; area 4: r = 0.767, P < 0.0001; and area 5: r = -0.319; P < 0.0023), except the posterior capsular area, whose correlation was negative (area 1: r = -0.426; P < 0.0001). In addition, there was a significant correlation between age and overall lens thickness (r = 0.756; P < 0.0001), thickness of nucleus (r = 0.543; P < 0.0001), and cortex (r = 0.632; P < 0.0001), and a negative correlation with anterior chamber depth (r = -0.513, P < 0.0001).

Conclusion: *This report shows human lens changes in density and thickness correlated with aging using Schempflug photography and image analysis techniques. The results will aid future development of systems for automated detection, classification, and monitoring of human cataracts, as well as other anterior segment disorders.*

The spatial arrangement of cones in the primate fovea. J D MOLLON and J K BOWMAKER. Nature, 1992, 360, 677-679.

The retinae of Old World primates contain three classes of light-sensitive cone, which exhibit peak absorption in different spectral regions. But how are the different types of cone arranged in the hexagonal mosaic of the fovea? This question has often been answered with artists' impressions, but never with direct measurements. Staining for antibodies specific to the short-wave photopigment has revealed a sparse, irregular array of cones; but nothing is known about the arrangement of the more numerous long- and middle-wave cones. Are they randomly distributed, with chance aggregations of one type, as Hartridge postulated in these columns nearly 50 years ago? Or do they exhibit a regular alternation, recalling the systematic mosaics seen in some non-mammalian species? Or, conversely, is there positive clumping of particular cone types, as might be expected if local patches of cones were descended from a single precursor cell? We have made direct microspectrophotometric measurements of patches of foveal retina from Old World monkeys, and report here that the distribution of long- and middle-wave cones is locally random. These two cone types are present in almost equal numbers, and not in the ratio of 2:1 that has been postulated for the human fovea.

Structure and evolution of the polymorphic photopigment gene of the marmoset. D M HUNT, A J WILLIAMS, J K BOWMAKER and J D MOLLON. Vision Res, 1993, 33 (2), 147-154.

The marmoset Callithrix jacchus jacchus, is typical of a New World monkey in exhibiting a polymorphism of photopigments in the middlewave to longwave (535-564 nm) region of the spectrum. The single X-linked opsin gene that encodes the protein component of these pigments is present in three allelic forms producing, in marmosets, pigments with maximum sensitivities at about 543, 556 and 563 nm. All male monkeys are dichromats, whereas females may be either dichromats or trichromats. A cDNA sequence corresponding to the 563 form of this gene is reported, together with partial genomic DNA sequences of exons 2, 3, 4 and 5 of all three alleles. The origin of these sequences and their divergence from the middlewave- and longwave-sensitive pigments of man is discussed from both a functional and an evolutionary standpoint.

Danno fotochimico sulla retina da radiazioni ultraviolette. (Photochemical damage to the retina from ultraviolet radiation) N PESCOSOLIDO and A FONDI. Atti Fond. G. Ronchi, 1993, No 1, 103-124 (In Italian).

The authors have undertaken research to establish, whether or not chronic or acute exposure to near UV radiation during outdoor activities or under intense artificial illumination (operating microscope) can cause a damage on the human retina, comparable to that occurring under conditions of experimental high light irradiation.

Suscettibilità retinica al danno da luce blu. (Retinal susceptibility to damage from blue light) N PESCOSOLIDO and A FONDI. Atti Fond G Ronchi, 1993, No 1, 125-144 (In Italian).

The action spectrum for photochemical retinal damage extends not only into near UV (300-400 nm) but also into blue light (400-500 nm) and histologic data show that the two types of lesion have different characteristics as will be discussed in some detail. In fact, there are several molecules in cones, rods and pigmented epithelial cells able to absorb high photon energy, to convey their excitation state to other constituents of retinal tissue and to cause irreversible damage.

NOMINATIONS FOR THE 1994 TILLYER AWARD

Nominations are invited for the 1994 Edgar D Tillyer Award, which will be prsented at next year's annual meeting of the Optical Society of America. The Tillyer Award is presented once every two years to a person who has "performed distinguished work in the field of vision, including (but not limited to) the optics, physiology, anatomy, or psychology of the visual system." Past recipients (since 1980) are Fergus Campbell, Leo Hurvich and Dorothea Jameson (jointly), Mathew Alpern, Donald Kelly, Russell DeValois, Vivianne Smith and Joel Pokorny (jointly), and Horace Barlow.

Letters of nomination should highlight the candidate's scientific achievements and, if possible, be accompanied by his or her vita. Address letters of nomination to

Optical Society of America
Attention: Tillyer Award Committee
2010Massachusetts Avenue, NW
Washington, DC 20036
email: aarbuckle@osa.org

Nominations should be received by May 15, 1993

THE JOHN DALTON CONFERENCE 1994

A major international conference on COLOUR VISION is to be held in Manchester, UK, in September 1994, from the 5th to 9th.

This is to commemorate the 200th anniversary of John Dalton who, in October 1794, first described his colour vision abnormality to the Manchester Literary and Philosophical Society.

The conference is being organised by staff from the Visual Sciences Group at UMIST on behalf of the Applied Vision Association and support has been secured from most of the major colour vision groups as well as the Manchester Literary and Philosophical Society.

It is intended to focus on five aspects of colour vision:

Colour measurement: The neurophysiological basis of colour vision: Psychophysical approaches to colour perception: Colour vision abnormalities: Modelling of colour perception.

Posters and short presentations, workshops and equipment exhibitions would all feature alongside an extensive social programme. A book of proceedings will be published.

Please contact

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if you are interested in further details.