Optica Fall Vision Meeting YIA Scoring Sheet

Please use a scale of 1 - 5 where **1 is the highest score** and **5 is the lowest score**.

Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **talk session, Fri at 1030**

Author: Pijewska, Ewelina

Coauthors: Denise Valente;Kari V Vienola;Ratheesh Meleppat;Robert J Zawadzki;Ravi S Jonnal

Email: eapijewska@ucdavis.edu

Institution: Center for Human Ophthalmic Imaging Research (CHOIR), UC Davis Eye Center, Sacramento, CA 95817, USA; EyePOD Imaging Lab, Dept. of Cell Biology and Human Anatomy, UC Davis, Davis, CA 95616, USA.

Title: Human cone response models for optoretinography with FF-SS-OCT and adaptive optics

Abstract: Recent work has shown that human rod and cone outer segments (ROS and COS, respectively) deform in response to visual stimuli. In phase-based optoretinography (ORG) the phases of backscattered light from the inner/outer segment junction (IS/OS) and the COS/ROS tips (COST/ROST), is measured, which allows observation of stimulus-evoked, nanometer-scale changes in the OS length. In this work, we used a full-field swept-source OCT with AO that allowed up to kHz volume rates. ORG responses were recorded in two healthy volunteers, with photopigment bleaching levels in the range of 1-60 %, and modeled using an exponential sum. The proposed harmonic oscillator-based response model allowed us to describe the shape of the cone's ORG responses by amplitudes of deflection and relaxation times. Our preliminary results show that responses to complex stimuli were consistent with photopigment availability, which in the context of the consensus theory that adaptation in cones is mediated by photopigment suggests that the ORG may be a useful way to probe light adaptation in cones. The development of simple quantitative parameters describing the ORG response should benefit future clinical applications and help to track the progress of blinding diseases.

Funding: National Institutes of Health (R01-EY-033532, R01-EY-031098, R01-EY-026556, P30-EY-183 012576)

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **talk session, Fri at 1030**

Author: Liu, Teng

Coauthors: Vimal Prabhu Pandiyan;Benjamin Wendel;Emily Slezak;Debarshi Mustafi;Jennifer Chao;Ramkumar Sabesan

Email: tengl7@uw.edu

Institution: Department of Ophthalmology, University of Washington

Title: Correlating cone structure and function in retinitis pigmentosa using coarse-scale optoretinography (CoORG)

Abstract: Optoretinography (ORG) has the potential to serve as a powerful diagnostic biomarker, owing to its sensitive and objective localization of function and dysfunction. Majority of ORG implementations employ adaptive optics (AO) for imaging activity at a cellular scale. Coarse-scale Optoretinography (CoORG), an ORG paradigm without AO, offers rapid, extended-field recordings and wider applicability in patients with retinal disease, by compromising cellular resolution. This study investigates the feasibility of CoORG in assessing cone dysfunction in patients diagnosed with retinitis pigmentosa (RP). Five RP patients aged 26 – 60 were recruited, alongside age-similar controls. The stimulus for evoking cone activity had a photon density between 15.5x10e6 - 19.7x10e6 photons/ m2, and was centered at 532 ± 5nm. Eight imaging trials per bleach were performed, allowing for 1 min. between successive trials for dark adaptation. The total experimental time for each bleach was 10-20 mins. In RP, cone function, estimated as the change in optical path length in the outer segment in response to a stimulus, was diminished and generally lower than normal controls. This deficit was observed in areas of seemingly normal outer retinal structure. Contrary to normals, no correlation was observed between outer segment length and cone function in RP. This highlights CoORG's potential for early, sensitive detection of retinal dysfunction prior to apparent structural degradation.

