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ABSTRACT BOOK
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Flow parsing in healthy ageing and schizophrenia: Evidence that optic flow suppression is functionally critical

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Background: Extensive evidence suggests the existence of a flow parsing (FP) mechanism that suppresses global patterns of retinal motion due to observer movement (optic flow), so remaining motion can be attributed to environmental movement. Here we present behavioural data investigating FP in two groups with established, relevant deficits in sensory processing - healthy ageing (HA) and schizophrenia (Sz).

Methods: *Experiment 1 (Task 1):* 40 participants (20 control, 20 Sz) viewed hemi-field radial flow stimuli simulating forward observer movement while a probe object (4 deg left/right of central fixation) moved vertically upwards, subsequently adjusting an onscreen gauge to indicate perceived probe trajectory. These stimuli lead to a perceived deflection in probe trajectory due to motion suppression. Relative tilt (difference between actual and perceived trajectories) quantifies this suppression and by comparing conditions in which flow and probe are in same and opposite hemi-fields we can investigate global (FP) and local contributions.

Experiment 2 (Tasks 1&2): 30 participants (aged 20-76) undertook *Task 1* as above and *Task 2*, involving viewing a 3D scene comprising background objects and probe, and reporting scene-relative probe movement direction (left/right). In condition 1 only the probe moved. In condition 2 optic flow consistent with forwards observer movement was added across the display. Differences between probe direction discrimination thresholds in conditions 1&2 reflect high-level FP performance (larger differences suggest worse performance).

Results & Significance: *Task 1:* Global suppression (FP) increased with age ($BF_{10} = 25.64$) and the balance between local and global suppression shifted significantly towards the latter in Sz relative to appropriate controls ($BF_{10} = 4.22$). *Task 2*: High-level FP performance did not change with age ($BF_{10} = 0.29$). Based on these data we suggest that FP is functionally critical, warranting compensatory changes in underlying processing (boosted global suppression) to maintain high-level performance to counteract other processing deficits.

Anomalous Pupillary Responses to M-Cone Onsets Are Linked To Lm Ratio

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Background: Whereas L cone isolating onset induces a conventional pupillary contraction, M-cone offset generates a pupillary contraction. Similarly the onset of M-cones is perceived as an offset and vice versa. The phenomenon has an electrophysiological corollary in that M-cone onsets generate an offset ERG. Here we test the possibility that the effect may be linked to the relative numbers of L-and M-cones, the so-called LM ratio.

Methods: A four-primary ganzfeld (Diagnosys Colordome) was used to generate selective M- and L-cone stimulation using triple silent substitutions. Cone contrast was 0.26 and mean luminance was 20cd/m^2. Pupil responses were measured with an Espion E3 system (Diagnosys) using the inbuilt ganzfeld camera and a LiveTrack interface (CRS).

Pupillary responses were obtained from a series of 23 stimuli with luminance bias values ranging from 1.45 (brighter than cone isolation) to 0.55 (dimmer than pure cone isolation) in steps of 0.05. The value of 1.0 represented 'pure' cone isolation. Fifteen subjects with a wide range of L:M ratios from 1.0 to 4 were tested, all had normal colour vision and non had any family history of colour vision defects.

Results: As previously reported, most subjects exhibited a conspicuous paradoxical constriction to a decrease in M-cone stimulation. However, those with an L:M ratio close to unity did not. For all subjects, the luminance bias sequences showed a neutral point at which the pupil responded equally to both onset and offset of the stimulus. For the M-cone stimulus, the neutral point for subjects with low L:M ratio occurred close to, or at, the pure isolation point, so that their paradoxical pupil response for M-cone stimulation was virtually absent.

Significance: The neutral point varies systematically with L:M ratio, compelling evidence that the predominance of L-cones in the typical human retina is implicated in the paradoxical M-cone response.

Assessing visual acuity with a novel picture test

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Background: Measuring visual acuity (VA) is the most widely used way to estimate visual function but standard tests are unsuitable for certain patient groups, including those with learning disabilities. Patients with learning disabilities are at higher risk of serious sight problems and are also at risk of these being underdiagnosed (Van Den Broek et al., 2006). We investigated the visibility and discriminability of a new set of Kay picture optotypes, designed to be used in patients with learning disabilities.

Methods: 40 (mean age 24.75 ± 5.44 years) volunteers with corrected-to-normal vision (best vision sphere -1.49± 1.69 DS) participated in the study. VA thresholds were obtained for standard Bailey-Lovie logMAR letter charts and the new optotypes. The new test comprised 9 uncrowded optotypes; observers were shown optotypes in isolation and had to indicate the presented optotype (9-alternative forced choice). Each optotype was presented at 5 different sizes and repeated 10 times. The resulting data were fit with a Quick function using a maximum likelihood procedure. VA thresholds were extracted from this function at the 55.5% point.

Results: VA thresholds were -0.39±0.12 for Kay optotypes and -0.05 ± 0.09 for Bailey-Lovie chart (logMAR). The difference in estimated VA thresholds, -0.340 logMAR, 95% CI [-0.37, -0.31], was statistically significant ($p < 0.001$). A repeated-measures ANOVA identified a significant effect of the different Kay optotypes on VA thresholds ($p < 0.001$); with the cup optotype showing the best (-0.48± 0.11 LogMAR) and the bird optotype the poorest (-0.33±0.25 LogMAR) VA.

Conclusion: These results suggest some variability between the new Kay optotypes. The test over-estimated VA by approximately 0.3 logMAR compared to the standard Bailey-Lovie letter chart. Crowding and cues that may affect sensory processing such as orientation and contrast energy are likely contributors to the differences between optotypes and need to be considered when comparing with standard logMAR VA. The new test is promising for use in patients with learning disabilities where standard tests are not appropriate. This study will help to define protocols to optimise the usability and comparibility of Kay picture optotypes.

Can ocular supplements improve your working memory?

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Background: Ocular supplements that claim to increase a subject's macular pigment have recently been implicated in improvements in cognition and memory. We were interested in investigating whether macular pigment supplements could improve the working memory of healthy students. Working memory is used when individuals are required to retain one piece of information while carrying out another task.

Methods: 20 healthy student subjects were recruited. 10 to the active arm and 10 as controls. Subjects in the active arm took a daily over-the-counter supplement (Time Health) containing 10mg Lutein 10mg Meso-Zeaxanthin and 2mg Zeaxanthin and underwent macular pigment optical density (MPOD) and working memory evaluation prior to the study and after approximately 4 months of daily supplementation. Control subjects were assessed identically without daily supplementation. Working memory was assessed using 4 variants of an operation span task – two designed to assess verbal working memory and two designed to assess visual working memory.

Results: Subjects initial MPOD values ranged from 0.12-0.74 (average 0.45 assessed using the MPS II) and were not significantly different between the two groups. As expected subjects taking the ocular supplement significantly increased their MPOD scores 4 months after supplementation while the control group did not change. This increase in MPOD was associated with an increased accuracy in both verbal working memory assessments ($p < 0.05$) but no significant increase was detected for the visual working memory tasks ($p > 0.05$). No significant changes were found for the control group.

Significance: This study highlights the possibility of using ocular supplements for working memory enhancement. Given the reported misuse of nootropics, particularly within the vulnerable student population, further study into the memory enhancing effects of ocular supplements is warranted.

Low contrast or Low luminance visual acuity as an outcome measures in choroideremia clinical trials.

