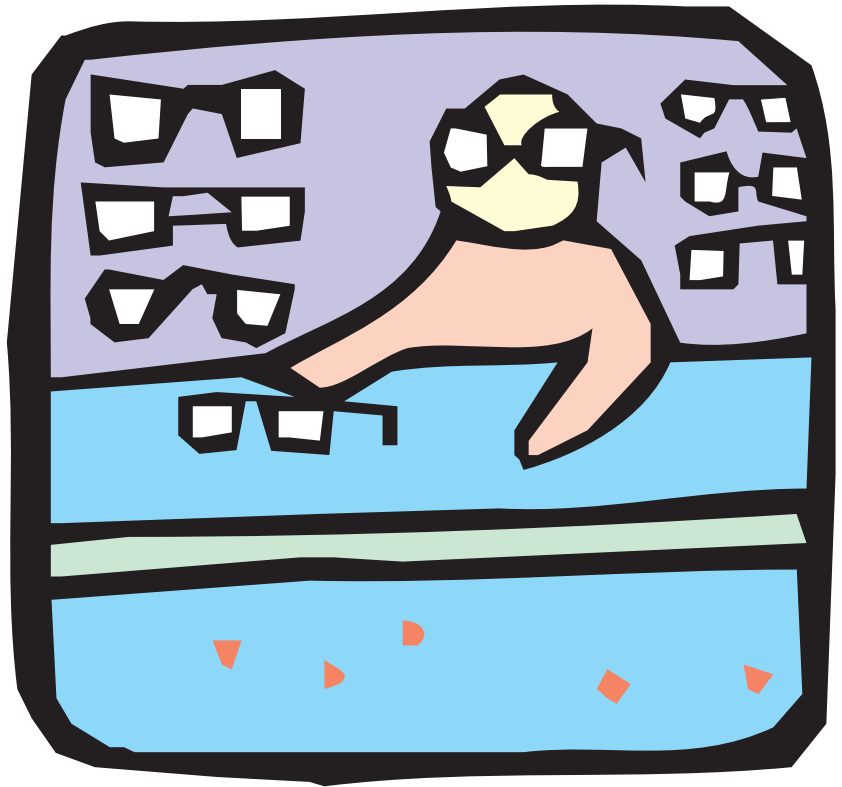


Bulletin of the Applied Vision Association



Vision Scientists Memorial Fund
GJB award report
Defective Vision - abstracts
References on Vision

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*AIM OF THE AVA: TO PROMOTE AND ADVANCE THE APPLICATION
OF RESEARCH WORK IN ALL AREAS RELATED TO VISION*



Noticeboard



AVA on the Internet

The Applied Vision Association now has its own world wide web pages at:
<http://www.dmu.ac.uk/ava/>

The pages contain details of who is on the committee, contact emails, latest details on forthcoming AVA meetings and links to other vision related pages. There are also archives of abstracts from previous AVA meetings.

There is also an AVA anonymous ftp site at: *<ftp://ftp.psy.dmu.ac.uk>*
This site contains:

- a hyperspectral data set of natural scenes produced by Gavin Brelstaff (see <http://www.crs4.it/~gjb/ftpJOSA.html>).
- David Foster's bootstrap program for estimating the accuracy of a statistical estimate derived from a set of experimental data (see <http://www.op.umist.ac.uk/bootstrap.html>).

If there is anything else you think this archive should contain then let us know.

AVA and OPO Subscriptions

Membership for 2002/2003 will be as follows: ordinary members £20, student members £10. It is now possible to pay by direct debit or credit card.

Editorial

This issue of the Bulletin contains the meeting abstracts from the AVA/BCOVIS meeting in Cambridge and also a report from Mariana Silva who was awarded the Geoffrey J. Burton travel bursery.

The time has come for me to transfer the editing of the Bulletin to new hands. From the next issue the bulletin will be co-edited by Andrew Welchman and Paul Hibbard. I wish them well.

Mark Scase

Deadline for copy for the next Bulletin – 4th October 2002

Geoffrey J. Burton Travel Award

(note a change in the criteria for applications below)

The Geoffrey J Burton fund was established in 1986 with the aim of providing financial assistance to students (postgraduates studying for a higher degree or first-year postdoctoral junior scientists) based in the UK travelling to any conferences or meetings at which they will be presenting a paper or poster. This fund has been renamed to the Vision Scientists Memorial Fund but the AVA will continue to award an annual Geoffrey J. Burton Travel Award from this fund. Donations to the fund can be directed to the AVA secretariat and cheques etc. should be made payable to "The Vision Scientists Memorial Fund".

The maximum award to any one individual is £400.

The closing date for awards will be the last day in February each year and will be for conferences held from 1st March to the end of the following February (i.e. there will not be retrospective awards). Applicants do not have to be presenting at an AVA conference.

The next closing date for applications is:
28th February 2003

for conferences held between 1st March 2003 and 28th February 2004.

NOTE change in application criteria:

Applicants must:

- * Be AVA members
- * Should have attended at least one AVA meeting in the last 18 months.

To apply for an award you need to complete an application form which is available from:

The AVA Secretariat,
College of Optometrists,
42 Craven Street,
London, WC2N 5NG.

A PDF format version of the application form is available on the AVA web site at: <http://www.dmu.ac.uk/ava/>

2002 Geoffrey J. Burton Travel Award

The 2002 Geoffrey J. Burton Travel Award has been given to Mariana Silva from the Department of Psychology, University of Surrey. Mariana presented at VSS. Here is her report:

Report of VSS 2nd Annual Meeting, Sarasota, Florida, May 10-15, 2002

The Geoffrey Burton Memorial Fund awarded by the AVA allowed me to attend a major international vision sciences conference - the VSS 2nd Annual Meeting, in Florida. Both the event and the place are worth experiencing, and for me they were a first.

Florida did not let me down in any respect. The long sandy beaches with the palm trees, the fiery sun, the emerald ocean, the cafes and restaurants, all seem to invite you to engage in total laziness, indulgence and negligence. It was hard to keep your mind in the science, and it was almost 'compulsory' to dedicate at least one afternoon to the beach. The Florida Keys are a tropical paradise and one may well be caught by an occasional fast running merciless monsoon while sunbathing under the burning sun... However, these tend to go away within an hour and the most beautiful colours paint the sky, leading to a gorgeous sunset and promising evening. Still on a personal level, the event was indeed full of 'firsts': alligator and sushi were among my gastronomy adventures. For the more suspicious, alligator actually tastes and feels like turkey, and although sushi can also be eaten in England, it was still quite innovative for me. Other foods of interest in the Florida state include oysters and an enormous variety of fish and seafood (shouldn't comment on that, I believe there is nothing like the fish and seafood from the South of Europe...!).

On a professional level, the conference proved to be an invaluable source of experience, knowledge and networking. It was the first time I was to present part of my work among some important names within the psychology academia, and at an international level. Encountering with what I previously called 'my references' – prominent names within my field of research materialised into people with whom I could talk and discuss ideas – was fun and quite enlightening. The opportunity to browse through other posters also proved to be extremely fruitful and lead to the promotion of new ideas and projects of all sorts. I found particularly interesting the work that is now being done on memory for pictures, especially of complex real-world scenes. It was not long before I started

relating research by Oliva et al and Gottesman and James III on boundary extension, and Mary Potter and colleagues' findings to my own work. It appears and that we tend to 'predict' parts of scenes we do not actually see due to the expectancy associated with the gist of the context being observed. Also, when viewing scenes, we don't retain much about viewpoints, rather the concepts within pictures seem to be viewpoint-independent. The impact of memory structures in the nature of the information we hold short-term seems to underlie the way we view real-world scenes.

The talks also provided me with updated knowledge on several fields of interest and some of them were of very high quality and charged with sense of humour, which was quite refreshing. I particularly enjoyed Alvarez's animated talk on memory load.

Although there weren't many posters or talks on research investigating the influence of memory structures in the representation of scenes depicting actions, conversations with other attendees provided me with new insight into this area and also some advice to overcome part of the methodological constraints of my experiments.

Our poster, 'The role of action-relevance in the perception and representation of natural scenes' originated a fair amount of interest, most of the times in a constructive form. The main focus of our research is on complex scene perception and the relationship between perception and action. For some time, many researchers (e.g. Palmer, 1975, Friedman, 1979) have approached the role of schemas in scene perception, but how much these are action-related appears to be of the most importance. We propose to investigate the whether action schemas affect the processing of natural scenes using memory tasks and the standard change-blindness 'flicker' paradigm. Our work is based on previous research on action-schemas by Goodman (1980), where she showed that the amount and type of visual information retained after scene viewing is a function of such schemas. In our experiments, observers viewed photographs of natural scenes, which displayed a salient action performed by an actor within them. Four objects in each scene were pre-classified to be of high or low relevance to the action depicted. Eye movements were recorded throughout and related to the participants' memory performance on both recall and recognition tasks for each degree of object relevance. In the change blindness experiment, time to detect changes that involved surface properties of objects (colour) was compared with change detection of those involving object identity (swapping with a different object). Presence of high relevant objects was better recalled than low relevant objects, but the latter were better recognised. This implies superior retention of visual

detail about inconsistent items. Mean fixation dwell times and number of fixations were significantly higher for low relevant objects, supporting the idea that attention has been selectively guided towards those items. In the change-blindness experiment, reaction time was found to be somehow related to object relevance, for generally, changes in low relevant objects were detected faster than changes to high relevant items. Furthermore, drastic disruption of the semantics of the scene (identity changes) led to better detection performance. The data suggests that prior knowledge or assumptions about the world, organised in the form of action schemas can affect the eye movement inspection patterns of natural scenes, the allocation and active deployment of attention within them and the nature of the visual information retained. Physical features of items seem to be encoded globally and perhaps represented according to their functional role. Particularly, in routine day-to-day well-known simple activities, physical detail of objects is not essential for the coherent performance of actions involving those items.

I received very good feedback on our present work and other ideas for the future. Particularly, Ronald Rensink showed a very positive attitude and interest towards the work we carried out up to now (thanks for your interest and contribution!).

To summarise, this conference proved to be an extremely worthwhile experience at all levels: personal, academic and even professional. For that, I have to thank the AVA for greatly facilitating my attendance there. Overall, I went to Florida in a calm 'exploring' mode and came back in an unsettled 'invigorating' mode. With so many ideas, I will probably be incredibly busy until the next VSS, which I surely hope to attend, bringing new work that which will definitely carry signs of the first conference.