Funding: NIH grants U01EY032055, EY029710, P30EY001730, Burroughs Wellcome Fund Careers at the Scientific Interfaces, Foundation for Fighting Blindness, Unrestricted grant from the Research to Prevent Blindness

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Scorer initials:

Session: **talk session, Fri at 1030**

Author: Baez, Hector

Coauthors: Laporta Jennifer;Walker Amber;Fischer William;Hollar Rachel;Patterson Sara;DiLoreto David;Gullapalli Vamsi;McGregor Juliette

Email: Hbaez@ur.rochester.edu

Institution: Center for Visual Science, University of Rochester

Title: Inner limiting membrane peel extends vivo calcium imaging of ganglion cells (RGC) beyond the fovea in non-human primate

Abstract: Viral expression of the calcium indicator GCaMP in primate RGCs has enabled optical readout of retinal function at a cellular scale in vivo. To date, functional recording has been limited to transduced RGCs close to the foveal pit. In this study we evaluate ILM peel as a strategy to expand the area of transduced RGCs and allow functional recording beyond the fovea in the living eye. 4 eyes of 3 immunosuppressed macaca fascicularis received a 9-12° ILM peel centered on the fovea, followed by intravitreal injection of GCaMP8s 4-8 weeks post-peel. A 660nm flickering visual stimulus drove RGC GCaMP responses which were recorded with fluorescence adaptive optics scanning laser ophthalmoscopy. In all eyes GCaMP was expressed throughout the peeled area, representing a mean 8-fold enlargement in the area of expression relative to a control eye with no peel. Functional responses were obtained from RGCs at max eccentricities of 11.7 o, 8.0 o, 9.7 o, and 13.7 o and could be classified as ON or OFF types up to the edge of the peel. Mean RGC responses in ILM peeled and control eyes of the same animal were comparable at 3.5 o and longitudinal tracking of individual RGCs showed stable responses up to 6 months post-peel. ILM peel substantially expands the region of primate retina accessible for in vivo GCaMP beyond the foveal ring of RGCs. This presents new opportunities for physiological study of the retina and pre-clinical testing of novel therapies in retinal degeneration models.

Funding: Research reported in this publication was supported by the National Eye Institute of the National Institutes of Health under Audacious Goals Initiative funding Award No. York U24 EY033275 Accelerating photoreceptor replacement therapy with in-vivo cellular imaging of retinal function in primate, P30 EY001319 (core) and F32 EY032318 Foveal ganglion cell function in the living eye. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Inst. of Health. This study was supported by an Unrestricted Grant to the University of Rochester Department of Ophthalmology from Research to Prevent Blindness.

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Scorer initials:

Session: **talk session, Fri at 1030**

Author: Yücel, Ezgi Irmak

Coauthors: Vaishnavi Mohan;Geoffrey M. Boynton;Ariel Rokem;Ione Fine

Email: yucel@uw.edu

Institution: Department of Psychology, University of Washington

Title: The perceptual experience of optogenetic vision

Abstract: Optogenetic therapy for retinal degenerative diseases aims to elicit light response in remaining retinal cells (bipolar and/or ganglion cells). Animal models suggest that these proteins have lower sensitivity, and slower kinetics compared to neurotypical vision. Here we describe a framework for simulating 'virtual patients' to quantify the predicted perceptual experience of optogenetic vision. We simulated the neural responses of rd1 mouse retina expressing 4xBGAG12,460:SNAP-mGluR2 (Holt et al., 2022) and used this simulation to generate virtual patients: sighted participants viewing the visual stimulus filtered through our simulations. We measured the visual performance of these virtual patients (n=6) using temporal contrast sensitivity functions. Virtual patients had a 10x fold loss of sensitivity, which was exacerbated at higher temporal frequencies, corresponding to a loss of Snellen acuity from ~20/40 at low temporal frequencies to ~20/100-20/200 at high temporal frequencies. We predict that the ability to process fast-moving objects may be impaired in optogenetic vision, and patients with uncontrollable nystagmus may be poor candidates for optogenetic treatments with sluggish kinetics. Our virtual patient framework can easily be extended to simulate any optogenetic protein, and thereby provides a way to quantify and compare the expected perceptual performance of different opto-proteins based on in vitro retinal data.