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Background: Choroideremia is an X-linked inherited retinal degeneration. Patients present with nyctalopia and progressive visual field loss. However, visual acuity (VA) remains well preserved until late in the disease process, limiting its usefulness as a clinical trial endpoint. VA measurements under low luminance and low contrast conditions may be affected sooner and have been suggested as early biomarkers in other ocular diseases. Here, we assess whether low luminance VA and low contrast VA, provide useful end points in choroideremia clinical trials.

Method: High contrast and low luminance VA was obtained on 51 choroideremia subjects and 21 healthy controls, using a logMAR chart at 4m or 1m as required. Low luminance VA was tested using a 2.0-log unit neutral density filter, with the same chart set up, without formal dark adaptation. A subset of 29 choroideremia and 16 controls had low contrast VA measured using 1.25% and 2.5% contrast logMAR charts placed at 4m or 1m as required. Analysis involved right eye only, using parametric statistics. Low luminance and low contrast VA minus high contrast VA provided low luminance and low contrast decrease.

Results: Patients with choroideremia had a greater low luminance and low contrast decrease compared to control subjects (P = < 0.001, Kruskal Wallis tests). Low luminance VA and high contrast VA in choroideremia had the strongest positive correlation (ρ = 0.824, P = >0.001). Compared with 2.5% low contrast VA (ρ = 0.671, P = >0.001) and 1.25% low contrast VA, (ρ = 0.328, P = 0.41) which were less strongly correlated.

Significance: Low luminance VA in choroideremia showed more consistent progression throughout high contrast VA ranges, therefore may provide a more consistent therapeutic outcome measure as opposed to low contrast VA. These tests may be representative of different visual processing pathways in the retina.

Luminance contrast sensitivity for achromatic and chromatic parafoveal stimuli under mesopic conditions.

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Biography: In 2014, I completed my Optometry – Vision Science BSc degree in Portugal. Then, I worked as an Optometrist for 3 years. Meanwhile (2016 to 2017), I made a detour into a Biomedical Engineering MSc degree, which I opted to pause due to the opportunity to start a funded MPhil/PhD study at the University of Plymouth in the Optometry department. My current topic integrates psychophysical concepts into the clinical environment creating bridges between both fields, where I hope to provide practical tools to better understand and explore age-related macular degeneration.

Background: Parafoveal rod dysfunction and reduced contrast sensitivity are known features of AMD. These impairments are more pronounced under dim (mesopic) light conditions when the input of rods is relatively larger. We know that rods have a peak sensitivity towards shorter wavelengths (blue) and are insensitive to long wavelengths (red). Here, we investigate whether differences between rod and cone function can be measured under mesopic levels, by altering the stimulus chromaticity.

Methods: A "C" shape stimulus of 7.5 degrees radius and 2 degrees width was centrally presented on a calibrated CRT monitor. Luminance contrast thresholds (Weber contrast) were measured for achromatic and chromatic conditions under three light levels (10, 1, 0.1 cd/m^2), in four young healthy participants. Participants had to locate the stimulus gap in a 4AFC task (top, bottom, left or right), and thresholds were estimated with a QUEST adaptive staircase method. The chromatic conditions were chosen to closely match the 480 nm (blue, maximising rod input) and 615 nm wavelengths (red, minimising rod input) and fall within our monitor gamut ([x=0.192; y=0.225] and [x=0.589; y=0.317]).

Results: For all observers, contrast thresholds for the achromatic and blue stimuli were similar under the light levels of 10 cd/m^2 (2.7% ± 0.2% [mean ± 1 SEM]) and 1 cd/m^2 (3.3% ± 0.2%) but higher for the red stimulus (10 cd/m^2: 3.2% ± 0.3%; 1 cd/m^2: 3.9% ± 0.3%). At 0.1 cd/m^2, the difference between thresholds for the blue and the red stimuli was more pronounced (8.1% ± 0.4% and 9.1% ± 0.6%).

Significance: This experiment suggests that under lower mesopic conditions a differentiation between the input of rods + cones and cones alone might provide an indirect measure of rod function. Such contrast sensitivity tests could be applied in AMD patients to more specifically measure rod dysfunction in the parafoveal region.

Structural And Functional Changes In Early Amd; Scotopic And Photopic Function Are Linked To Fundus Abnormalities

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Background: The purpose of this paper is to describe the extent to which scotopic and photopic measures of visual function predict fundus photograph and Fundus Auto Fluorescence (FAF) changes in early and intermediate non-exudative AMD.

Methods: Sixty-nine observers were recruited, 56 AMD patients (mean age 73 ± 12.98 years) and 13 controls (mean age 67.77 ± 9.72 years). A Non-Mydriatic Retinal Camera was used to obtain stereo fundus and FAF images were recorded with a sCLO Heidelberg Spectralis HRA+OCT. Visual Acuity (VA) was measured using an ETDRS chart. Contrast Sensitivity (CS) was assessed with a Pelli Robson chart. Dark Adaptation curves were recorded at 3° eccentricity using a PC-based technique. Analysis of these curves yielded 5 parameters, cone threshold (CT), cone time constant (CC), the cone-rod break (α), the slope of the second rod component (S2), and the rod-rod break (β).

Results: Both cone and rod sensitivity recovery was grossly abnormal in the patients. The rod recovery slope (S2) most accurately predicted the fundus photograph-based grade and the FAF classification (rho=0.61 and rho=0.60 respectively; both p<0.0001). CS showed a strong association with FAF (r=0.50, p<0.0001) and with fundus photograph-based grade (r=0.38 p<0.002). There was no correlation between VA and either imaging method.

Significance: Dynamic, rod-based measures most accurately reflect the severity of early AMD. Although less specific to AMD than DA changes, static photopic abnormalities such as CS also correspond with morphological changes. Assessment of function in early AMD should include dynamic rod- and cone- mediated measurements of sensitivity recovery.

Structural And Functional Changes In Early Amd; Scotopic And Photopic Function Are Linked To Fundus Abnormalities

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Significance: Dynamic, rod-based measures most accurately reflect the severity of early AMD. Although less specific to AMD than DA changes, static photopic abnormalities such as CS also correspond with morphological changes. Assessment of function in early AMD should include dynamic rod- and cone- mediated measurements of sensitivity recovery.

Can service users enhance our provision of student feedback?

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Background: A practitioner's ability to articulate clinical findings and management to patients through effective communication is a vital skill in all healthcare professions. The use of simulated patient (SiPs) and standardised patients (SPs) in education, training, and assessment of healthcare practitioners has been recognised for over 50 years.[1] A SiP is someone who simulates the signs and symptoms of an actual patient. Simulated patient encounters with feedback have proven successful in providing a measurable improvement in student-patient communication skills[2]. A SP is a specific type of simulated patient who has been trained to give consistent verbal and behavioural responses to the examiner and complete a checklist that allows an assessment of the examination. SPs are unique in that they can be trained to give feedback from a patient's perspective[1] both 'in character' and 'out of character' to cover different aspects of their interaction with the student. Unannounced SPs are regarded as the gold standard for quality measurement in clinical practice. In this pilot study, we evaluated the feedback on students' communication provided by unannounced SPs.

Details of your innovation or achievement: Final year undergraduate optometry students examine members of the public during primary care clinics whilst being observed by visiting clinical tutors (VCTs). Upon completion of the examination, students receive individualised feedback from the VCT with details on areas for improvement, including their communication. In this study, two SPs received intensive training on all elements of the eye examination to enable accurate reporting of the content of the eye examination including communication skills. SPs presented unannounced (incognito) as patients seeking routine eye examinations. The SPs provided objective patient-centred feedback on their examination through completion of a pre-designed checklist for each encounter. Qualitative thematic analysis has been performed on sixty-four sets of feedback (thirty-two each from SPs and VCTs). Five overarching themes emerged through analysis of feedback around communication. These findings were presented to the full cohort of students. A focus group was held to explore students' perception of this novel method of providing feedback.