Mariana M. Silva, University of Surrey

Mariana's abstract was as follows:

The role of action-relevance in the perception and representation of natural scenes

M.M. Silva, M.F. Bradshaw, J.A. Groeger Psychology, University of Surrey, Guildford, UK

Goodman (1980) showed that action schemas influence the retention of

visual information within pictures. Here, we investigate whether such schemas affect perceptual processing of natural scenes using the standard 'change-blindness' flicker paradigm. Target objects were selected as either of high or low relevance to a salient action performed by an actor within the scene. Time to detect changes which involved surface properties of objects (e.g. colour or swapping with a similar object) was compared to time to detect those which involved object identity (e.g. deletion or swapping with a different object). Eye movements were recorded throughout using a head-mounted eye tracker, and related to the detection of change and relevance of the target object to the action. Observers viewed photographs of natural scenes which displayed one action performed by an actor within them. Four objects in each scene were pre-classified to be of high or low relevance to the action and to the scene. Subjects were required to inspect each scene in order to either (i) recall or (ii) recognise the objects at a later stage. Observers were also requested to react as soon as any change was detected. Time to change detection was found to be related to object relevance as well as to the scene. In general, changes to low relevant objects were detected faster, which suggests that expected items are less attended to. Fixation position was invariably found to be near the area where the change occurred when it was detected. The data suggests that prior knowledge or assumptions about the world, organised in the form of action schemas can affect the eye movement inspection patterns of natural scenes, and the allocation of visual attention within them. These results are consistent with those reported by Holfingworth and Henderson (2000).

Vision Scientists Memorial Fund

(An update to what was published in the last issue of the bulletin)

The AVA has been administering the Geoffrey J. Burton memorial fund for over 15 years. This fund was set up in memory of Geoffrey Burton who tragically died young. The purpose of the fund was to help young vision scientists with travelling expenses to conferences. In recent years the AVA has been conscious that it might be appropriate also to remember other vision scientists who have died young. One example is that of Richard Eagle. The AVA committee therefore considered what might be the best way forward. We do want to continue remembering Geoffrey Burton yet we are aware that it is difficult and inefficient to administer a number of restricted funds with relatively small sums in them. Therefore the AVA committee proposed that the Geoffrey J. Burton memorial fund be renamed the Vision Scientists Memorial Fund. This proposal was taken to members with voting in accordance with the AVA constitution. The proposal to rename the fund was narrowly passed. I think it appropriate that a number of things are made clear:

1. The Geoffrey J. Burton memorial lecture at the AVA AGM will continue.
2. The Geoffrey J. Burton travel award will continue with applications being made in the same way as in previous years.
3. The AVA committee would like to set up a Richard Eagle award. It is proposed that this award will be annual and awarded at the end of each summer (to distinguish it from the Geoffrey Burton travel award).
4. The AVA would like to invite contributions to the Vision Scientists memorial fund. The fund would then be used to make the awards when necessary.

I hope that this clarifies the current position and reassures members that the AVA will continue to honour the memory of Geoffrey Burton and the awards associated with his name will continue.

The AVA Committee has discussed proposals for the new Richard Eagle award. We are now in a position to announce the following:

1. The Richard Eagle award will be an annual award of up to £400.

2. The award will be given 6 months out of phase to the Geoffrey J. Burton award (to distinguish between the two awards) with the first award in late summer 2003.
3. The Richard Eagle award is open to anyone (postgraduate or postdoctoral) on “soft” money (ie a short term contract)
4. The award will be an open award that helps the applicant with their research. For example it could be for a small item of equipment, for travel for a collaborative visit or for subject payments.
5. To apply for the award applicants must write a proposal in up to 750 words detailing why they would like to apply and what they would use the money for. Proposals will be judged on content and originality.

Mark Scase
AVA Chairman

AVA/BCOVS - Defective Vision Meeting

9-10 July 2002

**Anglia Polytechnic University
Cambridge**

Meeting Abstracts

Invited speakers and titles:

RONALD S HARWERTH

John and Rebecca Moores Professor of Optometry, University of Houston,
U.S.A.

“Defective Vision from Glaucoma: Structure-Function Relationships.”

MICHAEL E BOULTON

Professor, Head of Cell and Molecular Research Group, Department of
Optometry and Vision Sciences, Cardiff University, U.K.

“Do Age-Related changes in the Retina contribute to Age-Related Macular
Degeneration?”

GARY S RUBIN

Helen Keller Professor of Ophthalmology, Institute of Ophthalmology,
University College London, U.K.

“Reading without a Fovea”

STEADY-STATE V.E.P. AND BEHAVIOURAL MEASURES OF VISUAL ACUITY IN INFANTS AND CHILDREN WITH DOWN SYNDROME.

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Purpose: Children with Down syndrome (DS) have reduced behavioural visual acuity (VA). This may reflect sensory deficits, or alternatively, a loss of performance in later mechanisms responsible for behavioural responses. This study compared acuity measured using visual-evoked potentials (VEP), with behavioural tests, in children with DS. The goal was to determine whether reduced VA could be detected in VEP recordings from the first stages of the response pathway.

Methods: The subject group contained 34 children with DS and 35 controls, aged 3 mos. - 14 yrs. VA was measured using steady-state, swept VEP (Norcia and Tyler, 1985). VA was also measured using behavioural techniques.

Results: VA was analysed using a subject group (DS vs. controls) \times test type (behavioural vs. VEP) ANOVA with age as a covariate. A significant effect of subject group was observed ($F_{(1,59)} = 8.632, p < 0.001$) and a significant interaction between subject group and test type ($F_{(1,59)} = 5.169, p = 0.027$). The DS group showed reduced VA compared to the controls in both VEP and behavioural tests, but the deficit was more pronounced with behavioural testing. Reduced VA in the DS group was still seen when analysis was restricted to children who accommodate accurately ($F_{(1,26)} = 8.047, p = 0.009$).

Conclusions: Reduced VEP acuity in the DS group, supports the idea of an underlying sensory deficit in the DS visual system. Increased reduction with behavioural techniques implies additional losses at later stages of processing. Accommodative inaccuracy does not fully explain reduced VA in DS. Children with DS who do not have significant levels of defocus still exhibit reduced VA when compared to controls.

Does accommodation inaccuracy matter in children with Down syndrome?

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Welsh Centre for Learning Disabilities, University of Wales College of Medicine, Cardiff CF14 3BL, Wales, UK²

Purpose: Almost 57% of children with Down syndrome have significant refractive error (hypermetropia $\geq +3.00D$, myopia $\leq -1.00D$) (Woodhouse et al., 1997); they are 17 times more likely to have significant long or short sight than their typically developing peers. Also, for the age range 4.5 months to 11.1 years, 34% of children with Down syndrome have strabismus, compared with 4-7.5% of control children (British College of Optometrists, 1991-4). In addition, 82% our cohort of children with Down syndrome (n=100) have reduced accommodation at near. In order to investigate the influence of accommodation accuracy on refractive error and strabismus, this study compared the above parameters in children with Down syndrome who accommodated accurately with those who did not. **Method:** Accommodation was measured using dynamic retinoscopy technique at testing distances of 25, 16.6 and 10cm. An accommodative lag of plano to 0.75D is normal for typically developing children (Rouse et al., 1984). Accurate accommodation for our cohort was therefore defined as $\leq 0.75D$ lag of accommodation (at a minimum of 2 out of 3 testing distances). Children with Down syndrome who accommodated accurately were age matched with a child with inaccurate accommodation, based on their most recent visit for which a full data set was available. **Results:** χ^2 analysis of the data for the two groups revealed that there was a greater number of children with significant hypermetropia ($p=0.003$) and strabismus ($p=0.003$, Fisher's Exact Test) in the under-accommodating group. **Conclusion:** Children with Down syndrome who under-accommodate are more likely to be strabismic and have significant hypermetropia.

References: Rouse, M. W., Hutter, R. F., Shiftlett, R. (1984). *A Normative Study of the Accommodative Lag in Elementary School Children*. American Journal of Optometry and Physiological Optics, Vol. 61, No. 11, pp. 693-697, British College of Optometrists (1991 - 4). *Children's Visual Problems*. Radcliffe Medical Press, Oxford, UK.

VISION STATUS OF CHILDREN WITH OCULOCUTANEOUS ALBINISM

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Purpose: Black South African children with oculocutaneous (OCA) albinism were examined optometrically to establish the level of vision improvement that could be achieved following optical correction.

Method: The children (N = 153) (males 50.3%; females 49.7%), aged 7-17 years (mean = 10.76 ± 2.25 years) were examined with a logMAR VA chart, cover tests, retinoscopy (dry), subjective refraction, Vistech contrast sensitivity test, ophthalmoscopy, Randot stereotest, Ishihara and Farnsworth Panel D-15 tests.

Results: Many (34.6%) of the children had strabismus, 2 to 25 prism diopters. Uncorrected distance VAs were: OD: Finger counting (FC) to 6/7.5⁻², OS 6/75⁺² to 6/7.5⁻³, OU 6/60⁻¹ to 6/7.5. Most (67.6%) of the children had myopia. Others (30.8%) had hyperopia or emmetropia (1.7%). Astigmatism was present in 92.25% of the children. The nearest equivalent spherical powers were: OD -12.00 D to +2.75 (mean = -1.48 ± 2.28 D) and OS -8.00 D to +5.75 (mean = 1.36 ± 2.18 D).

Following optical corrections, VA improvement ranged from one to three lines in 71.2% of the children. The corrected VAs were, OD FC to 6/6⁻¹, OS 6/75⁺² to 6/6⁻¹.and OU 6/60 to 6/6. Many (84.3%) of the children had corrected VA worse than 6/18 in the better eye and therefore, were classified as partially sighted or blind (VA worse than 3/60). Stereoacuity was poor (500 – 70 secs arc) in most (89.5%) of the children, others could not perceive the minimum 500 secs arc on the test. Contrast sensitivity was poor, maximum spatial frequency being 18cpd with peak sensitivity at 3cpd. Many (83%) of the children, however, had normal colour vision.

Conclusion: These children with OCA had poor VA, which could be improved significantly with optical correction. Their poor contrast sensitivity and depth perception, however, were not improved. Most of the children with OCA had normal colour vision.

Relative letter legibility of Punjabi optotypes

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Purpose: To investigate relative letter legibility of Punjabi optotypes.

Method: In experiment 1, the influence of font type on letter legibility was studied on 9 subjects optically defocused using a +1.00 DS lens in front of one eye. Two Punjabi font types used in widely read Punjabi language newspapers and magazines were selected. Legibility was determined according to the method of Strong & Woo (1985). In experiment 2, a single Punjabi font (selected from expt. 1) was used to investigate relative letter legibility in 10 subjects who were optically defocused with a +1.00DS, +2.00DC, axis 180 & 90. The Punjabi letters were modified to fit into a 5x5-grid using Coral draw and presented on a standard PC monitor at high contrast using Powerpoint. The method of Strong and Woo (1985) was used to determine relative letter legibility.