Funding: NEI

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **talk session, Fri at 1030**

Author: McLean, Iona

Coauthors: Esther Sherbak;Loganne Mikkelsen;Ian Erkelens;Robin Sharma;Emily Cooper

Email: ionamclean@berkeley.edu

Institution: Herbert Wertheim School of Optometry and Vision Science, University of California, Berkeley

Title: The effects of monocular and binocular retinal image minification on eyestrain

Abstract: While corrective spectacles have been worn for centuries, relatively little is known about the physical and perceptual effects associated with their optical distortions. Retinal image minification, for example, is caused by myopic spectacle correction and may also occur in near-eye displays. Previous work suggests that different amounts of minification (or magnification) between the eyes can produce perceptual distortions and oculomotor discomfort, but the extent to which these effects are problematic is unknown. In our first study, forty observers wore minifying spectacles of 2% or 4% in both eyes (binocular), just one eye (monocular), or neither eye (control). After performing a task that incorporated reading, interacting with objects, and visual search, participants reported their symptoms. Overall, participants found monocular minification to be slightly more uncomfortable than the binocular counterpart. Monocular minification produced greater eyestrain and self-reported difficulty interacting with objects. In a second study, we investigated how these two symptoms change after one hour of adaptation to monocular 4% lenses. We found that both symptoms worsened during adaptation. Interestly, the difficulty interacting with objects declined soon after the lenses were removed, while eyestrain persisted. Taken together, these studies indicate specific types of discomfort during natural tasks that may be reduced through improving optical lens designs in the future.

Funding: Funded by the National Science Foundation (Award #2041726) and Meta Reality Labs.

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **talk session, Fri at 1030**

Author: Kruper, John

Coauthors: Adam Richie-Halford;Noah Benson;Sendy Caffarra;Julia Owen;Yue Wu;Aaron Lee;Cecilia Lee;Jason Yeatman;Ariel Rokem

Email: jk232@uw.edu

Institution: University of Washington

Title: Specific and non-linear effects of glaucoma on optic radiation tissue properties

Abstract: Changes in sensory input with aging and disease affect brain tissue properties. To establish the link between glaucoma, the most prevalent cause of irreversible blindness, and changes in major brain connections, we characterized white matter tissue properties in diffusion MRI measurements in a large sample of subjects with glaucoma (N=905; age 49-80) and healthy controls (N=5,292; age 45-80) from the UK Biobank. Confounds due to group differences were mitigated by matching a sub-sample of controls to glaucoma subjects. A convolutional neural network (CNN) accurately classified whether a subject has glaucoma using information from the primary visual connection to cortex (the optic radiations, OR), but not from non-visual brain connections. On the other hand, regularized linear regression could not classify glaucoma, and the CNN did not generalize to classification of age-group or of age-related macular degeneration. This suggests a unique non-linear signature of glaucoma in OR tissue properties.

Funding: This project was funded by NSF grant 1934292 (PI: Balazinska), NIH grant R01 AG 060942 (PI: Lee), NEI grant R01 EY033628 (PI: Benson), NIH grant RF1 MH121868 (PI: Rokem), NIH grant R01HD095861 (PI: Yeatman). SC was funded by the "Rita Levi Montalcini" program, granted by the Italian Ministry of University and Research (MUR). Unrestricted and career development award from RPB (Julia Owen, Yue Wu, Cecilia Lee, Aaron Lee), Latham Vision Science Awards (Julia Owen, Yue Wu, Cecilia Lee, Aaron Lee), NEI/NIH K23EY029246 (Aaron Lee) and NIA/NIH U19AG066567 (Julia Owen, Yue Wu, Cecilia Lee, Aaron Lee, Ariel Rokem).