Enhancement of student experience: Whilst students felt they immensely valued the feedback on their actual techniques and clinical skills provided by the VCT, we found the SPs generally provided more detailed subjective feedback around the emerging themes on communication when compared to the VCTs. During the focus group, the students' reported that the SPs picked up on elements of communication (e.g. rapport and body language) that the VCTs may not have picked up on. Overall, students felt that this type of feedback helped to develop skills and elements of their communication that cannot be learnt from didactic teaching. What is more, students revealed that they actually changed their communication after being presented with the feedback from the SPs. Performing eye examinations on unannounced SPs who provide individualised feedback on the students' ability to articulate clinical findings and future management in a patient friendly manner during the final year of undergraduate training can provide an additional training and assessment resource. We believe that the findings of the present study can be applied to other healthcare undergraduate programmes that are predominantly patient facing.

References:

1. Barrows HS (1993) An overview of the uses of standardized patients for teaching and evaluating clinical skills. AAMC. *Acad Med* **68**, 443–51.
2. Anderson HA, Young J, Marrelli D et al. (2014) Training students with patient actors improves communication: a pilot study. *Optom Vis Sci* **91**, 121–8.

The Dry Eye Disease Workshop: Does 'Play Time' Enhance the Learning Experience?

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Background: Dry Eye Disease (DED) is a complex, multifactorial condition of the ocular surface and is referenced across a number of units within the Optometry undergraduate curriculum including anatomy, pharmacology, ocular disease and contact lenses; however, in clinical settings, students' understanding of currently available diagnostic tests and management options for entry level Optometrists seems limited.

The Dry Eye Disease Workshop was introduced to emphasise the findings of the DEWSII[1] report and enable students to create structured investigation and management plans for patients with suspected DED.

Methods: All final year Optometry students (academic year 2017-2018) were invited to attend; they were randomly allocated to small groups for round-table, 'hands-on' tasks and discussions, to encourage interaction with students they may not normally work with. At the end of the session they were asked to provide post event feedback.

Results: Attendance was 90% of the cohort with 76 of the 78 attendees completing the feedback form. All respondents rated the overall session as excellent or good with 79% indicating that the intended learning outcomes had been fully met. When listing what they enjoyed most about the session, 72% mentioned the interactive groups sessions with 63% adding the product comparison tasks.

Significance: Further research is required to quantify the impact this style of teaching session has on clinical practice; however, anecdotal evidence suggests that students' understanding of DED increased with improved detection, investigation and management across the Optometric Examination and Contact Lens clinics. This is evidenced by an increase in internal DED referrals to the Further Investigative Techniques clinic. As a result of this, the Dry Eye Workshop has been formally incorporated into the curriculum for final year Optometry students.

[1] Craig JP, et al., TFOS DEWS II Report Executive Summary, The Ocular Surface (2017), http://dx.doi.org/10.1016/ j.jtos.2017.08.003

Teaching Empathy by Simulated Practice in Optometry: The TESPO project.

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Background: Empathy is an important factor in patient-practitioner relationships with growing recognition that this should be taught at undergraduate level. This study aimed to assess impact of three teaching interventions on student empathy levels.

Methods: Final year optometry students were invited to 'experience' vision loss caused by age-related macular degeneration (AMD). Students were randomly allocated to one of three groups:

(i)   Simulation spectacles (n=18);
(ii) Virtual Reality (VR) simulation of AMD using the Fove0 VR headset with integrated eye-tracking for simulating gaze-contingent central scotomas (n=18);
(iii) Written-text description of AMD (n=8).

Students completed the Jefferson Scale of Physician Empathy (JSPE) pre- and post-intervention. Understanding of visual function related quality of life in visually impaired patients was also evaluated pre- and post- intervention using the National Eye Institute Visual function questionnaire (NEI VFQ-25). Students completed the questionnaire based on how they perceived a patient with advanced bilateral AMD would answer. Their answers were scored against published data from real patients (Orr et al., 2011 doi:10.1167/iovs.10-5645).

Results: While empathy scores increased pre- (simulation spectacles: 101.2±16.0; VR: 108.0±14.1; text 108.3±12.9) to post- intervention (simulation specs: 103.1±15.4; VR: 111.4±11.6; control 109.6±16.4), this was not statistically significant in any group (p>0.05). Students largely overestimated the impact of bilateral AMD on visual function, with pre-intervention NEI VFQ-25 overall composite scores of 36.0±14.5 (simulation specs); 30.9±15.3 (VR); 37.0±14.2 (text) and post-intervention scores of 37.0±21.3 (simulation specs); 36.0±11.6 (VR); 54.4±13.2 (text) compared to 72.7±19.7 (Orr et al., 2011) (p<0.001).

Significance: Our final year students had high levels of empathy that did not increase following an intervention activity. However, they tended to overestimate the impact of bilateral AMD on visual function. Further work is needed to identify appropriate teaching tools to improve students' awareness of the impact of visual impairment on patients' every day lives.

Ethical approval: The project received ethical approval (Local Research Ethics Committee) and adhered to tenets of the Helsinki Declaration.

Conflicts of interest: We confirm that there are no conflicts of interest.

Unit Evaluation Questionnaires – we value what we think we can measure, not measure what we value

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Background: Students' evaluations of teaching have been around for many years. Two of the universal reasons given for collecting these data are:

1. To provide feedback for staff in order for them to improve their teaching
2. To measure how effective the teaching has been, which may be used in probation and promotion decisions

Universities give little thought to the numerous flaws in the data collection and processing. Students' subjective responses to teaching quality are ordinal data, however Faculty treat it as interval. Students are asked a variety of questions about the unit. The response categories students choose from are given a score. Agree (5), mostly agree (4), neither agree nor disagree (3), mostly disagree (2), disagree (1). Faculty report the means and standard deviations of these data and this is used to evaluate teaching performance.

Methods: Unit evaluation questionnaires (UEQ) from nine different lecturers and units on the undergraduate Optometry programme at the University of Manchester were submitted for analysis. Using the data sets upper and lower confidence intervals were constructed for two questions:
"Overall I would rate this unit as being excellent"
"The feedback I received on my work was helpful"

Results: The response rates for the UEQ varied from 18.9% to 62.5%. Eight of the UEQ had confidence intervals larger than the individual scores of the questions. Only three UEQ had a confidence interval of <0.3.

Significance: The variability in confidence intervals indicates Faculty should only report median values, it is inappropriate to report means and standard deviations. When response rates are low it is not acceptable to assume the rest of the population would have responded in the same manner.
Until UEQ have undergone robust testing of their validity and reliability they should not be used as a "measure" of teaching quality.

No ethical approval was required and I have no conflicts of interest.

Optimisation of en face OCT images for visualisation of retinal nerve fibre bundles: A pilot study

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Background: Current techniques for detection and monitoring of glaucoma are imperfect. Recent developments in OCT technology enable direct en face visualisation of retinal nerve fibre bundles (RNFBs) lost in glaucoma. However, the optimum tissue depth at which to visualise RNFBs across the retina and across different patients is unknown. Further, optimum axial image depth (slab thickness) and image-processing techniques for identification of RNFBs have been minimally investigated.

This study will explore visualisation of healthy RNFBs across the retina in en face OCT images with varied image extraction and processing. We aim to determine optimal parameters for RNFB visualisation and thus for the identification of glaucomatous defects, ultimately improving the utility of this technique in glaucoma diagnosis and monitoring.