Results: The results of experiment 1 showed no effect of font type on letter legibility (ANOVA, $p > 0.05$). The results of experiment 2 were analysed in two ways. Firstly, ANOVA revealed an interaction between blur condition (sphere, cyl axis 90, cyl axis 180) and letter legibility ($p < 0.05$). Post hoc analysis (analysis of main effects and Tukey HSD test) showed a significant effect of letter legibility only under the +2.00D Cyl 90 blur condition ($p < 0.05$). Secondly, the percentage difference in relative legibility under cylinder blur (axes 180 & 90) was plotted against the legibility under spherical blur. We selected 11 letters of equal legibility on the basis of a difference in relative legibility for each cyl condition of no more than 10% of the value of the spherical blur condition.

Conclusion: Relative legibility of Punjabi letters was determined resulting in the selection of 11 letters. These letters will form the basis of a new, standardised vision chart in Punjabi.

Strong G, Woo G C (1985) A distance visual acuity chart incorporating some new design features. Archives of Ophthalmology, 103 (1), 44-46.

Accuracy of wavefront measurement and the potential effect of erroneous custom corneal correction on the modulation transfer function

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Purpose: To assess the accuracy of repeated measurements of ocular aberrations using wavefront sensing in a small group of observers and to assess the potential effect of measurement error on custom corneal correction.

Method: A Shack-Hartmann wavefront sensor was used to measure the ocular wavefront in 9 eyes. Head position was stabilised using a dental bite bar and the pupil centred using a CRT monitor and circular grating. Twenty Shack-Hartmann images were collected for each measurement. Each observer had three sets of measurements taken; the first and the second after careful alignment and the final after regrasping the bite bar in the same position as for the second measurement, but without pupil realignment. The modulation transfer functions for each set were calculated and the effect of ideal custom treatments on the modulation transfer function (MTF) was estimated.

Results: There were highly statistically significant differences in a large number of Zernike modes between the three sets of measurements. The MTFs calculated for the residual wavefronts following ideal custom treatment were below the diffraction limit. The RMS wavefront errors were consistently better for the residual wavefronts obtained using the realigned data than using data taken without pupil realignment

Conclusions: Sequential measurement of ocular aberrations shows statistically significant differences in a large number of Zernike modes. If aberrations determined by a single measurement are to be used in a custom correction the resulting modulation transfer function is likely to remain below the diffraction limit. Pupil realignment is critical in reduction of the residual root mean square wavefront values to a minimum.

On-Eye Spherical Aberration of Soft Contact Lenses and Effective Lens Power

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BD7 1DP.

Purpose: Soft contact lenses (SCL) produce a significant level of spherical

aberration (SA). A simple model assuming that a thin SCL aligns to the cornea predicts that these effects are similar on-eye and off-eye. We investigate the effect SA has on the power of an SCL on-eye.

Methods: The wavefront aberration for 17 eyes and 33 soft contact lenses on-eye was measured with a Shack-Hartmann wavefront sensor. The Zernike coefficients describing the on-eye SA of the SCL were compared to off-eye ray tracing results. Paraxial and effective lens power changes resulting from the SCL-induced SA were determined.

Results: The model predicts the on-eye SA of SCL closely. The SA induced by spherical SCL partly cancelled the ocular SA for 11 of the subjects. The power change resulting from SCL-induced SA is $\pm 0.5D$ for a $\pm 7.00D$ spherical SCL on a 6mm pupil. Power change is negligible for SCL corrected for off-eye SA.

Conclusions: For thin SCL the level of SA is similar on-eye and off-eye. SCL corrected for off-eye SA are aberration free on-eye but the benefit depends on the individual level of ocular aberrations and the viewing condition. The effective power change of spherical SCL depends on pupil size and can be significant for large pupils even for moderate refractive errors. For SCL without aberration correction, for higher levels of ametropia and large pupils, the SCL power should be determined with trial SCL with their power and p-value similar to the prescribed lens.

The implications of forward light scatter for visual performance post-excimer laser surgery

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Purpose: To determine the effect of photorefractive keratectomy (PRK)

and laser assisted in-situ keratomileusis (LASIK) on forward light scatter and visual performance. Method: 32 PRK, 52 LASIK subjects (average follow-up time of 137 and 16 weeks respectively) and 53 control subjects were assessed. All three groups were matched for age and refractive error. The City University Scatter Program was used to assess forward light scatter and contrast acuity thresholds and visual search performance were also examined. Results: Neither refractive surgery group showed a statistically significant increase in the overall quantity of light scatter. The PRK group showed a significant increase in the spread of straylight (reduced scatter index, n) associated with a small but statistically insignificant increase in the straylight parameter, k . Both contrast acuity thresholds and mean visual search times were significantly greater for the PRK group than the other two groups. The LASIK group showed a significant increase in k , associated with a small but statistically insignificant increase in the scatter index, n . There was no statistically significant increase in contrast acuity thresholds or visual search times. Conclusion: PRK causes an increase in contrast acuity thresholds and visual search times. This is despite the long average follow-up times, and appears to suggest that the degradation of visual performance seen post-PRK is permanent. LASIK does not appear to cause a significant reduction in visual performance. Since aberrations are not greater following PRK than LASIK, this reduction in visual performance can be attributed to the modified distribution of forward light scatter seen post-PRK.

Work funded by research grant from UK Civil Aviation Authority

Induced Irregular Astigmatism in Hypermetropic PRK and LASIK; a Bilateral Cohort Study

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Purpose: To determine if there was a difference in irregular astigmatism following hypermetropic correction with Photorefractive Keratectomy

(PRK) and Laser In Situ Keratomileusis (LASIK) by Fourier analysis of corneal topographical data.

Methods: Thirty-six eyes of eighteen patients affected by hypermetropia were enrolled as part of a prospective study in which one eye was treated with PRK and the other with LASIK. In the eyes that underwent LASIK the flap was cut on a nasal hinge with a LSK One microkeratome. The laser system was a Summit SVS Apex Plus with an optical zone of 6.5 mm and a blending zone of 1.5 mm. Corneal topographical data was acquired with a TMS-1 preoperatively and at 1, 3, 6 and 12 months postoperatively. The dioptric files for each time point were converted into ASCII format and subsequently analysed with purpose written software to extract the Fourier harmonics. This permitted the objective analysis of the irregular astigmatism, equivalent spherical component and regular astigmatism.

Results: The irregular astigmatism increased in both groups postoperatively, reached a peak at three months and then reduced over the next 9 months. There was no statistically significant difference between the two groups at any time point ($P < 0.05$ all cases). At twelve months the irregular astigmatism values for both groups remained above their preoperative levels.

Conclusion: The irregular astigmatism analysed in this study showed no statistically significant difference between the PRK and the LASIK group throughout the follow up period. It appears that, from a corneal topographical point of view, the two procedures induce an equal amount of irregular astigmatism.

CHROMATIC AND ACHROMATIC LOSS OF SENSITIVITY IN GLAUCOMA

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Purpose: Loss of both chromatic and achromatic sensitivity in glaucoma has been shown, however the relative loss is unknown. We aim to quantify and establish which of these systems is affected most in glaucoma.

Methods: Earlier experiments have shown that thresholds for detection of coherent motion of colour-defined, spatially structured stimuli are not

affected by dynamic luminance contrast noise. We used these results to design stimuli conditions that isolate chromatic and achromatic mechanisms. We studied 13 subjects with Primary Open Angle Glaucoma (POAG) with mean age of 70 years, 17 control subjects with a mean age of 68 years and 13 young normal subjects with a mean age of 31 years. Contrast thresholds were measured using a 4-alternative, forced-choice procedure involving discrimination of motion direction. Achromatic and chromatic sensitivities were measured, the latter along the tritan and protan confusion axes, foveally and at 8° eccentricity.

Results: There were statistically significant differences between the 3 subject groups. Comparison of the control and POAG groups revealed a loss of sensitivity in the POAG group. Achromatic sensitivity thresholds increased 1.4 fold (both fovea and 8°), whereas chromatic thresholds increased 1.8- (B/Y) and 1.5-fold (R/G) at the fovea and 2- (B/Y) and 1.6-fold (R/G) at 8°. Comparison of the control and young groups reflected the ageing effects. Achromatic sensitivity showed 1.5 fold reduction (both fovea and 8°), but the chromatic loss was more severe: 3.5- (B/Y) and 3-fold (R/G) at the fovea, and 3.6- (B/Y) and 3.2 fold (R/G) at 8°.

Conclusions: The results confirm that the B/Y channel is most affected in glaucoma, but both chromatic and achromatic mechanisms are affected by ageing and glaucoma.

CHANGES IN SHORT-WAVELENGTH RESOLUTION ACUITY WITH AGE AND DEFOCUS IN THE PERIPHERY: IMPLICATIONS FOR RELATIVE GANGLION CELL LOSS.

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PURPOSE. Resolution acuity is known to be sampling limited for achromatic gratings in peripheral vision. In addition, peripheral achromatic resolution is unaffected by defocus up to 3 dioptres. We have also shown resolution for Short Wavelength Sensitive (SWS) system isolating gratings to be sampling limited in both the fovea and periphery.

This means that measurements of peripheral resolution with either stimulus can potentially be used to estimate the density of the corresponding underlying retinal ganglion cell population. We wished to examine the effect of optical defocus on detection and resolution acuity for this stimulus and also determine how peripheral resolution declined with age for both the achromatic and SWS system.

METHODS. We measured detection and resolution for SWS-isolating gratings in the fovea and at 20 degrees eccentricity for optical defocus between 0-4 dioptres. In addition we measured resolution acuity for both achromatic and SWS-isolating gratings at 13 degrees in four retinal locations in 50 normal subjects ranging in age from 12-70 years. Measurements of lens density (age-related yellowing) were also made in subjects over 60 years of age.

RESULTS. Detection acuity was initially higher than resolution accompanied by observations of aliasing. Detection acuity declined steadily with defocus but SWS resolution acuity showed no decline until 1 dioptre in the fovea and 3 dioptres at 20 degrees. Resolution acuity was higher for achromatic gratings than SWS-isolating gratings at all ages and neither displayed any decline in performance until around 55 years. After this both declined in a parallel fashion at a rate of 10%/decade. The individual ratio of SWS/achromatic resolution (0.25) showed no correlation with increasing lens density.

CONCLUSIONS. Since resolution for both short-wavelength and achromatic gratings is robust to optical attenuation and declines in a parallel fashion after 55 years there appears to be no selective loss of SWS-driven ganglion cell density relative to achromatic density with age.

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PULSATILE OCULAR BLOOD FLOW MEASUREMENTS IN HEALTHY ASIAN EYES: REFERENCE VALUES FOR AN INDIAN POPULATION

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Purpose: To investigate pulsatile ocular blood flow (POBF) in a healthy Indian population and use the data derived as reference values.

Methods: Two hundred and fifty two healthy subjects (121 males, 131 females) underwent intraocular pressure and POBF measurement with the Ocular Blood Flow Analyzer (Paradigm Medical Industries, USA and formerly the POBF Tonograph). Before POBF measurement, subjects underwent a complete ophthalmic examination including refraction, slitlamp examination and biomicroscopic fundoscopy and Goldmann applanation tonometry (GAT). Subjects with ocular pathology were excluded from the study. Median age was 29 years (male median 32 years, female median 27 years).