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **talk session, Fri at 1315**

Author: Tessmer, Karen

Coauthors: Sylvia Jane Gasparini;Juliane Hammer;Trishla Adhikari;Klara Schmidtke;Sebastian Knöbel;Marius Ader

Email: karen.tessmer@tu-dresden.de

Institution: Center for Regenerative Therapies, TUD Dresden University of Technology

Title: Insights into retinal cell replacement: Optimising photoreceptor and RPE transplantation

Abstract: Retinal degenerative diseases, such as age-related macular degeneration and inherited retinal degenerations, are characterized by the dysfunction and ultimately loss of photoreceptors and retinal pigment epithelium (RPE). Retinal cell replacement has emerged as a potential therapeutic strategy. This is enabled by the availability of desired donor cells differentiated in large numbers from human embryonic or induced pluripotent stem cells. With many differentiation protocols around, detailed comparison of donor cell and host characteristics allowing improved transplantations outcomes are however still sparse. Here, I will present our work on a more detailed assessment of photoreceptor and RPE single cell suspension transplantations. Human photoreceptors incorporate extensively into a cone-degeneration mouse host, interact with host Müller glia and bipolar cells and polarize to form inner and outer segments as well as synapses. Importantly, increased donor-host interactions correlate with improved graft polarization and maturation, with donor cell age greatly influencing this process. Similarly, RPE transplantations into an acute RPE depletion mouse model showed that monolayer formation strongly depends on RPE differentiation times, with further improvement by enrichment of an RPE subpopulation by cell surface markers. Overall, our work highlights the need for careful selection of appropriate donor cells for structural integration into recipient tissue after transplantation.

Funding: DFG, BMBF, FFB

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **talk session, Sat at 800**

Author: Vlasits, Anna

Coauthors: Maria M Korympidou;Sarah Strauss;Timm Schubert;Katrin Franke;Philipp Berens;Thomas Euler

Email: anna.vlasits@northwestern.edu

Institution: Department of Neurobiology, Northwestern University

Title: Color processing in the mouse retina

Abstract: Across species, specialized retinal circuits allow animals to extract visual information from their environments. How retinal circuits extract relevant visual information is a major area of inquiry. In the mouse retina, cone photoreceptors possess a gradient of opsin expression leading to uneven detection of colors across visual space. However, at the output of the retina, ganglion cells' color preferences deviate from this gradient, suggesting that circuits in the retina may alter the color information before sending it to the brain. We explored how circuits in the retina shape chromatic information, focusing on the retina's interneurons, amacrine cells and bipolar cells. We found that inhibitory amacrine cells rebalance color preferences, leading to diverse color selectivity throughout retinal space. Since amacrine cells vary widely across species, these cells are poised to tune the chromatic information sent to the brain to each species' environmental niche.

Funding: German Research Foundation (DFG; BE5601/2-1; SPP 2041; BE5601/4-1,2; EU42/9-1,2), the German Ministry of Education and Research (Bernstein Award 01GQ1601 to PB; BCCN 01GQ1002 to KF), the Medical Faculty/U Tübingen (fortüne to AV), and the Max Planck Society (M.FE.A.KYBE0004 to KF).

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **talk session, Sat at 1015**

Author: Wang, Yiyi (Charlotte)

Coauthors: Congli Wang;Ren Ng;William S. Tuten

Email: yiyiwang@berkeley.edu

Institution: Herbert Wertheim School of Optometry and Vision Science, University of California, Berkeley

Title: High-resolution assessment of saccadic landing positions for S-cone-isolating targets

Abstract: The role of S-cone signals in guiding visuomotor behavior is not fully understood. Previously, we used high-resolution retinal tracking during a visual search-and-identification task to show that the preferred retinal locus (PRL) of fixation for S-cone-isolated targets was larger than and offset from the PRL measured with L/M-isolating optotypes (Wang et al, ARVO 2023). Here, we present an analysis of saccadic landing behavior under these conditions. We used an adaptive optics ophthalmoscope to record retinal videos while subjects (N = 6) made small saccades to a tumbling-E stimulus that appeared at random loci within a 3x3 square grid with 0.5° spacing. Subjects reported stimulus orientation via keypress, after which the target moved to a new location. Retinal videos recorded during each experiment were used to extract eye position traces and localize stimuli in retinal coordinates. Saccade PRLs were computed from the post-saccadic retinal landing positions using the ISOA method. The mean (± SEM) saccade PRL areas were 122 ± 8.1 arcmin2 and 525 ± 133 arcmin2 for the L/M- and S-cone conditions, respectively ($p<0.01$; Wilcoxon rank-sum test). For both conditions, the post-saccadic ISOA size reduced over the course of ~300 ms. The average displacement between the L/M- and S-cone saccade PRL was 7.72 ± 1.24 arcmin, similar to that reported previously for fixation, suggesting the retinal locus directed to a target of interest depends on the visual pathway mediating its detection.