Methods: High-resolution wide-field scans of the central 30° of the retina in 10 healthy adults were acquired using spectral domain OCT. En face reflectivity slab images of maximum axial resolution (4 µm thick) and varying post-processing will be extracted from 1 to 130µm below the inner limiting membrane – vitreous interface. Bundle visibility within sectors of a superimposed grid will be ranked subjectively by trained optometrists according to written instructions. Optimum image depths and post-processing for visualisation of RNFBs will be identified across varying retinal eccentricities.

Results: Preliminary findings from 10 healthy adults (mean age 68.9±6.1 years, 6 females) with no current or previous eye disease and normal visual fields will be presented.

Significance: We predict that different image depths will be optimal for visualisation of RNFBs across different retinal locations, resulting in varying parameters to adopt for the ideal identification of defects in glaucoma patients. This study will improve the use of en face OCT imaging for detection and management of glaucoma.

Differences in Perception of Emotion from Dynamic Faces – Testing a Novel Methodology

Mr. Benjamin Hamblin-Pyke (presenting – University of Manchester), Dr. Karen Lander (University of Manchester), Dr. Emma Gowen (University of Manchester)

Background: Facial expression recognition (FER) is essential for social interaction and is sometimes suggested to be impaired in people with Autism Spectrum Condition (ASC). While previous evidence on this is somewhat mixed, most studies have used static rather than dynamic faces. This study attempted to create a new methodology to assess FER using dynamic stimuli, as no widely-used test currently exists.

Methods: 50 control participants were recruited (46 female, aged 18-27), and shown dynamic facial expressions at gradually increasing durations. Anger, disgust, fear, joy, sadness, surprise, and neutral expressions were included, with the mean duration of stimulus required for a correct response calculated for each. ANOVA and Honest Significant Difference tests were used to assess if the differences in mean correct response time were significant.

Results: Neutral expressions were correctly identified fastest (175ms), while the slowest to be identified was fear (280ms). Ad hoc analysis revealed that neutral was indicated significantly more often than other emotions after shorter duration stimuli.

Significance: This suggests that neutral should be removed as an expression from future research, as participants may be selecting this option when they are unsure of the correct answer. The finding that some emotions would be identified at shorter durations was hypothesised, and suggests that this test might reveal differences in FER ability depending on emotion. Future research will use this test on participants with ASC, excluding the neutral emotion and including static as well as dynamic stimuli.

When is refraction stable following routine cataract surgery? A systematic review and meta-analysis.

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Background: Current advice recommends obtaining new spectacles 4-6 weeks following cataract surgery. Advancements in surgical techniques allow for smaller surgical incisions and shorter operative times, and we hypothesised that refractive stability would be achieved earlier post-operatively.

Methods: Medline, CINAHL, AMED, Web of Science and the Cochrane Library were searched with the key words chosen to find articles which assessed refraction following uncomplicated cataract surgery. Citation chains and the reference lists of all included papers were also searched. The review considered studies which measured automated or subjective refraction at regular intervals following routine cataract surgery until stability was achieved. Inclusion criteria included a refraction at 1 or 2 weeks post-operatively plus a gold standard refraction at 4-6 weeks.

Results: The search identified 6,680 papers of which two reviewers independently screened the abstracts to determine if they should be included in the study. Eleven papers were found to fit the criteria. The quality of the papers was evaluated using the Methodological Index for Non-Randomised Studies (MINORS) instrument. Meta-analysis of 436 patient data of spherical, cylindrical and spherical equivalent correction were performed using Review Manager 5 (RevMan 5). Refraction at 1-week vs the gold standard of 4-weeks showed no significant effect with effect sizes of 0.05 ($\pm$ 0.15, 95% confidence limits), -0.09 ($\pm$ 0.09), and 0.01 ($\pm$ 0.11) respectively. Heterogeneity was non-significant ($I^2 < 25\%$) for all three refractive elements. Data were similar for 2 versus 4 weeks post-op.

Significance: No effect was found when comparing refraction at 1 and 4 weeks post cataract surgery for spherical, cylindrical and spherical equivalent refractions. All studies concluded refraction was stable 1-2 weeks following routine cataract surgery indicating that post-refraction guidelines need to be updated from the current 4-6 weeks. A shortened time period could potentially provide significant benefits to patients.

Comparison of Objective Measures of Physical Activity, Light Exposure, Sleep and Near Work Activity when Gathered over 1-vs 2-Weeks

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Background: Evaluation of objective lifestyle data (physical activity, light exposure, sleep and near work activity) collected over one and two weeks.

Methods: 11 adult spectacle wearers were fitted with a wrist-worn light exposure, physical activity and sleep monitor (Actiwatch2, Phillips Respironics) for 14-days. Data were recorded every 30 seconds, 24 hours/day for the study period. A spectacle-mounted light exposure and viewing distance monitor (Clouclip) was attached to the participants' spectacles and recorded every 5 seconds during periods of spectacle wear (no overnight measures) for the same period. Participants downloaded screen-time apps onto their phones/ tablets. The averages over the course of 7 and 14-days were determined for light exposure (LE) and time spent outdoors (TSO) (Actiwatch2 and Clouclip), physical activity (PA), sleep time (ST), sleep efficiency (SE) (Actiwatch2), working distance (WD) (Clouclip) and time spent on screens (TSS) (Apps). Data from the first 7-day period were compared with cumulative data obtained over 14-days.

Results: Mean differences (limits of agreement [LOA]) between 7- and 14-day data were: Clouclip: LE -5.65lux (-91.91-80.61), WD -6.65cm (-52.77-39.47), TSO -1.96mins (-18.50-14.48); Actiwatch: LE -2.85lux (-53.81-48.11), PA -0.34counts per minute (-25.82-25.14), ST -4.45mins (-47.68-38.39), SE 1.42% (-4.21-7.05), TSO 0.02mins (-9.19-9.23); Apps: TSS -3.45mins (-25.99-19.09). Regression analysis, comparing 7- and 14- day data, demonstrated significant proportional bias for both WD (R=0.802, p=0.005) and TSO (R=0.711, p=0.021) derived from the Clouclip data, but not for any other parameters (p>0.05). LOA for sleep parameters were within the limits of repeatability published for the Actiwatch2.

Significance: 7-day data accurately profiles the sleep parameters when compared to 14-days. The LOA for PA, TSS and Actiwatch LE and TSO were also narrow, indicating that 7 days is sufficient to profile lifestyle. The proportional bias for WD and TSO (Clouclip) indicates a longer data collection period may be needed to satisfactorily profile these metrics.

Technical assessment of a low-cost remote video eye-tracker for use as an eye movement-rehabilitation tool in an elderly population

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Background: Significant visual field defects lead to persistent difficulties with tasks in everyday life. Current methods of eye-movement training encourage patients to adapt their ocular movements to overcome these deficits. However, paper- or screen-based activities lack the objective quantitative measurement of the eye´s position. By adapting a low-cost gaming eye-tracker, eye movements can be used for interactive rehabilitation.
The current study will validate the Tobii EyeX eye-tracker (Tobii, Danderyd, Sweden) for use in an older population.

Methods: Eight healthy subjects (mean years 27.6 ± 5.9) viewed stationary high contrast fixation targets on a VDU at 60cm in primary gaze and with eyes rotated 17 degrees to the right and left. Ocular surface dryness was induced by modulating tear film break-up time in an environmental chamber in dry (5%) and normal (40%) relative humidity (RH). Variations of the retinal reflex brightness were simulated by taking measurements through ND filters with log optical density ranging from 0.1 to 1.0. Data was normalised for differences in fundus pigmentation and pupil diameter. In each viewing condition, eye position was recorded continuously for 60 seconds at a rate of 60Hz. Data loss, accuracy and precision of the instrument were analysed.