Results: Average POBF in males was found to be 1052 $\mu\text{l}/\text{min}$ (95% CI: 988-1116 $\mu\text{l}/\text{min}$) and in females to be 1293 $\mu\text{l}/\text{min}$ (95% CI: 1222-1364 $\mu\text{l}/\text{min}$). Median age was significantly different between males and females (Mann-Whitney $U=6685$; $p=0.0311$) but POBF was found to be independent of age in both sexes. As a group, mean refractive error influenced POBF (Kendall's $\tau=0.24$; $p=0.0017$).

Conclusions: POBF values in Indians appear to be higher than reported in studies conducted on other racial groups. The reasons for this difference could be instrumental or anatomical (i.e axial length, ocular rigidity). Care should be taken in deriving normative data using the Ocular Blood Flow Analyzer in mixed race groups.

Objective Predictors of Subjective Visual Function for different age-related cataract morphologies

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Purpose: To find objective chart tests that give a measure of visual function in the different age-related cataract morphological groups and can be applied in a clinical setting.

Methods: Subjects with age-related cataract ($N = 33$) were recruited to the study from both private optometric practice and a hospital eye department. All subjects underwent LOCS III grading of their cataract and had their functional vision assessed using the VF-14 questionnaire. High (96%) and low (16%) logMAR visual acuity was measured together with Pelli-Robson contrast sensitivity. A stepwise linear regression was then performed on the data to find significant predictors for VF-14 in the three age-related cataract morphological groups as well as in a mixed group.

Results: Low contrast logMAR visual acuity was a significant predictor of VF-14 in the cortical ($P = 0.014$) and nuclear ($P = 0.024$) sub-groups. For the mixed morphological group both high and low contrast visual acuity were significant predictors ($P < 0.03$). There were only 3 subjects with pure posterior subcapsular cataract and so no meaningful analysis could be performed.

Conclusions: Low contrast logMAR visual acuity may be a better predictor of visual function in cortical and nuclear cataract compared to high contrast logMAR visual acuity or Pelli-Robson contrast sensitivity.

Peripheral resolution for achromatic and SWS gratings in early glaucoma: implications for selective ganglion cell density loss.

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Purpose: Measurements of achromatic grating resolution acuity in peripheral vision have been shown to be sampling limited and directly related to the underlying ganglion cell density. Recent studies have shown that peripheral grating resolution acuity for short wavelength sensitive (SWS) isolating gratings is also sampling limited and largely unaffected by lens absorption or optical defocus. Thus it permits us to make direct estimates of localized SWS-driven ganglion cell density.

We wish to determine if there is any selective reduction in SWS-driven relative to achromatic ganglion cell density in early glaucoma.

Methods: Resolution acuity was measured at 13° in 4 oblique meridians in 21 eyes (65.8 ± 9.0 years) with “early” glaucoma (16 Primary Open Angle Glaucoma, 5 Normal Tension Glaucoma; MD <-10dB Humphrey Field Analyzer C24-2 program). The results were compared to a group of 17 age-matched normal eyes (62.5 ± 6.6 years).

Results: Mean achromatic acuity was significantly lower in the glaucoma patients compared to normals (2.79 vs. 4.01 cycles/deg; P <0.01). Mean chromatic resolution was also significantly lower in the glaucoma patients than normals (0.67 vs. 0.99 cycles/deg) (P <0.01). The chromatic/achromatic resolution ratio was not statistically different in those with glaucoma compared to the normals (0.24 vs. 0.27; P = 0.34)

Conclusion: These initial results indicate that there is no selective reduction in SWS-driven ganglion cell density in early glaucoma.

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Effect of defocus on contrast sensitivity in myopes and non-myopes.

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Purpose: Myopes have altered accommodative responses when compared to non-myopes. We examined the contribution of the optical input to this known altered accommodative response by assessing the defocused contrast sensitivity function in myopes and emmetropes.

Methods: Contrast sensitivity (CS) to 20 spatial frequencies was measured under cycloplegia, with up to ±3 dioptres of defocus, in myopes and non-myopes. The differences in the contrast sensitivity functions as a result of defocus were analysed for the different spatial frequencies in the two groups. In addition, the optimum defocus at which peak contrast sensitivity occurred was compared between the two groups.

Results: The loss in contrast sensitivity with defocus was less symmetrical with positive and negative defocus in the myopic group, although there

was no latent accommodation left following cycloplegia. Defocus decreased contrast sensitivity symmetrically in non-myopes. The magnitude of decrease in CS was dependent on the spatial frequency tested, and was significantly different in myopes and non-myopes at 3 and 6 cycles/degree.

Conclusions: Differences in the effects of blur on CS exist between myopes and non-myopes. Existing models of spherical aberration may explain this asymmetry in positive and negative defocus in myopes.

Is visual efficiency reduced in myopic eyes?

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Purpose: Myopic eye growth has the potential to modify both optical and neural performance of the human eye. To examine the influence of these factors we measured contrast detection thresholds in the presence of different levels of stimulus noise.

Methods: Contrast detection thresholds were measured for a 4 c/deg sinusoidal grating windowed by a Gaussian contrast envelope using a 2AFC method of constant stimuli. The stimulus (Gabor) was embedded in different levels of external noise (from 9.86×10^{-5} secdeg² to 0 noise). Threshold measures when plotted against noise level produce a linear relationship: the slope provides a measure of sampling efficiency (neural index), and the intercept with the abscissa provides an estimate of internal noise (optical index). Six emmetropes and fifteen myopes (=6.00D) participated in the study. The data of the emmetropic subjects were used as a baseline for comparison with the myopic group. In addition, biometric data were collected from all subjects.

Results: All emmetropic subjects showed similar results ($p > 0.5$) with sampling efficiencies of the order of ~14% and internal noise measures of $\sim 2.4 \times 10^{-5}$ secdeg². All myopic subjects demonstrated reduced visual efficiency ($p < 0.01$) which could take the form of a reduced sampling efficiency or increased intrinsic noise levels, although most myopic subjects showed reduced sampling efficiency. Interestingly, reductions in sampling efficiency were compensated by lower levels of internal noise in this group.

Conclusions: Myopes show reduced visual efficiency in comparison to emmetropes. This can take the form of either increased internal noise or reduced sampling efficiency. However, deficits in sampling efficiency are associated with lower levels of internal noise. This may represent a compensation mechanism in the visual system of myopes to impaired neural sampling.

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Perceived Blur in Amblyopia

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Purpose It is well documented that visual acuity and contrast sensitivity in amblyopia are attenuated at high spatial frequencies, this would predict that amblyopes should perceive objects as blurred because they lack high spatial frequency information necessary to adequately represent sharp edges. In a series of experiments, we explored the representation of blur in amblyopia with blur discrimination and blur matching tasks.

Methods Monocular blur discrimination thresholds were measured in a spatial 2-Alternative Force Choice procedure. The luminance profiles of the blurred edge were cumulative Gaussians with the standard deviation of the reference blurred edge, being fixed at 1.88, 3.75, 7.5, 15, 30, or 60 arcmin. Observers were required to discriminate which edge (right or left) appeared to be the lesser blurred. Observers also inter-ocularly matched edges which were identical to those employed in the blur discrimination tasks, with the exception they were viewed dichoptically at all times.

Results Blur discrimination thresholds were elevated in both the amblyopic and fellow fixing eye but were within the normal range for interocular matching thresholds. Our results suggest that blur is veridically represented in the amblyopic visual system.

Conclusions The surprising result here is that all amblyopes, even those with the most severe visual loss, veridically matched all blurred edges, including the sharpest ones. This implies that amblyopes are able to

represent levels of blur that are defined by spatial structure beyond their resolution limit. These results also raise interesting questions about the mechanism by which blur is represented in the visual system.

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Distribution of rod bipolar cells in the retina of the albino rat

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Purpose: In the retina of albino mammals so far examined there is a deficit in the rod photoreceptor population. We reasoned that a consequence of the rod deficit might be a subsequent abnormality in the next level of the rod pathway, the rod bipolar cell. We therefore compared the distribution of rod bipolar cells in pigmented and albino rats.

Methods: Rod bipolar cells were labeled in 15 μm thick sections of fixed retinas with a monoclonal antibody directed against protein kinase C, and visualized using the ABC method. Counts of the cell bodies and processes of rod bipolar cells were undertaken at various locations across the retina.

Results: Qualitatively, the protein kinase C staining suggested differences between the albino and pigmented phenotypes both in the outer and inner plexiform layers and in the inner nuclear layer. Staining was denser in the pigmented retina and the bipolar cell bodies were arranged in multiple rows rather than a single row as found in the albino retina. The actual number of rod bipolar cells was reduced in the albino phenotype. At the neonatal age we examined (postnatal day 15), there was a 14% reduction in the total number whereas in the adult retina the reduction was around 9%.

Conclusions: Although the reduction in the rod bipolar population is not as great as that previously found for the rod photoreceptors (~25%), the reduction in both populations suggests a general abnormality in the rod pathway of albinos. Further, our data support the view that melanin is crucially involved in the normal development of retinal structure.

A Novel Ocular Photopigment Capable of Driving Pupillary Constriction in Mice

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Purpose While image forming vision is mediated by rods and cones, some tasks requiring information about overall levels of illumination utilise visual pigments housed in other retinal cells. Thus transgenic mice lacking both rods and cones continue to show circadian and pineal responses to light. Here we investigate the pupil reflex (PLR) in such rodless/coneless mice (*rd/rd cl*).

Methods Pupil areas were determined in dark adapted, wild type and rodless/coneless mice illuminated with various intensities of white and monochromatic light.

Results In response to bright light (3mW/cm²) both wild type and *rd/rd cl* mice responded with a rapid PLR, the extent of which was the same in both genotypes. The wild type response latency (0.45±0.022 s) was shorter than that of *rd/rd cl* mice (0.73±0.05 s). At lower intensities the PLR of transgenic mice was 2.5 log units less sensitive. That the PLR in *rd/rd cl* mice is not mediated by direct iris photosensitivity was indicated by the fact it is consensual and abolished by atropine. While the action spectrum of the PLR in wild type mice matched the absorption spectra of murine rod and green cone photoreceptors, no known pigment represented a good match for the *rd/rd cl* spectral response, which was well described by a opsin: vitamin A based photopigment with λ_{max} 479nm.

Conclusions These data indicate that the mouse retina contains photoreceptors other than rods and cones, which are capable of driving tasks such as the PLR, that require information about overall light levels. Recent evidence indicates that it may be the ganglion cells that are directly photosensitive.

Postural stability changes in elderly subjects due to disruption of the somatosensory and vestibular system inputs, refractive blur and dual tasking.

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Purpose. To determine the effect of disruption of the inputs from the somatosensory and vestibular systems, refractive blur and dual tasking on postural stability in healthy, elderly subjects.