Funding: This work was supported by NEI Bioengineering Research Partnership R01EY023591, NEI 5T35EY007139, American Academy of Optometry Foundation Ezell Fellowship, Hellman Fellowships, Alcon Research Institute Young Investigator Award, and the Air Force Office of Scientific Research under award numbers FA9550-20-1-0195 and FA9550-21-1-0230.

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **talk session, Sat at 1015**

Author: Hexley, Allie C.

Coauthors: Laura K. Young;David H. Brainard;Austin Roorda;William S. Tuten;Hannah E. Smithson

Email: allie.hexley@psy.ox.ac.uk

Institution: Department of Experimental Psychology, University of Oxford

Title: The relationship between temporal summation at detection threshold and fixational eye movements

Abstract: We studied the relationship between the threshold temporal summation of increment pulses and fixational eye-movements. Six participants completed a 2AFC increment detection task. Stimuli were 0.16 x 2.2 arcmin increments of 543 nm light presented via an AOSLO with a 60 Hz frame rate. Stimuli for temporal integration were two single frame presentations with a 16 ms (consecutive frames), 33 ms, 100 ms, or 300 ms inter-stimulus interval (ISI). Data were also collected for increments presented on a single frame. Stimuli were presented in either world-fixed coordinates (natural retinal image motion) or were stabilised on the retina. There were large differences in overall sensitivity across individuals, but the time-course of performance change with ISI was similar across participants. Thresholds for ISI=33 ms were close to performance with two consecutive frames, suggesting complete summation of light energy; whereas thresholds for ISI=300 ms were closer to the single-frame case, suggesting limited summation; and thresholds for ISI=100 ms were intermediate, suggesting residual summation. The effect of ISI on threshold was similar for stabilised stimuli and natural viewing, but there was a small trend towards lower thresholds for stabilised stimuli at short ISI and vice-versa at long ISI. We plan to present our results in the context of an ideal observer calculation that may clarify how the initial visual encoding, including temporal summation within cones, shapes performance.

Funding: UKRI/Wellcome Physics of Life; EP/W023873/1; National Institutes of Health R01EY023591; AFOSR FA9550-21-1-0230; Hellman Fellows Program;

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Scorer initials:

Session: **talk session, Sat at 1015**

Author: Chin, Benjamin M.

Coauthors: Martin S. Banks;Derek Nankivil;Austin Roorda;Emily A. Cooper

Email: bechin@berkeley.edu

Institution: Herbert Wertheim School of Optometry and Vision Science, University of California, Berkeley

Title: Bringing color into focus: Dynamic accommodation responses to polychromatic stimuli

Abstract: As humans look around the environment, the crystalline lens inside the eye changes optical power to bring retinal images into focus. This visuomotor response is called accommodation. For a given accommodative state, light at only one wavelength can be in focus because the eye contains significant chromatic aberration. We examined how the visual system weights different wavelengths for focusing polychromatic stimuli, especially those with peaks at more than one wavelength. With an autorefractor, we continuously measured human accommodative responses (at 30 Hz) to stimuli comprising various mixtures of short- and long-wavelength content. In a series of trials, seven human observers viewed a three-letter word stimulus spanning 1.5° (24 arcmins per letter) against a black background on an AMOLED display for seven seconds. The optical distance of the screen was varied using a focus-adjustable lens. Halfway through the trial, the stimulus underwent a step change in optical distance (±0.75, 1.00, or 1.50 diopters). Simultaneously, the color of the stimulus changed. Accommodative responses for each subject were analyzed with nested descriptive models, including a color-free model, a weighted-averaging model, and a color-switching model. The results show that stimulus color significantly influences the dynamic accommodative response, and that long wavelengths influence the response more than short wavelengths, even when their luminance is the same.