Results: Data loss due to blinks was 11% ± 9% in normal (40% RH) viewing and was the same irrespective of gaze position. Accuracy (<0.5°-<1.0°) and precision (<0.3°-<0.5°) were comparable to previously reported values depending on gaze position. This was not significantly affected by a reduction in RH (p>0.05). On average, the eye-tracker was found to maintain its precision until pupil brightness was reduced to 20.0% of its original value. Data loss increased significantly when pupil brightness was below 25.1% of its original value.

Significance: Confirmation of the gaming eye-trackers robustness under adverse viewing conditions supports its use in an elderly population.

Accommodative microfluctuations and visual displays units

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Background: Accommodative microfluctuations (AMFs) are small temporal variations that occur in the accommodative response (AR) when fixated on a stationary object. The use of digital display devices, such as tablets and phones, is increasing, along with reports of digital eyestrain. The purpose of this study is to investigate the effects that different display types may have on accommodative stability, which may contribute to ocular discomfort during screen use.

Method: The AR and AMFs for 10 myopes and 10 emmetropes were measured using a continuous recording Shin-Nippon SRW-5000 autorefractor for four different display types (paper, smartphone, e-book and a computer monitor) while observing a near target (3D demand). Fast Fourier transforms were used to analyse the high (1-2.3Hz) and low (0-0.6Hz) frequency band components of the AMFs

Results: Display type was found to have a significant effect on the mean accommodative response (repeated measures ANOVA, $F_{3,54} = 7.597$, $p < 0.001$). The paper target was found to produce the highest mean accommodative response, and the VDU screen produced the lowest. Display type was also found to significantly affect the LFC power ($F_{3,54} = 7.865$, $p < 0.001$). There was a strong positive correlation between the AR and the image resolution of the display types across all participants ($r = 0.967$ 95% BCa CI [0.95, 1], $p = 0.033$)

Myopic participants displayed a higher mean AR ($F_{1,18} = 11.31$, $p < 0.005$) and greater LFC power ($F_{1,18} = 11.314$, $p < 0.005$) compared the emmetropic participants.

Significance: This study indicates that display type influences the accommodation response, with higher resolution displays leading to increased mean accommodation responses.**Did**

the NICE Guideline for Glaucoma 2017 affect the content and quality of optometrists' referral letters for glaucoma?

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Background: The NICE Guidelines for Glaucoma were updated in 2017. It included a case-finding protocol listing 4 main tests that should be carried out by a primary eye care practitioner prior to referring: optic disc evaluation, intraocular pressure (IOP), visual field analysis (VFA) and peripheral anterior chamber configuration (PACC). The aim was to determine whether there was a difference in content and quality of referral letters sent by optometrists to a secondary care eye hospital, regarding patients with possible glaucoma, comparing before and after the introduction of the guidelines.

Methods: The first 30 glaucoma referral letters to Manchester Royal Eye Hospital from May 2017 and the first 30 from May 2018 were retrospectively audited. They were assessed primarily against standards found in the NICE Guidelines for Glaucoma 2017 (NG81), under case-finding.

Results: A total of 44 pre-NICE and 36 post-NICE letters were assessed. Of these, 14 pre-NICE and 6 post-NICE letters did not meet the inclusion criteria. Besides the decrease in attaching VFA plots to referral letters, no other statistically significant differences were found in content and quality of referral letters pre-NICE and post-NICE. Overall, the audited letters showed good adherence to NG81 with regards to optic disc evaluation (93% pre-NICE, 87% post-NICE) and IOP measurements (100% pre-NICE, 90% post-NICE), adequate adherence with VFA (73% pre-NICE, 80% post-NICE) and poor adherence with reporting PACC (50% pre-NICE, 50% post-NICE).

Significance: Overall, community optometrists were shown to produce good quality referral letters for glaucoma both before and after NG81. However, it is note-worthy to mention that optometrists should include their GOC number in any referral letter, and details of PACC in glaucoma-related referral letters. Optometrists should also be reminded that when referring based on IOP, this should be measured using contact applanation-based tonometry, to improve consistency between primary and secondary care settings.

Detection and discrimination of image blur in glaucoma: Preliminary results

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Background: Current clinical tests for glaucoma measure limited aspects of visual function, thus, do not capture all effects of the disease relevant to everyday visual performance. Patients have reported perceiving greater amounts of blur [1] but this has not been measured empirically. In this study, we aim to investigate the effects of glaucoma on detection and discrimination of image blur.

Methods: Two groups of glaucoma observers with central or non-central visual field defects and an age-similar healthy control group enrolled in the study. Stimuli were a single horizontal edge bisecting a hard-edged circle of 4.5 degrees diameter. The horizontal edge was blurred by a Gaussian kernel of varying spread which acts as a low-pass spatial filter. First, we measured contrast detection thresholds for these stimuli with two reference blurs (0 and 1 arcmin) centrally using a 2-interval forced choice procedure. Subsequently, we measured blur detection and discrimination thresholds for these stimuli (reference blur 0, 1 arcmin) using a 2-alternative forced choice (which is sharper?) procedure under two contrast conditions; 4x individual detection threshold for the low contrast condition, 95% contrast for the high contrast condition. In this condition the 2 stimuli were presented side by side separated by 0.5 degrees and subjects were allowed to view freely.

Results: To date, 17 controls, 7 glaucoma observers with a central visual field defect and 9 glaucoma observers with non-central visual field defects have completed data collection. Preliminary results of blur detection and discrimination thresholds will be presented.

Significance: This study will contribute to understanding of how glaucoma affects patients' everyday visual perception, and may uncover novel targets for diagnostic vision tests. This study is ongoing; we aim to recruit 18 participants per group.

Reference

Crabb DP, Smith ND, Glen FC, Burton R, Garway-Heath DF. How does glaucoma look?: patient perception of visual field loss. Ophthalmology. 2013;120(6):1120-6.

Tear proteins modulate the growth, motility and virulence of clinical *Pseudomonas aeruginosa* isolates

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Background: Bacterial keratitis in contact lens wearers is often associated with *Pseudomonas aeruginosa* infection and can cause irreversible visual impairment. The tear film is a key component of the innate immune system at the ocular surface and contains several antimicrobial proteins. Two of the most abundant proteins are lysozyme and lactoferrin, which exert bacteriolytic and bacteriostatic effects respectively. We have characterised the effect of these proteins on the growth, motility and virulence of clinical *P. aeruginosa* isolates.

Methods: *P. aeruginosa* isolates from five patients with both contact lens and non-contact lens related keratitis were grown in a chemically defined medium (CDM) with and without lysozyme and lactoferrin at physiological concentrations. Growth was monitored for a period of 24 hours and growth parameters were analysed using R statistical software. Motility was assessed using swim and swarm agar. Proteolytic and haemolytic activity was assessed using azocasein and haemoglobin assays respectively. Two laboratory strains (PA01 and PA90279) were used as controls throughout.

Results: Growth rates were attenuated by up to 38% depending on the isolate when grown in the presence of lysozyme and lactoferrin ($P<0.01$), with an increase of up to 63% in generation time ($P<0.01$). Haemolytic activity was also increased by up to 3-fold depending on the isolate when grown with lysozyme and lactoferrin ($P<0.01$), with no significant change in proteolytic activity observed. Swim and swarm zone diameter increased or decreased depending on the isolate.