Methods. Fifteen healthy, elderly subjects (mean age 71 ± 5 years, binocular VA -0.07 ± 0.05 logMAR, Snellen 20/17) with no history of falls and normal vision were recruited. Postural stability during standing was assessed using an AMTI force plate, and was determined as the Root Mean Square (RMS) of the Centre of Pressure (COP) signal in the anterior-posterior (AP) and medial-lateral (ML) directions collected over 30 second periods. Data were collected under normal standing conditions and when the inputs from the somatosensory and vestibular systems were disrupted. Measurements were also repeated with the subject being given an additional physical task (holding a tray of cups) and/or mental task (counting backwards). For all measurement conditions, postural sway was measured under conditions of binocular refractive blur of 0, 1, 2, 4 and 8D and with eyes closed. The data were analysed using a population-averaged linear model.

Results. All factors except the additional physical task significantly decreased postural stability ($p < 0.001$). The greatest decreases in postural stability were due to disruption of the somatosensory system (95% AP increase) and disruption of both the somatosensory and vestibular systems (152% AP increase). Increasing refractive blur caused decreasing postural stability, with 8D blur causing a 44% increase in AP RMS COP under normal standing conditions. The effect of refractive blur was greater when the input from the other sensory systems was disrupted (81% increase in AP RMS COP with 8D blur). Performing an additional mental and physical task increased AP RMS COP by approximately 24%. All these detrimental effects on postural stability were cumulative.

Conclusions. All the factors tested, except the additional physical task, significantly decreased postural stability and were cumulative. This highlights the multifactorial nature of balance control. Findings indicate that the visual system becomes increasingly relied upon when inputs from the other two balance control systems are disrupted.

Oculomotor adaptations produced by virtual reality environments

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Purpose. Virtual reality (VR) displays require a static accommodation response to be maintained despite continual variation in vergence. The aim of this experiment was to establish the effect of VR stimulation upon the tonic elements of the accommodation and vergence controllers.

Methods. 20 subjects (mean age 22.0 ± 4.5 years) participated with informed consent in the experiment. The subjects were emmetropic and free of all ocular or systemic disease. Tonic accommodation (TA) was measured in darkness using the Shin-Nippon SRW-5000 infrared autorefractor which takes a measure of the accommodative state every 1s. Readings were taken over a period of 3 minutes and an average TA value was calculated when the accommodative state had reached a stable level. Tonic vergence (TV) was measured in darkness continuously for 3 minutes using an Eyetrace 300X infrared limbal eyetracker and an average TV value was calculated when the traces had reached a stable level. Subjects were then immersed in a VR environment, for 30 minutes, generated using SimulEyes field-sequential shutter goggles controlled by a Dell XPS R450 PC. The VR display required a constant accommodation response of 3D, while the vergence response typically varied between 0 and 5MA. Following immersion, measurements of TA and TV were repeated.

Results. A significant relationship ($y=1.13x-0.71$, $R=0.85$, $P=0.001$) was found between the initial TV level and the shift induced by the VR environment such that negative TV positions shifted in the positive direction and vice-versa. No significant change in TA was observed.

Conclusions. The VR environment produced substantial adaptation of TV. These findings suggest that the vergence controller acts to shift vergence bias in order to reduce stimuli conflicts with accommodation found in VR environments. This enables subjects to maintain a stable accommodation response despite continual changes in the vergence position.

Mindsight: pathological completion in a case of occipital damage without neglect.

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Purpose

Islands of blindness (scotomata) caused by damage to the visual regions of the brain may be accompanied by the subjective experience of completion of forms that “should” be occluded by the visual defect, a symptom termed Pathological Visual Completion. We report our investigations of the basis of this phenomenon and the level of visual processing that is implicated.

Method

We report a single case with left occipital brain injury who showed pathological visual completion in a clear and reliable form. His disorder could not be explained by residual vision or an attentional disorder.

Results

The likelihood of completion was systematically influenced by changes in the stimulus display. Pattern masking, varying the contrast characteristics of stimuli and changing visible cues to structural symmetry all had precise effects whereas familiarity and structural coherence did not.

Conclusion

We suggest that in this case, pathological completion may be a positive cognitive event implicating processes that underpin the normal experience of occluded forms.

The support of the Wellcome Trust is gratefully acknowledged.

Contrast sensitivity and copy drawing performance in patients with cortical lesions: high or low level deficit?

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Purpose:

Copy drawing is a complex task involving perception, attention and the generation of motor output, and it is sensitive to the effects of brain lesions or dementia. Our research examines the relationship between high and low level visual deficits and copy drawing.

Method:

We have obtained copy drawings of a Navon figure (a global letter H composed of local letter T's), and measured visual contrast sensitivity (CS), visual fields, and neglect (line bisection and star cancellation), in 105 patients with cortical lesions. Copying of global and local letters was scored independently. CS was measured using single letters (Bailey-Lovie) or symbols (Ffooks test) at varying sizes.

Results:

Correlations were found between local and global copying performance and CS. Disorganisation of copy drawing at the global level was dissociable from disorganisation at the local level. Global disorganisation was associated with reduced CS, particularly at larger letter sizes. Patients showing extreme distortions such as the omission or duplication of part of the global figure all had reduced CS to the largest letter size. However the converse is not true: not all patients with reduced CS to large symbols were unable to copy the global figure.

Conclusions:

The perceptual component of constructional apraxia may include reduced CS to large stimuli.

Acknowledgement:

Access to the patient volunteers in this study was provided through the clinical collaboration of Dr Frances Clegg and Dr Lynne Turner-Stokes.

Temporal integration of astigmatic blur information.

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Purpose: The accommodation response has recently been shown to improve visual acuity (VA) in the presence of astigmatism in some individuals. This improvement could potentially result from the accommodation system exhibiting a cyclic tracking response. This type of response would allow the integration of target features over time, resulting in an improvement in VA. In this study we measure VA in simulated astigmatic blur conditions, with the magnitude of astigmatic blur being temporally modulated over a range of astigmatic blur intervals. Improvement of VA with increased range of astigmatic blur would support the integration of visual information over time hypothesis.

Methods: Three fully corrected subjects participated in a 3-AFC method of constant stimuli paradigm where they were asked to identify one of three randomly chosen letters (K, R or X). The stimuli (Arial, font size 18) were subjected to varying amounts of Gaussian blur along the horizontal and vertical meridian and presented at a distance of 1.3m. On any trial, the stimuli were randomly presented to the subjects at one of six astigmatic blur intervals. Each blur interval revolved at a temporal frequency of 2 Hz around the circle of least confusion with the smallest interval presenting the stimuli at the circle of least confusion and the largest oscillating the stimuli across the full interval i.e. from the most horizontally to vertically blurred meridian.

Results: From the resulting psychometric functions it was shown that all subjects exhibit a progressive improvement in letter recognition with increasing astigmatic blur interval.

Conclusions: The improvement of VA with increased astigmatic blur interval strengthens the hypothesis that visual information can be integrated over a period of time.

Errors in the visual perception of size in left hemi-parkinson's disease

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Purpose: Although Parkinson's disease (PD) has been considered to be primarily a motor disorder, there is increasing evidence for perceptual abnormality in the illness, which might impair the visual control of movements. We investigated how the perceived size of visual stimuli in PD depends on their position in external space, as well as on the involvement of the right hemisphere.

Methods: Patients with mild/moderate idiopathic PD were allocated to a primarily left- or a primarily right-sided group (LPD, RPD; n= 7 or 8 in different experiments) from the severity of tremor, rigidity, and akinesia in the left and right limbs. The ratio of severity of symptoms between the worse and least affected side averaged more than 3:1. In a method of constant stimuli, observers judged whether the width or height of a (variable) rectangle in one region of space was greater than that of a (standard) rectangle in another region. Psychometric functions were fitted to each observer's data by probit analysis, from which the mean (point of subjective equality) and slope were obtained.

Results: In LPD (but not RPD or controls) rectangles in left space had to be wider than identical rectangles in right space, and rectangles in right space narrower than identical rectangles in left space, to be perceived as of equal width. Similarly, a rectangle in lower space had to be shorter than an identical rectangle in upper space to be perceived as of equal height, whether the rectangles were positioned in right or in left space.

Conclusions: The results are consistent with a perceptual compression of objects in left and upper space in LPD (but not in RPD), implicating right-hemisphere dopaminergic mechanisms in the visual perception of size. The effects are small (about 4%) but may be important in the visual

control of precise movements in LPD.

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HABITUAL BINOCULAR PERFORMANCE AND VISION-RELATED QUALITY OF LIFE

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Purpose: Binocular summation (binocular > monocular) and inhibition (binocular < monocular) have been shown in various laboratory and clinical situations. The occurrence of habitual binocular summation/inhibition is unknown. The aim of this study was to investigate binocular performance in 100 'ocularly normal' subjects over the age of 45 years attending an optometric practice. In addition, very little data exist on habitual quality of life (QOL) scores in normal subjects. We aimed to investigate whether binocular performance for different visual tasks affected QOL scores.

Methods: Right eye, left eye and binocular contrast sensitivity (CS), near and distance LogMAR acuity (VA), and face recognition were measured. Vision-related quality of life (QOL) scores were measured using the NEI – VFQ 25 questionnaire.

Results: Binocular summation ratios were similar to those reported under laboratory conditions. Binocular summation ratios for visual acuity were 26%, 47% for CS and 11% for face recognition. Binocular inhibition (binocular < monocular) was shown by 12 subjects with VA, 7 people in CS and 31 subjects with face recognition.

Conclusions: Face recognition showed the poorest summation as it falls under the complex pattern recognition known to produce lower summation under laboratory conditions. Binocular summation ratios were not significantly associated with either the age of the subject or to the differences between the two eyes.

Accommodation responses in late-onset myopia are improved by spatiotopic stimulation

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Purpose. Inaccurate accommodation responses to retinotopic stimuli have been shown in late-onset myopia (LOM). The aim of this experiment was to determine whether spatiotopic (perceived proximity) and binocular stimulation would improve the quality of accommodation responses in LOM subjects.

Methods. 10 emmetropic subjects (mean age 22.3 ± 2.3 years) and 10 LOM subjects (mean age 21.8 ± 1.5 years) participated. A specially modified Canon R-1 infrared optometer was used to measure accommodation responses. Three conditions were presented: 1. Monocular blur-only stimulus, 2. Monocular free-space stimulus, 3. Binocular free-space stimulus. Each condition was presented on a separate day to avoid fatigue effects.

Results. Accommodation stimulus-response curves in the LOM group showed improved accuracy with the spatiotopic stimulus. Microfluctuations were significantly ($p < 0.01$) smaller in magnitude in the LOM group with the spatiotopic stimulus, due to reductions in the low frequency components of the fluctuations. A significant ($p < 0.01$) increase in the percentage of correct step accommodation responses for the spatiotopic stimulus was found in the LOM group. However, step response times in the LOM group with the spatiotopic stimulus were not significantly different than those found with the retinotopic stimulus, and were significantly ($p < 0.01$) longer than those found in the emmetropic group.