Funding: National Science Foundation (Award #2041726)

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **talk session, Sat at 1015**

Author: Segala, Federico G.

Coauthors: Joel T. Martin;Aurelio Bruno;Alex R. Wade;Daniel H. Baker

Email: fgs502@york.ac.uk

Institution: Department of Psychology, University of York, York, United Kingdom

Title: Binocular combination of the pupil response depends on photoreceptor pathway

Abstract: The pupillary light response is driven by three classes of retinal photoreceptor. Cones and rods are involved in the initial constriction of the pupil, whereas melanopsin-containing intrinsically photosensitive Retinal Ganglion Cells (ipRGCs) maintain constriction over longer timescales. Previous work has characterized the contributions of photoreceptor signals to pupil control, but relatively little is known about binocular combination of these signals when simultaneously stimulating the retina in both eyes. We measured changes in pupil size in 48 participants using a binocular eye-tracker, targeting specific photoreceptor classes with a binocular 10-primary light engine and the silent substitution method. We stimulated the periphery of the retina using light flickering at 0.4 and 0.5 Hz. Participants viewed a disc of either achromatic flickering light, or contrast modulations that targeted the ipRGCs, or the opponent colour pathways L-M or S-(L+M). Using a modified virtual reality headset, we presented the stimuli at a range of modulation amplitudes in three different ocular configurations: monocular, binocular, and dichoptic. We obtained clear pupil responses at both the first and the second harmonic frequencies. Suppression levels differed across conditions with the strongest suppression measured for the L-M condition. We account for the results in a single modelling framework where the weight of interocular suppression determines the binocular combination properties.

Funding: Biotechnology and Biological Sciences Research Council grant BB/V007580/1 awarded to DHB and ARW

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Session: **talk session, Sat at 1015**

Author: Rodriguez, Carlos

Coauthors: Ling-Qi Zhang;Alexandra E. Boehm;Maxwell J. Greene;William S. Tuten;David H. Brainard

Email: carlos.rodriguez@pennmedicine.upenn.edu

Institution: University of Pennsylvania

Title: Computational modeling of shift in unique yellow for small stimuli

Abstract: Unique yellow (UY) is largely invariant to L:M cone proportion for spatially-extended stimuli in healthy trichromats. However, a recent adaptive-optics-based study by Boehm et al. reveals that when stimulus size is reduced to a few arcmin, color appearance depends on the local L:M proportion in the patch of the retina on which the stimulus was imaged. We aimed to determine if such findings are consistent with a normative account of visual processing. A series of 3.5 and 10 arcmin stimuli were simulated as isoluminant mixtures of 540 and 680 nm primaries. We modeled sensory encoding under adaptive-optics conditions using the open-source software ISETBio, for simulated retinal cone mosaics with varying local L:M proportions. The resultant cone excitations were decoded using a Bayesian image reconstruction algorithm (Zhang et al., 2022). For the 3.5 arcmin stimuli, as local L:M proportion decreased, the 540 nm component of the reconstructions increased relative to the 680 nm component. This is qualitatively consistent with the experimental observations of Boehm et al. For 10 arcmin stimuli, in contrast, reconstructions were stable across variation in local L:M cone proportion. Notably, reconstructions depend not only on the local L:M cone proportion, but also on the proportion in the immediately surrounding retina, leading to a testable prediction. The computational observations frame the experimental results as a normative consequence of visual processing.

Funding: The University of Pennsylvania Post-Baccalaureate Research Education Program, grant number R25 GM071745, and a research gift from Meta

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Session: **talk session, Sat at 1015**

Author: Popovkina, Dina V.