Significance: Modulation of the growth rate, motility and virulence of clinical *P. aeruginosa* isolates by lysozyme and lactoferrin provides insight into the interaction of bacteria and components of the innate immune system at the ocular surface. These data will inform the development of an ocular surface model which will be used to further understand the interaction of the ocular surface epithelium, tear fluid and bacteria during infection.

What do pre-registration supervisors think of graduate optometrist clinical abilities?

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Background: The General Optical Council publishes a list of clinical competencies ('stage 1 competencies') which undergraduate optometry students must demonstrate before they enter a pre-registration placement. This study set out to gather the views of pre-registration supervisors on whether they possess the stage 1 competencies at the start of their placement.

Methods: An invitation to complete an online survey was sent to all those on the College of Optometrists' supervisor database. Supervisors were asked to consider each of the stage 1 competencies individually and report whether they believed their trainee was able to demonstrate it before any training. Possible responses were 'Yes', 'No' and 'Don't Know'.

Results: Forty six supervisors completed the survey in August and September 2015. The competencies relating to management plans, interpreting records and visual impairment were the least likely to be considered possessed, with 17 percent of supervisors affirming trainees had these competencies. Competencies relating to refractive correction were the most likely to be considered possessed (89 per cent).

Significance: This sample of supervisors considered that their trainees did not possess some of the competencies which were demonstrated at undergraduate level. Possible reasons for this include the standards for stage 1 being set too high, a lack of supplementary information about what is meant by each competency and deficiencies in training/assessment at undergraduate level. Further work needs to be done to understand where mismatch occurs since a reliable and mutually understood set of clinical competencies will facilitate public protection (supervisors will know when they can delegate/need to check) and trainee attainment of registration level competencies. Limitations of this study include the fact that the sample size was small and the participants were self-selecting.

Throwing Bricks at the Problem: Using LEGO® To Teach The Mechanics of a Slit Lamp

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Slit lamp biomicroscopy is taught to University of Manchester Optometry students at the beginning of 2nd year. This poses a dilemma over how to introduce the topic.

If a lecture is first, this involves lecturing about the 3D mechanics of the slit lamp without having the instruments physically there for students with which to interact or explore. The practical first allows students to explore the instrument but without the theory necessary to understand basic concepts such as corneal sections.

A LEGO® kit building exercise was carried out in a flat lecture theatre with 80 to 90 second year Optometry students at the University of Manchester. The students worked in groups of 4-5 and competed to complete the building exercise successfully. The aim of the activity was to give students hands-on experience of the moving parts of the slit lamp bio-microscope prior to small group practical sessions.

In addition to the learning through construction and team work elements, the activity provided students with the opportunity to manipulate their moving model once complete, allowing delivery of more complex theories later in the lecture. Feedback was generally positive: of those responding, 97% found the activity fun, and 92% found that it helped understanding.

These tactile, interactive learning activities could readily be utilised in teaching other aspects of health sciences.

Investigating optometric and orthoptic conditions in autistic adults.

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Background: Limited research has been conducted to investigate visual experiences, optometric and orthoptic conditions in autistic adults. Existing research focusses on autistic children and mostly those with co-existing learning disabilities; little is known about the visual experiences of autistic adults without learning difficulties, or their opinions on the current optometric care system in the UK. This study aimed to characterise visual experiences and their impact in autistic adults, and investigate autistic adults' experiences of eye examinations.

Methods: Four focus groups were conducted with a total of 18 autistic adults. A pre-set schedule was followed which involved questions around visual experiences, methods of reducing visual symptoms, the impact of visual symptoms on daily life, and experiences of eye examinations. Transcripts of these sessions were thematically analysed using a realist, semantic approach from the point of view of an optometrist.

Results: 13 themes emerged from data analysis. Of these, *visual experiences; autistic individuals' knowledge; eye movements; coping strategies; colorimetry; personal wellbeing; impact on personal life; travel; public understanding of autism* related to the participants' vision. Specific to eye examinations, *the practice; testing techniques; patient-practitioner relationship; patient education* was discussed.

Significance: Although visual experiences can have both positive and negative impacts on autistic adults, our participants largely reported being dissatisfied with their vision. They expressed visual sensitivity and binocular vision issues which affected their personal lives, daily routines and wellbeing. In addition, visual experiences frequently tied into larger multisensory issues. While participants often attempted to reduce visual experiences, their strategies have limited effect. Participants reported that eye examinations were currently not very accessible for autistic adults; improvements can be made in terms of the practice, the manner of the staff, the testing procedure and information provision to make these more "autism-friendly".

Evaluating Whether Sight is the Most Valued Sense

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Background: Sight is often considered to be the most valuable sense, but there is limited empirical data to support this. We therefore sought to determine which senses are rated most valuable by the general public, and to quantify attitudes towards sight and hearing loss in particular.

Methods: A cross-sectional web-based survey was conducted in March 2016 through a market research platform (FlexMR), involving a heterogeneous sample of UK-based adults. 250 participants (aged 22-80 years, 56.4 percent female) were recruited. Participants were first asked to rank the five classical senses (sight, hearing, touch, smell, taste) plus three other senses (balance, temperature, pain), in order of most valuable (8) to least valuable (1). Next, the fear of losing sight and hearing was investigated using a Time Trade-Off exercise. Participants chose between 10 years without sight/hearing, versus varying amounts of perfect health (from 10 to 0 years).

Results: 88 percent of participants ranked sight as their most valuable sense (mean rating of 7.8; 95 percent CI 7.6-7.9). Hearing was ranked second (mean rating of 6.2; 95 percent CI 6.1-6.4), and balance third (mean rating of 4.9; 95 percent CI 4.7-5.1). All three were ranked above the classical senses of touch, taste and smell (Wilcoxon signed-rank tests; all Ps less than 0.05).

The Time Trade-Off exercise indicated that, on average, participants preferred 4.6 years (95 percent CI 4.2-5.0) of perfect health over 10 years without sight, and 6.8 years (95 percent CI 6.5-7.2) of perfect health over 10 years without hearing.

Significance: Among a cross-section of UK adults from the general public, sight was the most valued sense, followed by hearing. These results suggest people would, on average, choose 4.6 years of perfect health over 10 years of life with complete sight loss. However, how these findings generalise to other populations is unknown.

Are ophthalmology patient-reported outcome measure (PROM) questionnaires easy to read?

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Background: Patient-reported outcome measures (PROMs) are commonly used in clinical trials and research in ophthalmology. Yet, in order to be effective, the PROM instrument or questionnaire needs to be understandable to its respondents. The aim of this study was to assess the reading comprehension level of PROMs, specifically those validated for use in common eye conditions.

Methods: Forty PROMs that had been previously validated for use in at least one of three common ophthalmological conditions (age-related macular degeneration, glaucoma and/or diabetic retinopathy) were included. Reading comprehension level determines the readability that a text must have so that a reader understand the written materials; these were calculated using the Flesch-Kincaid Grade Level test, the FORCAST test, and the Gunning-Fog test using readability calculations software package Oleander Readability Studio 2012.1. The American Medical Association (AMA) and the National Institutes of Health (NIH) recommend readability of patient materials should not exceed a sixth-grade reading level. Number of PROMs requiring a reading level exceeding this threshold was calculated.

Results: Median (interquartile range; IQR) readability scores were 7.9 (5.4, 10.5), 9.9 (8.9, 10.7) and 8.4 (6.9, 11.1) for the Flesch-Kincaid Grade Level test, the FORCAST test, and the Gunning-Fog test respectively. Depending on the metric used this meant 61% (95% confidence interval [95% CI] 45 to 76%), 100% (95% CI 91 to 100%) and 80% (65 to 91%) fell outside the 6th Grade reading level recommended by the AMA and NIH.