Conclusions. 1. Spatiotopic stimulation produces significant improvements in static accommodative accuracy in LOM subjects compared with retinotopic stimulation. 2. The quality of dynamic accommodation responses in LOM subjects was found to improve significantly with spatiotopic stimulation. 3. LOM subjects appear to

rely upon proximity driven stimuli to improve accommodative response accuracy.

The development of The Quality of Life Impact of Refractive Correction (QIRC) Questionnaire

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Purpose: To develop an instrument for the comprehensive measurement of the impact of refractive correction on quality of life in the pre-presbyopic age group. To design the questionnaire to be relevant to refractive correction by spectacles, contact lenses and refractive surgery. **Methods:** Quality of life domains were identified using literature review and professional focus group discussion. Items within these domains were selected from the scientific literature (global, vision-specific and cosmetic surgery-specific quality of life instruments) and from suggestions of professionals and lay people. Six focus groups were used for item reduction: Three groups of professionals (psychology and eye care professionals experienced with spectacle, contact lens and refractive surgery patients) and three groups of lay public. The reduced item set was built into a pilot questionnaire. Statistical analysis for item reduction included factor analysis (SPSS) and Rasch modelling (Quest, Rumm 2010). **Results:** Seven domains of quality of life were selected. Within these, 647 items were selected as possibly being relevant. This number was reduced based on the responses of the focus groups to 90 items, which form a pilot questionnaire. The responses of 306 subjects (102 spectacle wearers, contact lens wearers and people who have had refractive surgery) were used to further reduce items using factor analysis and Rasch modelling. This resulted in the final version of the Quality of Life Impact of Refractive Correction (QIRC) questionnaire. **Conclusions:** The methodological approach for item selection, item reduction, question construction and response scaling ensures construct validity of the QIRC questionnaire. The QIRC questionnaire is suitable for measuring quality of life in

spectacle, contact lens wearers and refractive surgery patients, for outcome and cross-sectional research.

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Does corneal polarisation vary with corneal astigmatism?

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Purpose: To assess the correlation between the axis of corneal astigmatism and/or corneal thickness with that of corneal birefringence in a small group of observers using a subjective polarimeter and a corneal topographer.

Method: The corneal polarisation axis and corneal astigmatism directions were measured in 11 subjects, providing data for 22 eyes. One kerataconic subject was included in the sample. The study utilised subjective ellipsometry using an instrument engineered at Imperial College, London to determine the corneal polarisation axis. An *Orbscan* corneal topographer (kindly made available by Dr. David Anderson, from Moorfield's Eye Hospital, London) was used to measure corneal astigmatism and corneal thickness.

Results: It was found that the angle of corneal polarisation axis and the steepest direction of corneal astigmatism were correlated. The correlation coefficient for the RE was -0.49 , whilst that for LE was 0.43 . A similar relationship was found for the flat axis of the cornea.

Conclusions: There was a fair correlation between the corneal polarisation direction and both the flat and steep axis of corneal astigmatism. It was also found, in agreement with other studies, that corneal polarisation axis in either eye was symmetrical about the nose, as was corneal astigmatism. The kerataconic cornea followed the trend observed, although nothing conclusive can be stated. A relationship between the corneal polarisation axis and corneal thickness was not established. Analysis of the data provided us with simple equations, which could help to predict a polarisation axis for a known direction of corneal astigmatism

Ability of Frequency doubling perimetry and scanning laser polarimetry to detect Ocular Hypertension and POAG in an Indian population.

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Purpose: To evaluate the ability of Frequency doubling perimetry (FDP) and scanning laser polarimetry (GDx) in the detection of Ocular hypertension (OHT) and Primary Open Angle Glaucoma (POAG). **Method:** Subjects were classification as being normal or having OHT or POAG (mild, moderate and severe) based on clinical findings and visual field results (Anderson classification). 104 eyes of 86 subjects who satisfied the inclusion criteria and completed the successfully were analysed. Sensitivity and specificity of C-20 screening test (Patel et al 2000 scoring) and N-30 Full field (Mean Deviation (MD), Pattern standard deviation (PSD)) FDP tests were analysed for OHT and three POAG groups. Sixteen GDx parameters were compared between normal subjects and other groups. Receiver operator characteristic (ROC) curves were plotted for the GDx parameter "The Number". **Results:** All sixteen GDx parameters showed progressive changes (OHT to severe POAG) and statistically significant results, when compared with the normal subjects. The other significant results are summarised below.

Classification	GDx The number	FDP			
		C 20-5 screening Patel et al scoring (>5)		N 30 Threshold Mean deviation (P < 5)	
	Area u/ROC	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity
OHT	0.73	16	100	22	83
MILD POAG	0.90	35	100	59	87
MODERATE POAG	0.97	92	100	88	96
SEVERE POAG	0.98	100	100	100	100

Conclusion: Both FDP and GDx are valid screening tools for detection of OHT and POAG. Both instruments appear to be highly specific and sensitive for the detection of moderate and severe POAG. An appropriate normative database of Indian population would help to improve the sensitivity and specificity of FDP and GDx in detecting the early changes and helps in better understanding of the Progression of OHT and POAG.

GANZFELD CHANGES IN SHORT WAVELENGTH AUTOMATED PERIMETRY

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Purpose: The change in perception of background illumination known as Ganzfeld changes occurs while performing perimetry test. It occurs under higher background illumination and whilst covering the non-tested eye with a black patch. We investigated the occurrence of ganzfeld changes in Short Wave Length Automated Perimetry (SWAP) and assessed the performance while covering the non-tested eye with a standard black patch and with a translucent occluder.

Method: Twenty-eight volunteers of age 22 ± 3 years participated in the study. A custom made 16-point test was used to analyse the sensitivity with a standard black patch and with the translucent occluder. The number and duration of ganzfeld changes in each condition were detected by subjective responses. The visual comfort of the subjects under each patching condition was assessed using a comfort scale (0-5) and subject's preference.

Results: Ganzfeld changes occurred when a standard black patch was used and appears to influence the ability to see the test targets. With a standard black patch 5 Ganzfeld changes were observed per minute and it varied between 2 and 8 sec. The duration and occurrence increased towards the end of the test. Using a translucent occluder at most eliminates the occurrence of Ganzfeld changes and improved the sensitivity ($P = 0.001$). Out of 28 subjects, 22 preferred translucent occluder to black patch.

Conclusion: Use of a translucent spectacle occluder over the non-tested eye significantly reduces the Ganzfeld changes and improves the performance in SWAP.

Stimulus Size and the Variability of the Threshold Response in the Central and Peripheral Visual Field

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Purpose: The investigation of the peripheral visual field has shown considerable interest for the investigation of field loss attributed to anti-convulsant therapy. The purpose was to determine the within-visit between-subject, the between-visit between-subject, and the between location variability of the threshold response in the normal eye with increase in stimulus eccentricity out to 60° as a function of stimulus size.

Methods: Forty-eight normal subjects attended for a total of three visits (mean age=49.5 years, SD 18.9, range 22 to 84 years). At the first visit, one randomly assigned eye of each subject was examined with the Humphrey Field Analyzer 750 and the Full Threshold algorithm using Programs 30-2 and 60-4 and stimulus sizes III and V. The combination of stimulus size and of program, and the order of the combination within- and between-sessions, were randomized for each subject. The results of the first visit were considered as a familiarization period and were discarded. The protocol at the second and third visits was identical to that at the first visit for each subject.

Results: The ratio of the standard deviation (SD) of the group mean sensitivity was determined at each stimulus location for stimulus size III compared to stimulus size V for Programs 30-2 and 60-4 at Visit Three. The SDs were greater than unity for Program 30-2 ($p < 0.0001$) and for Program 60-4 ($p < 0.0001$) indicating greater variability for the size III stimulus. The SDs were also greater than unity for the central inner zone ($p < 0.0001$), central outer zone ($p < 0.0001$) and peripheral inner zone ($p < 0.0001$). The ratios in the peripheral outer zone were not quite greater than unity ($p = 0.054$). The ratios increased with increase in eccentricity by up to 2.7 times between 15° and 30° eccentricity and by up to 2.7 times between 30° and 60° eccentricity. The group mean ratio did not vary significantly between the two visits for Program 30-2 stimulus size III ($p = 0.563$), Program 60-4 stimulus size III ($p = 0.935$) and for Program 60-4 stimulus size V ($p = 0.005$). However, the group mean SD was lower at visit three compared to visit two for Program 30-2 stimulus size V ($p = 0.0004$). The SDs associated with the extreme peripheral locations in the superior and nasal fields were smaller for stimulus size III because the threshold was frequently attenuated by lid and facial contour.

Conclusions: Considerably narrower confidence limits for normality for the peripheral regions of Program 30-2 and for 60-4 are demonstrated with the use of Goldmann size V.

Modified Attentional Fields In Ageing

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Purpose: Clinical vision testing tends to underestimate age-related visual decline. We have modified an automated perimeter by adding a second task at fixation and have investigated visual fields in conditions of focused (FA) and divided attention (DA).

Methods: Two lasers were mounted on a Humphrey Visual Field Analyzer. They projected red targets 2mm either side of the standard fixation target. 15 young (mean age: $20 \pm 1.4y$; range 18-23) and 15 healthy old subjects ($72 \pm 5.1y$; 65-80) were assessed under FA using Fastpac 30-2 program (sequence 1). Subjects then repeated the test twice under DA (sequences 2 & 3), in which they were instructed to press a second handheld button in response to an asynchronously presented central laser target. They also responded to continuing laser targets after the threshold program finished.

Results: For old subjects under DA, the mean threshold increased by 2.87cd/m^2 (seq2) and 0.8cd/m^2 (seq3) compared to FA (seq1). By comparison young subjects increased by 0.03cd/m^2 (seq2) and decreased by 0.55cd/m^2 (seq3). Compared to young subjects, mean threshold for old subjects was 8.44cd/m^2 (seq.2) and 6.89cd/m^2 (seq.3) greater. Mean reaction times for the fixation task alone were comparable (young: $353 \pm 46 \text{msec}$ vs. old: $352 \pm 52 \text{msec}$). However, when combined with the threshold field task, reaction times increased by much more in the old group (e.g. $497 \pm 46 \text{msec}$ vs. $557 \pm 50 \text{msec}$ seq.2).

Conclusion: The visual fields of old subjects were only slightly reduced in DA conditions although the reduction was clearly greater than for the young group. There were marked increases in the reaction times of the older group to targets presented at fixation. Continuing studies will assess impact of DA on patients with ocular and cerebral disease.