Coauthors: Kelly Chang;Lucas M. Suarez;John Palmer;Cathleen M. Moore;Geoffrey M. Boynton

Email: dina4@uw.edu

Institution: Department of Psychology, University of Washington

Title: Neural correlates of serial processing during divided attention across multipart objects

Abstract: Judgments of multiple simultaneously presented stimuli produce a variety of divided attention effects. For example, participants can detect colors in two locations as well as in one, but can recognize only one masked word at a time (White, Palmer, & Boynton, Psych Science 2018). Here, we ask whether judging objects with interchangeable parts, similar to letters in words, also produces performance deficits consistent with serial processing, and which brain areas subserve this process. In a probe recognition task, participants discriminated abstract objects made of Duplo™ parts. On each trial, two objects were presented, with either one or both objects cued as relevant (single- and dual-task conditions, respectively). The distractor probes were made of the same parts in a different order. The difference in performance between the single- and dual-task conditions was 17±1% (n=13), consistent with the prediction of a serial model and rejecting the fixed-capacity parallel model. This result suggests that there is a visual brain area where information can be processed about only one object at a time. Currently, we are using fMRI to examine activity in object-selective regions of the human lateral occipital cortex. To seek evidence of serial processing, we are assessing how stimulus-related modulation is mediated by selective attention; the area of interest should show a modulation for only the attended stimulus location.

Funding: This work was supported in part by grants from the National Eye Institute (F32 EY030320 to D.V.P. and EY12925 to G.M.B. and J.P.).

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **talk session, Sun at 1015**

Author: Welbourne, Lauren

Coauthors: Joel Martin;Federico Segala;Alex Wade;Daniel Baker

Email: lauren.welbourne@york.ac.uk

Institution: University of York

Title: Measuring binocular combination of luminance and chromatic stimuli using fMRI

Abstract: There are clear and measurable benefits of using two eyes instead of one (e.g. at detection thresholds, stereopsis). However, at high contrasts, excitation and inhibition between binocular ("Bin") and monocular ("Mon') responses are balanced, resulting in ocularity invariance behaviourally, and in the primary visual cortex. Little is known about whether and how signals are combined binocularly in other brain regions, including MT and some subcortical areas. We investigated whether we could measure differences in fMRI BOLD responses in Bin vs Mon across different brain regions, for high contrast luminance and chromatic stimuli. Thirty-six subjects had four functional MRI scans consisting of a block design with five stimulus types (three luminance stimuli, L-M, and S-cone) presented in Bin and Mon. Expanding ring and rotating wedge stimuli scans were also used for retinotopic mapping of the early visual areas. Full brain analyses showed greater overall responses to Bin vs Mon stimuli, centered on the occipital lobe. In individual (retinotopically-defined) ROI analyses, we saw a significant difference in beta weights between Bin and Mon conditions in V1 for luminance and L-M, but the increase in response to Bin stimuli was much lower than would be predicted by strong binocular facilitation (Quaia et al, 2019). In the LGN and MT we saw no significant differences in Bin vs Mon for any condition.

Funding: BBSRC

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Ash, Ryan

Coauthors: Morteza Mohammadjavadi;Kim Butts Pauly;Anthony Norcia

Email: rytash@stanford.edu

Institution: Department of Psychiatry and Behavioral Sciences, Stanford University

Title: Noninvasive neuromodulation of subcortical visual pathways with transcranial focused ultrasound

Abstract: Transcranial ultrasound stimulation (TUS) is an emerging tool to noninvasively modulate neural activity in deep brain areas. In preparation for our first in-human TUS studies, we targeted TUS to the lateral geniculate nucleus (visual thalamus) in a large mammal (sheep). Full-field light flash stimuli were presented with or without concomitant TUS in randomly interleaved trials. Similar to what has previously observed by Fry et al (Nature 1959) in cats, EEG visual-evoked potentials (VEPs) were reversibly suppressed by TUS to the LGN. No changes in VEPs were observed in sheep who received sham-TUS to a control site in the basal ganglia, ruling out potential transducer auditory-somatosensory confounds. Magnetic resonance acoustic radiation force imaging (MR-ARFI), a technique to measure the ultrasound focus in situ, showed a focal volume of microscopic displacement at the expected target. Excitingly, MR-ARFI predicted the suppressive effect on VEPs in individual subjects, suggesting that MR-ARFI can be used to confirm TUS targeting and estimate neurophysiological impact. We are now translating this paradigm into human, targeting TUS to the LGN while participants perform a contrast detection task with EEG recording of steady-state VEPs. MR-ARFI will be measured to evaluate targeting and estimate TUS dosage in each participant. This work provides the foundation for a dissection of the roles of different subcortical nuclei in different aspects of human vision.