Significance: Over half of the PROM questionnaires and instruments commonly used in ophthalmology require a reading comprehension level better than that recommended by the AMA and NIH for patient material. Some PROMs likely contain questions that are at a level too advanced for most patients to comprehend. Greater care is needed in designing PROMs appropriate for the literacy level of a population.

A needs assessment for a Minor Eye Condition Service within Leeds, Bradford and Airedale, UK

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Background: There are a number of limitations to the present primary eye care system in the UK. Patients with minor eye conditions typically either have to present to their local hospital or GP, or face a charge when visiting eye care professionals (optometrists). Some areas of the UK have commissioned enhanced community services to alleviate this problem; however, many areas have not. The present study is a needs assessment of three areas (Leeds, Airedale and Bradford) without a Minor Eye Conditions Service (MECS), with the aim of determining whether such a service is clinically or economically viable.

Method: A pro forma was developed for optometrists and practice staff to complete when a patient presented with an ocular problem not related to spectacle prescription. This form captured the reason for visit, whether the patient was seen, the consultation funding, the outcome and where the patient would have presented to if the optometrists could not have seen them.

Results: 75% of patients were managed in optometric practice. 9% and 16% of patients required subsequent referral to their General Practitioner or hospital ophthalmology department, respectively. Should they not have been seen, 34% of patients would have presented to accident and emergency departments and 59% to their general practitioner. 53% of patients paid privately for the optometrist appointment, 28% of patients received a free examination either through use of General Ophthalmic Service sight tests (9%) or optometrist good will (19%) and 19% of patients did not receive a consultation and were redirected to other providers (e.g. pharmacy, accident and emergency or General Practitioner). Patient satisfaction was high (88%) and cost-analyses revealed a theoretical cost savings.

Significance: This assessment demonstrates that a MECS scheme in the local areas would be economically and clinically viable and well received by patients. As such, Bradford CCGs have now commissioned a MECS.

Keywords: Needs Assessment, MECS, Minor Eye Condition Service, optometry, Primary Care, PEARS

Investigating the Effect of Stimulus Area and Duration on Fixation Stability in Standard Automated Perimetry

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Background: Stable fixation is a key perimetric requirement. Whilst well accepted this can be affected by disease and fixation target selection, the impact of stimulus area, duration and visibility is currently unknown. In this study the effect of these stimulus features on fixation stability in healthy observers was examined under adaptation conditions of Standard Automated Perimetry (SAP).

Methods: Fixation data were collected using a high-speed eye-tracker (1000 Hz, EyeLink 1000-plus) in fifteen healthy observers (mean age: 67.9 years, range: 55-80) whilst performing a custom gaze-contingent perimetry test. Achromatic contrast thresholds were measured for two stimulus durations (3.7 and 190 ms) using a Goldmann III (GIII) equivalent stimulus (0.43°) and stimuli scaled to the local Ricco's area (RA) at eight locations (four each at 2.5° and 5° eccentricity). Fixation stability was quantified by calculating the bivariate contour ellipse area (BCEA) for each stimulus presentation period (incorporating stimulus presentation and inter-stimulus interval) in all tests. Data were subsequently grouped according to stimulus area, duration & relationship to measured threshold (i.e., sub- or supra-threshold) for analysis purposes.

Results: Median log BCEA (log minarc^2) values were significantly smaller ($P<0.001$) for the GIII stimulus (2.55, IQR 2.29 – 2.85) compared to the RA-scaled stimulus (2.60, IQR 2.36 – 2.88). For both stimuli, log BCEA was significantly greater for the 190 ms stimulus (both $P<0.001$) compared to the 3.7 ms stimulus. Additionally, log BCEA values were also larger for suprathreshold stimuli (GIII: 2.60, 2.34-2.89; RA: 2.63, 2.39 – 2.92) compared to subthreshold stimuli (GIII: 2.51, 2.24 – 2.81; RA: 2.56, 2.33 – 2.85) for both stimulus areas (both $P<0.001$).

Significance: Fixation behaviour under the conditions of SAP is influenced by stimulus area, presentation duration and contrast in healthy observers. Such differences, while small and not reflective of test sensitivity, are likely related to the relative visibility of presented stimuli and the minimum velocity of voluntary saccadic eye movements.

Clinical application of an adaptive kinetic perimetry algorithm, in advanced glaucoma.

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Background: Through computer simulations, we designed a simple but efficient approach for estimating isopter positions with automated kinetic perimetry. Here, we evaluated the performance of this strategy in patients with moderate to advanced glaucoma.

Method: In 9 patients kinetic tests were performed on an Octopus 900 perimeter (Haag Streit, Switzerland) controlled through the Open Perimetry Interface (Turpin et al., 2012) twice per subject. Goldmann stimuli (V-4e, speed 5°/s) were presented along 7 meridians of the temporal and inferior visual field in steps of 30°. Isopter positions were estimated from at least two responses, and additional stimuli (up to 3, for a total of 5) were presented until the distance between the two closest responses was less than a criterion value. Previous simulations had suggested that a criterion value of 5° would provide sufficient precision for a wide range of response variability.

Results: The mean (range) age of the patients was 75 (69 to 80) years. Visual field mean deviation (MD) in the worse and better eyes were -18 (-8 to -29) dB and -8 (-2 to -20) dB, respectively. Partial isopters could be estimated using 16 (14 to 19) presentations. With the addition of 4 false positive catch trials, the test took 2 (1.3 to 4.7) minutes on average. The isopter positions were estimated to within a 90% retest interval of ±3.5°. The median error between isopter positions was -0.7°, this indicates little change between test 1 and test 2, which could arise from learning effects.

Significance: Clinical application of this procedure suggests that estimates of the inferior and temporal visual field from the adaptive kinetic strategy, are precise to within approximately ±4°; less than the space between locations in conventional static automated perimetry. This simple and fast technique can capture important aspects of far-peripheral vision.

Turpin, A., et al. (2012). "The Open Perimetry Interface: an enabling tool for clinical visual psychophysics." Journal of vision 12(11): 22-22

Optical Coherence Tomography: Monitoring Disease Progression and Treatment Response in Relapsing-Remitting Multiple Sclerosis.

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Background: Optical coherence tomography (OCT) is a technique capable of producing high resolution images of biological tissue layers, such as the retina, in situ (Costello et.al, 2018). As the retinal axons are un-myelinated, OCT offers a unique way to visualize and monitor neurodegeneration. (Petzold et.al, 2010). OCT allows analysis of discrete changes within retinal layers. Hense OCT has been proposed as a method to analyze disease progression and treatment response, in people with relapsing-remitting multiple sclerosis (RRMS) - the only sub-type of multiple sclerosis for which disease modifying therapies (DMTs) are available.

Methods: A systematic review of the literature examined the efficacy of OCT used in this setting. In addition to this, the impact on the well-being of people with MS (pwMS) and economic benefits were also considered to determine the true potential for OCT to be used on a wider scale to monitor MS.

Literature searches were carried out using PubMed, Wiley Online Library, Springer, Cochrane Library and Google Scholar. Once duplicates and papers not directly relevant to the research question were removed, 130 papers were included in the review.

Results: The low-cost, well-tolerated nature of OCT means it has the potential to be easily incorporated into clinical practice for this purpose in the future. Available literature highlights the potential for OCT as useful technique to identify neuronal, axonal and inflammatory pathology in pwRRMS and aid in the prediction of future disability. Evidence also points to OCT as a possible way to monitor DMT efficacy in pwRRMS.