The Effect of Ageing on the Range of Ocular Movements

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Purpose: Although it is generally believed that defective conjugate upward gaze is common in the elderly, there is little evidence in the literature to support this. We investigated the range of ocular movements in both an elderly and a young group of subjects, under both binocular and monocular conditions.

Methods: Ten old (mean age 71.38 ± 5.2 years) and six young subjects (20.17 ± 1.7 years) with good and equal visual acuity, normal binocular single vision and normal ocular movements participated. Heterophoria in nine positions of gaze was measured on the synoptophore. The range of eye movement was assessed binocularly and monocularly using Snellen fusion slides and the extent of elevation, depression, right gaze and left gaze recorded.

Results: Under binocular and monocular conditions, the range of movement decreased for all positions in the older group. The difference was only statistically significant in elevation ($p < 0.05$). There was no statistically significant asymmetry between the eyes for any position for either group. Under monocular conditions there was a statistically significant symmetrical reduction in the extent of abduction in the older group in both right ($p < 0.01$) and left eyes ($p < 0.05$) compared to the younger group. In contrast, there was no statistically significant difference for either eye on adduction.

Conclusion: These results confirm a decrease in elevation in healthy older individuals with slight restrictions in all other positions. There was a statistically significant and previously unreported decrease of abduction under monocular conditions in the elderly group. Thus asymmetry between the eyes remains the best tool when diagnosing a pathological weakness in eye movement, but more research is needed to confirm the extent of these age related restrictions.

Oblique Saccades in Visually Normal Human Observers

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Introduction: Recent evidence suggests that oblique eye movements are differentially affected by some systemic diseases (for example Graves' disease). Previous studies of eye movements have tended to concentrate on horizontal or vertical eye movements. The aim of this study is to establish baseline data (latency, duration and peak velocity) for oblique eye movement in normal human observers.

Methods: Eye movements were measured using an IRIS 6500 infrared limbal eye tracker (Skalar Medical, Delft, The Netherlands) customized for the direct recording of oblique eye movements. Data were collected at a sampling rate of 205Hz and a resolution of 0.05° using a Gould 1604 digital storage oscilloscope. Data were subsequently transferred via an IEEE488 interface bus to a PC for analysis. Ten visually normal observers recruited from the student and patient population of the University of Bradford's Eye Clinic participated in the study. Subjects made saccadic eye movements in 5° to 15° steps in horizontal, vertical and oblique orientations. Stimuli were presented in random order to ensure there was no predictable component to the response.

Results: Saccadic responses to vertical and horizontal step stimuli were consistent with previous published work. The modification to the eye tracker allowed direct measurement of oblique saccades. The duration of the saccade increased as a function of stimulus amplitude and conformed to the relationship: $D = D_0 + d.A$. Calculation of latency ($\sim 200\text{ms}$), duration ($\sim 80\text{-}100\text{ms}$) and peak velocity ($\sim 300\text{ms}^{-1}$) for oblique saccades gave responses, which were similar to those, reported using indirect measurement.

Conclusion: A veridical measure of oblique saccadic eye movements was obtained using the modified eye tracker. Oblique responses were generally slower than for horizontal measures of saccadic eye movements. These baseline data will allow a comparison in age-matched subjects with early onset ocular motor anomalies.

Within-Texture Alignment Improves Human Texture Segmentation

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Purpose

Spatial arrangement has been shown to be a critical factor both in detection facilitation of a threshold target by collinear flankers and in detection of smooth chains within random arrays of suprathreshold elements. Here, we investigate the effect of alignment between texture elements on human texture perception.

Methods

Texture displays, consisting of arrays of elements, were presented to observers for 100ms. Trials were completed with both line elements and with Gabor patches. A discrimination task consisted of one stimulus presentation, and observers distinguished between two possible orthogonal orientations of a central block, which differed from the surround by the orientation of its elements. A detection task required observers to indicate in which of two presentations the central block was present. For both tasks, the degree of alignment within stimuli was varied either by increasing orthogonal offset between elements or by decreasing the length of chains of aligned elements. Both alterations result in an overall reduction of collinearity within the display. A close-spaced and a far-spaced condition were tested. Global element density was kept constant within all line trials and within all Gabor trials.

Results

For nearly all conditions, alignment was found to improve thresholds. The effect was robust to orientational jitter up to a standard deviation of the array-element population of 8 degrees.

Conclusions

Our results suggest that collinearity between elements results in both short and long-range interactions, which contribute to the formation of a texture-defined surface. Interactions between close-spaced elements might be explicable in terms of a linear-filter summation paradigm, but results for far-spaced elements would definitely require additional mechanisms.

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Digital Imaging System for Assessing Posterior Capsular Opacification; a Preliminary Report

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Purpose: Posterior capsular opacification (PCO) is the commonest complication of cataract surgery. The aim of this work is to develop a system that could be used by primary care practitioners to monitor the progression of PCO using familiar equipment. **Methods:** A Kodak DCS 100 digital data back, which uses a Nikon F3 body, was connected to the camera port of a Nikon FS-2 photo slit-lamp. A fixation stimulus was developed and systematic studies carried out to determine optimum exposure and slit-lamp settings using patients recruited from the YAG laser capsulotomy clinic at the Royal Eye Unit, Kingston Hospital. In all cases conventional illumination was used. Inter and intra-observer trials were then carried out using observers ranging from a non-clinician to an experienced ophthalmologist. All images were analysed using ImagePro Plus image processing software prior to statistical analysis. **Results:** Optimum slit-lamp parameters were found to be a 45degree slit beam angle, 3mm slit width and 25x magnification. The flash intensity was set to 2. The optimum camera and digital storage unit speed settings were both ISO 200 for fibrotic PCO but 800 and 1600 respectively for Elschnig pearl type PCO. Intra-observer repeatability gave $\pm 0.375\text{mm}$ (95% confidence) variation in fixation. However, initial results from inter-observer trials showed significant variability. **Conclusions:** The current digital assessment system uses a standard piece of consulting room equipment coupled to a digital 35mm camera. Initial results indicate that it should be suitable for use in monitoring PCO although a more exact measurement protocol is required to reduce inter-observer variability. Work is currently underway to complete validation trials and to find suitable image statistics.

RETINAL PROJECTIONS TO THE THALAMUS IN ALBINO FROGS.

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Melanin in the embryonic retinal pigment epithelium (RPE) is essential for normal development of the mammalian visual system: in albino and other mutant mammals lacking this pigment, many temporal retinal ganglion cells (RGCs) that usually project ipsilaterally misroute their axons across the optic chiasm to the opposite side of the brain. In human albinos, this misrouting results in higher visual centres receiving predominantly monocular input from the opposite eye and in defective binocular stereovision.

The RPE-RGC signalling mechanisms that govern the chiasmatic pathway choices of ganglion cell axons are unknown, but may involve gap junctions, which are a conserved feature of the embryonic retina in all vertebrate classes. To determine whether chiasmatic abnormalities also generalize to non-mammalian pigment mutants, we compared the distribution of crossed and uncrossed retinal projections to the thalamus in normal and albino *Xenopus* frogs. In both phenotypes, retinal terminations from the opposite eye covered ~80% of the neuropil of Bellonci and corpus geniculatum thalamicum (analogous to the mammalian lateral geniculate nuclei), with uncrossed inputs occupying ~75% and 25%, respectively, of the two terminal fields. Ipsilateral projections originated from ~3000 RGCs in the wild-type and albino frogs, and in both phenotypes they were restricted to a ventrotemporal crescent comprising ~40% of the total retinal area.

In sum, we found no evidence of chiasmatic misrouting in albino *Xenopus*, despite the fact that this species normally possesses retinal projections with a substantial ipsilateral component. Our findings support other recent evidence that a lack of RPE melanin leads to defective development of the retina and its central pathways only in mammals.

Does Optic Disc Topography Vary During Office Hours?

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Purpose: To investigate whether there is variation in optic disc topography as measured by the Heidelberg Retina Tomograph (HRT), in normals during office hours.

Methods: Thirty normal subjects (22F and 8M, median age 28 years, range 18 to 58) underwent Goldmann tonometry and optic disc analysis with the HRT. Three HRT readings were taken at each visit and a mean topographic image (MTI) produced. Measurements were performed in the morning (0700h to 0900h) and were repeated later the same day (1700h to 1900h). We studied the following topographic parameters: cup-to-disc area ratio (CDR), rim volume (RV), cup shape measure (CSM), and retinal nerve fibre layer thickness (RNFLT) in relation to time of day and the change in intraocular pressure (IOP).

Results: The median changes in the topographic parameters were as follows (a negative value indicates a larger value in the evening): CDR (median 0.001, 95%CI -0.007-0.007), RV (median 0.003, 95%CI -0.021-0.016), CSM (median -0.003, 95%CI -0.015-0.007) and RNFLT (median 0.006, 95%CI -0.010-0.009). No parameter exhibited statistically significant change. The median morning IOP was 14 mmHg (95%CI 13-16mmHg) and was not significantly different (Wilcoxon's $W=234$; $p=0.27$) to evening IOP when it was 13 mmHg (95%CI 12-15mmHg). The median difference in IOP was 1mmHg higher in the morning than the evening (range 6mmHg higher in the morning to 4mmHg higher in the evening). The parameter changes between the morning MTI and the evening MTI were independent of IOP changes using Kendall's tau statistic for each parameter.

Conclusions: There was no variation in HRT parameters when measured during office hours. Small intra-individual changes in IOP do not significantly affect optic disc topography.

Effects of ethnic origin on pulsatile ocular blood flow

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Purpose: To study the effect of ethnicity on pulsatile ocular blood flow (POBF).

Methods: Eighty subjects from the staff and student population at Anglia Polytechnic University were examined. Forty subjects (20 males, 20 females) were Asian (originating from the Indian subcontinent) and 40 (20 males, 20 females) were Caucasian. The subjects underwent a complete ophthalmic examination including refraction, slitlamp examination and biomicroscopic funduscopy. Subjects with ocular pathology were excluded from the study. Subjects underwent POBF measurement on a randomly selected eye with an Ocular Blood Flow Analyzer (Paradigm Medical Industries, USA). The Analyzer probe was mounted on a slitlamp and all measurements were performed by an experienced observer (PG).

Results: The median age of the Asian subjects was 22 years (males 22; females 22 years) and of the Caucasians was 24 years (males 26; females 23 years). The racial groups were comparable for age (Mann-Whitney $U=686.5$, $p=0.27$), refraction (Mann-Whitney $U=735.5$, $p=0.4658$) and IOP (Mann-Whitney $U=856$, $p=0.5899$). The mean POBF values in the Caucasian and Asian groups were $1033 \mu\text{l}/\text{min}$ (95% CI $940\text{--}1125 \mu\text{l}/\text{min}$) and $1061 \mu\text{l}/\text{min}$ (95% CI $958\text{--}1165 \mu\text{l}/\text{min}$) respectively. The difference in POBF between the ethnic groups did not reach statistical significance (Mann-Whitney $U=0.07$, $p=0.7987$). Females had a higher mean POBF than males (Mann-Whitney $U=1163$; $p=0.0005$) but there was no interaction with race (2-way ANOVA $F=1.09$; $p=0.2997$).