Although at present, non-interchangeability between OCT systems, and with limited literature examining the effect of optic neuritis on OCT measurements, may present barriers to adoption of this technique.

Significance: OCT shows promise for monitoring disease progression and treatment responses in patients with RRMS, further research is needed to confirm its usefulness in these settings.

Repeatability and agreement of the swept source OCT-based IOLMaster 700 compared with the IOLMaster v3 in healthy, young adult eyes.

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Background: To evaluate the intra-examiner repeatability of a swept-source optical coherence tomographer (Zeiss IOLMaster 700) and compare its outputs with those of the IOLMaster v3 in a clinically normal, young adult population.

Methods: This is a cross-sectional, observational study. Ocular biometry (axial length [AL], corneal curvature [K] and anterior chamber depth [ACD]) measures were recorded from one eye of each participant using both the IOLMaster 700 and IOLMaster v3 at Visit 1. Visit 2 occurred within two weeks of Visit 1, at which all measurements from Visit 1 were repeated on the same eye using the IOLMaster 700. Mean differences, 95% limits of agreement (LOA's) and confidence intervals (CI's) were calculated and Bland-Altman plots used to explore intra-examiner repeatability of the IOLMaster 700 and to compare agreement between the IOLMaster 700 and IOLMaster v3. Pearson's correlations or their non-parametric equivalent (Spearman's correlations) were used to identify the presence of proportional bias ($p<0.05$ was statistically significant).

Results: Full biometric data were obtained from 51 participants at Visit 1 (mean age 23.3±4.6 years) and 46 participants returned for Visit 2 (mean age 23.5±4.8 years). Intra-examiner repeatability showed small mean differences and narrow LOA's for AL (0.00mm, -0.03mm to 0.03mm), K (0.00mm, -0.05mm to 0.05mm) and ACD (0.00mm, -0.10mm to -0.10mm) respectively. Similarly, small mean differences and narrow LOA's illustrated good agreement between instruments (AL -0.02mm, -0.10mm to 0.06mm; K -0.02mm, -0.09mm to 0.05mm; ACD -0.01mm, -0.26mm to 0.24mm). No significant proportional bias was found for any of the parameters in either inter-instrument agreement or intra-examiner repeatability analyses ($p>0.056$).

Significance: When used on healthy, young adult eyes our data demonstrate the IOLMaster 700 to be highly repeatable for axial length, corneal curvature and anterior chamber depth measures. There is good agreement between devices for axial length and corneal curvature measurements; anterior chamber depth measurements show weaker agreement. These findings will be useful for future studies comparing outputs from these two devices.

The Roles of hV5/MT+ and V3A in Processing Depth-From-Motion: Evidence from Neurostimulation

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Background: The ability of the human visual system to analyse motion underpins the success of a wide range of behaviours including the perception of motion relative to ourselves. Of particular importance for this study is the idea that motion signals can reveal a lot about the environment around us, including the relative depth/ distance of objects. For example, if two cars drive perpendicular to you at identical speeds, but one is located behind the other, it will appear to be moving at a slower speed. This implies increasing distance produces a wider speed gradient between yourself and the object.
In non-human primates, V5/MT+ neurons are responsive to speed gradients that result when planes of motion are tilted (in depth), suggesting V5/MT+ plays a prominent role in the analysis of depth-from-motion. One particular sub-division of monkey V5/MT+, FST, has been most strongly implicated in the analysis of depth-from-motion but a human homolog of this area has yet to be reliably identified. Instead, neuroimaging studies suggest hV5/MT+, V3A, and IPS0-4 appear to process these signals.

Methods: fMRI-guided repetitive TMS was delivered to sub-divisions of hV5/MT+ (MT/TO-1, MST/TO-2) and V3A in order to determine the roles of these areas in a depth-from-motion discrimination two-interval forced choice (2IFC) task. The task involved identifying which of two intervals contained a 'flatter' motion plane, defined by varying speed gradients (centred at 60° above horizontal). The difference in degrees (equivalent to speed gradient range) across the two intervals was set to each individual's threshold level.

Results: Application of TMS to all three areas, MT/TO-1, MST/TO-2, and V3A can disrupt ability to perceive depth-from-motion by approximately 10%.

Significance: The notion that all three of these motion-selective regions appear to be involved in analysing depth-from-motion purports that they all contribute to a network of areas analysing 3D global motion.

In the absence of extrastriate visual areas, functional responses in striate cortex remain but behavioural responses are absent.

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Background: The posterior visual pathway is retinotopically organised such that neighbouring parts of the visual field are processed by neighbouring regions of visual cortex. Striate or primary visual cortex (V1) is the first cortical representation receiving information from the eyes via the lateral geniculate nucleus (LGN). Beyond V1, extrastriate cortex contains multiple maps of the visual field which become increasingly specialised in their functional properties. Whilst studies have reported on effects of lesions to V1 or neighbouring extrastriate cortex (V2/V3), it remains unclear what V1 responses remain when V2/V3 are lesioned but V1 remains intact.

Methods: Following a stroke, patient HD (age 65) exhibited a left-sided homonymous visual field defect splitting the macula, despite evidence of spared tissue in V1. Magnetic resonance imaging (MRI) at 3T was used to examine structural and functional properties of the visual pathways. Functional MRI defined representations of the visual field on visual cortex with standard retinotopic mapping methods. Connections between the LGN and V1 in both hemispheres were also assessed using diffusion-tensor imaging (DTI) tractography.

Results: Structural MRI confirmed the presence of spared tissue along the calcarine sulcus (cortical location of V1) in the damaged hemisphere in the midst of a large lesion in locations representing extrastriate cortex. FMRI demonstrated normal responses to contralateral visual field stimulation in V1 of both damaged and intact hemispheres. Retinotopic mapping revealed a preserved and functional retinotopic map of the 'blind hemifield' in the damaged hemisphere. DTI indicated an intact projection from the LGN to V1 in the damaged hemisphere, comparable to the intact hemisphere.

Significance: To our knowledge, this is the first study to report that despite spared inputs to primary visual cortex (V1) revealing retinotopic organisation, lesions to extrastriate areas V2/V3 produce functional blindness. This suggests that extrastriate cortex is necessary for normal perception.

Assessing the Status of Visual Cortex in Macular Disease

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Background: The current focus in ophthalmological research concerns physiological changes within the eye, aiming to treat eye disease and prevent further loss of vision. However, comparatively fewer studies have examined the consequences of eye disease on visual cortex. Macular Degeneration (MD) embodies a collection of disorders causing a progressive loss of central vision. Cross-sectional studies have revealed structural changes in visual cortex in MD, notably a reduction in cortical thickness compared to sighted controls, however the rate at which the changes occur is unknown.

Methods: We acquired structural MRI data on patients with different forms of MD and age-matched controls over multiple time points in a ~2 year period, to explore the rate of change in cortical thickness within the occipital pole (OP), the cortical representation of the retinal lesion and the calcarine sulcus (CS), the cortical representation of the intact visual field. Data were analysed using a linear mixed-effects model.

Results: Preliminary data show that all participants show a decline in cortical thickness over time, as expected with natural ageing. However, results also revealed a significant reduction in grey matter in patients in the OP, and an accelerated rate of decline compared to controls. Whilst patients did have a significantly thinner CS, the rate of change did not differ between groups.

Significance: Understanding the time course of changes may prove important for visual restoration. The projected increase in the percentage of the UK population over 65 years old will in turn result in more cases of age-related MD, already the leading cause of blindness in the UK; if visual cortex is no longer viable and unable to process new incoming visual information, the success of interventions aiming to restore functionally useful vision will be limited.