Conclusions: There was no significant difference between the mean POBF values for subjects originating from the Indian subcontinent and Caucasian subjects. The previously reported gender difference in mean POBF was confirmed. We suggest that reported differences in POBF values in different races may arise from instrumental factors.

THE USE OF CRITICAL FLICKER FREQUENCY (CFF) AS A POTENTIAL VISION TEST PRIOR TO CATARACT SURGERY. A PILOT STUDY

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Background

To determine whether a patient would benefit from cataract surgery, a preoperative evaluation of retinal visual function is required. Age-related macular disease has been reported as the most important factor leading to poor outcome after cataract surgery.

The CFF is a psychophysical test that measures temporal resolution properties in the visual system.

Purpose: 1). To evaluate if CFF can be used as a tool to predict visual outcome after cataract surgery. 2). To assess if lens opacities and/or retinal damage affects CFF values. 3). To assess the optimal configuration for the CFF target in relation to stimulus size.

Methods: 32 patients have been included in the pilot study. Subjects were divided into the following categories: cataract, central retinal disease, pseudophakes and cataract after pupil dilatation. CFF threshold measurements were obtained after optimal refraction and visual acuity measurement using a Bailey-Lovie logMAR chart. A staircase method was used to find the CFF threshold. For each subject, three different stimulus sizes were analysed.

Results: CFF measurements were unaffected by the presence of cataract ($p > 0.05$). Pupil dilatation gave slight higher results in patients with cataracts, although this difference was not statistically significant (ANOVA $F=3.6$, $p=0.07$). A significant difference for the three targets sizes was found (ANOVA $F=41.94$, $p<0.05$). Retinal disease produced an insignificant decrease in CFF ($p>0,05$) ($n=5$).

Conclusions: CFF appears to be independent of the image degrading effects of cataract. Comparison of the means for the different conditions studied show a slight decrease in CFF measurement for retinal disease in comparison to the cataract group. However, more subjects are needed to determine the usefulness of CFF as a potential vision test.

The Contrast Acuity Assessment (CAA) test for quantifying reduced visual performance post-refractive surgery.

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Purpose: A relatively large proportion of patients complain of poor quality night vision after undergoing corneal refractive surgery. Previous work

by the author has suggested a small but statistically significant reduction in visual performance that persists many years after photorefractive keratectomy. This has been attributed to an increase in forward light scatter and/or aberrations. High contrast acuity is a relatively insensitive measure of retinal image degradation and contrast sensitivity studies often contradict each other. The aim was to develop a screening test relevant to commercial aviation that was sensitive to intraocular light scatter and aberrations.

Method: The Contrast Acuity Assessment (CAA) test employs parameters (target size, light level and visual field size) determined during the study of a modern commercial flight deck. The size of the Landolt ring stimulus was scaled for retinal eccentricity based on the assessment of 64 normal subjects at 24% contrast (photopic 12 cd m^{-2}) and 48% contrast (mesopic 0.05 cd m^{-2}). Contrast thresholds (gap discrimination) were measured at 7 eccentricities between $\pm 5^\circ$, presented in a random order using a four-alternative, forced-choice staircase procedure. Contrast thresholds were obtained in 100 normal subjects under photopic and mesopic conditions and were found to be approximately 24% and 48% respectively, defining the “standard” observer. Seventeen PRK and eight LASIK subjects were examined to validate the test. **Results:** Many of the subjects were identified as having good visual performance with data points clustered around the “standard” observer. In a few subjects, increased scatter and aberrations caused a characteristic \wedge -shaped increase in contrast thresholds indicating reduced visual performance. All symptomatic patients exhibited contrast acuity thresholds outside the normal 99% range. **Conclusions:** The majority of refractive surgery patients have good visual performance as indicated by the CAA test but a minority suffer reduced visual performance with data points falling outside the normal range.

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COMPUTER COLOUR TESTS FOR THE MAJOR CAUSES OF BLINDNESS USING AN INEXPENSIVE PC SYSTEM

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Background. Computer-graphics methods of assessing acquired losses of colour vision are superior in many ways to all others. They can employ briefly flashed stimuli, that can be presented in the retinal periphery; any luminance signal can also be masked by dynamic random luminance noise; and chromaticity can be varied very precisely. We have devised a program that is designed to detect and quantify disturbances in the 3 major blinding conditions (Glaucoma, ARMD and Diabetes). **Methods;** A standard PC, fitted with a dual-head graphics board, and suitable software, displays alphabetic letters or peripheral crescents on the face of a suitably calibrated 100Hz monitor. The subject responds with the letter name, or the position of the peripheral target. If the subject is wrong, or fails to respond, this is an error. The program modifies the chromatic contrast between background and target in a Modified Binary Search procedure, and terminates the test when a present degree of precision is obtained. The chromatic threshold so obtained is printed out with graphics to show the age-related degree of abnormality. **Results;** Normal results from age-matched groups prove prominent tritan losses in all 3 conditions. In diabetes, relatively large abnormalities can be detected before the appearance of mild background retinopathy, and worsen with the appearance of microaneurysms. In suspected glaucoma, abnormalities can be detected when conventional perimetry is ambiguous. There is a good correlation with minor changes on HRT. The loss is related to IOP. In ARM, even with normal visual acuity, very large losses of tritan contrast sensitivity can be seen. Although patients can see the colours on the monitor screen, the targets (small optotypes) cannot be recognised, apparently due to the presence of very small tritan scotomas, which can be demonstrated when the target is flashed briefly. **Conclusions;** Colour vision testing permits rapid screening of patients at risk of developing sight-threatening disorders, and thus is potentially of considerable use in health-care programmes.

Visual Performance of the Human Eye

A Festspiel for W.N.Charman

11th & 12th September 2002
UMIST, Manchester, UK.

A conference to celebrate Professor Neil Charman's extensive contributions to vision science and optometric education.

Programme

Wednesday 11th September

Morning session

09.30 – 10.30: Registration

10.30 – 10.40: Welcome

10.40 – 11.25: Nearwork induced transient myopia
K. Ciuffreda (SUNY, USA)

11.25 – 11.45: Continuous measurement of accommodation in human factor application
J. Wolffsohn (Aston University, UK)

11.45 – 12.05: Accommodation function and ageing
G. Heron (Glasgow Caledonian University, UK)

12.05 - 12.25: Modelling the mechanics of accommodation and presbyopia
S. Judge (University of Oxford, UK)

12.25 – 14.00: Lunch (Harwood Room)

Afternoon session

14.00 – 14.45: Individual variations in the aberration structure of human eyes.

L. Thibos (Indiana University, USA)

14.45 – 15.05: Reaction time – an index of visual conspicuity.
S. Plainis (Volos, Greece)

15.05 – 15.25: Visual functionality entering the mesopic range.
L. Ronchi (AOI, Italy)

15.25 – 16.05: Break. Tea/Coffee/Biscuits

16.05 – 16.25: Design parameters for precision tinting.
A. Wilkins (University of Essex, UK)

16.25 – 17.10: Ocular optics, electroretinograms and primary open angle
glaucoma.
N. Drasdo (Cardiff University, UK)

19.00 – 19.30 Dinner (Harwood Room)

Thursday 12th September

Morning session

09.30 – 10.15: Crystalline Lens Development: The influence of genetics
vs the visual environment.
J. Sivak (University of Waterloo, Canada)

10.15 – 10.35: Sympathetic control of accommodation: evidence for inter-
subject variation.
B. Gilmartin (Aston University, UK)

10.35 – 10.55: Effect of beta adrenoceptor antagonists on autonomic control
of ciliary smooth muscle
B. Winn (University of Bradford, UK)

10.55 – 11.30: Break. Tea/Coffee/Biscuits

11.30 – 11.50: Dynamic properties of near triad of 3D-display observers
measured by aid of video refraction unit
K. Ukai (Nihon Fukushi University, Japan)

11.50 – 12.35: Optics and vision unlimited
M. Freeman (Derbyshire, UK)

12.35 – 14.15: Lunch. (Harwood Room)

Afternoon session

14.15 – 15.00: Monochromatic aberrations of the eye.

H. Howland (Cornell University, USA)

15.00 – 15.20: The contrast sensitivity function for detection and resolution of blue-yellow gratings in foveal and peripheral vision.

R. Anderson (University of Ulster, UK)

15.20 – 15.50: Break. Tea/Coffee/Biscuits

15.50 – 16.20: Neurotoxic effects of GABA: Transaminase inhibitors in the treatment of Epilepsy; Ocular perfusion and performance.

S. Hosking (Aston University, UK)

16.20 – 17.05: New developments in supra-threshold perimetry.

D. Henson (Manchester Royal Eye Hospital, UK)

17.05: Close

Fees

Faculty and others £80.00* Yes/No

Graduate Students and Post Docs £30.00* Yes/No

Wednesday, September 11th Conference dinner £26.00 Yes/No

*Cost for the two day meeting including lunches

UMIST Accommodation

Accommodation is available on campus at the Manchester Conference Centre.

Single room with breakfast, £56.50.

Double/Twin room with breakfast, £65.80.

Hotel Accommodation in Manchester

Nearby hotel accommodation is available at the Ibis Hotel on Charles

Street (0161 272 5000), the Palace Hotel on Oxford Road (0161 288 1111), the Britannia Hotel on Portland Street (0161 228 1361), or the Jarvis Piccadilly Hotel (0161 236 8414).

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The cost of the Dalton conference book is £43 (including postage in the UK) for AVA members or £48 for non-AVA members. If you are outside the UK then add £5 per book.

Dickinson, C., Murray, I. and Carden, D. (1996) **John Dalton’s Colour Vision Legacy**. Taylor and Francis (784 pages).



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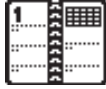
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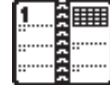
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Mark Scase



Meetings Calendar



2002

- August 25-29 ECVP, Glasgow, Scotland
<http://www.ecvp.org>
- September 11-12 Optical Performance of the Eye, UMIST
<http://www.umist.ac.uk/optometry/conference.htm>
- October 2 Colour Group Postgraduate Meeting,
City University
<http://www.colour.org.uk>
- November 2-7 Society for Neuroscience, Orlando, Florida
<http://apu.sfn.org/>
- December AVA Christmas Meeting, Aston
t.s.meese@aston.ac.uk

2003

- January 8 Colour Group Vision Meeting
<http://www.colour.org.uk>
- March 19 AVA 2003, College of Optometrists, London
<http://www.dmu.ac.uk/ava>
- May 4-9 ARVO, Ft Lauderdale, Florida
<http://www.arvo.org/>
- May 9-14 VisionSciences, Sarasota, Florida
<http://www.vision-sciences.org>