Funding: nan

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Kavcar, Osman B.

Coauthors: Michael E. Rudd;Christabel Arthur;Alex J. Richardson;Michael A. Crognale

Email: okavcar@nevada.unr.edu

Institution: Integrative Neuroscience Program, University of Nevada, Reno

Title: Tests of a contrast gain control model of parabolic brightness matching functions

Abstract: The brightness induction produced by a surround annulus on a target disk can be measured by adjusting the luminance of a second disk to match the target in brightness. This produces parabolic brightness matching functions (BMFs) when average perceptual matches are plotted against annulus luminance on a log-log scale. A model developed by Rudd et al. (JOSA A, 2023), in which a contrast gain control operates between the outer and inner edges of the annulus, predicts that a linear relationship should hold between the first-order (k1) and second-order coefficients (k2) of the parabolic BMFs. We previously verified this prediction and discovered that the slope of this linear relationship depends on the contrast polarity of the target with respect to its annulus, but is unaffected by the annulus size or the background luminance. Here, we further tested the model by varying the target disk luminance in two conditions where the target disk was either a decrement or an increment with respect to its annulus and the background was white (highest display luminance). The model predicts that the slope of the k1 vs k2 plots will itself decrease as a linear function of the log luminance of the target disk, and the rate of decrease will equal -1. Our results confirmed the first prediction, but the slope was -2 instead of -1. This pattern held both in the decremental and incremental target conditions.

Funding: nan

Optica Fall Vision Meeting YIA Scoring Sheet

Please use a scale of 1 - 5 where **1 is the highest score** and **5 is the lowest score**.

Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Birman, Daniel

Coauthors: Kai J Fox;Justin L Gardner

Email: dbirman@uw.edu

Institution: Department of Biological Structure, University of Washington

Title: Gain, not changes in spatial receptive field properties, improves task performance in a neural network attention model

Abstract: Attention allows us to focus sensory processing on behaviorally relevant aspects of the visual world. One potential mechanism of attention is a change in the gain of sensory responses. However, changing gain at early stages could have multiple downstream consequences for visual processing. Which, if any, of these effects can account for the benefits of attention for detection and discrimination? Using a model of primate visual cortex we document how a Gaussian-shaped gain modulation results in changes to spatial tuning properties. Forcing the model to use only these changes failed to produce any benefit in task performance. Instead, we found that gain alone was both necessary and sufficient to explain category detection and discrimination during attention. Our results show how gain can give rise to changes in receptive fields which are not necessary for enhancing task performance.

Funding: Washington Research Foundation, NEI T32EY07031, Research to Prevent Blindness, Lions Clubs International Foundation, Hellman Fellows Fund

Optica Fall Vision Meeting YIA Scoring Sheet

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Martin, Joel T.

Coauthors: Lauren Welbourne;Federico G. Segala;Ellie Baker;Monique Bhullar;Rowan Huxley;Allice Wardle;Daniel H. Baker;Alex R. Wade

Email: joel.martin@york.ac.uk

Institution: Department of Psychology, University of York, York, United Kingdom

Title: Binocular facilitation of the BOLD response to melanopsin stimulation in the suprachiasmatic nucleus

Abstract: In a recent analysis of archival data, Spitschan and Cajochen (2019) identify what appears to be substantial binocular facilitation of melatonin suppression due to melanopic light stimulation. This putative effect likely originates in the melanopsin-containing intrinsically photosensitive retinal ganglion cells (ipRGCs) which project directly to the suprachiasmatic nucleus (SCN) of the hypothalamus. We asked whether we could measure a direct physiological correlate of this binocular facilitation using a binocular, MRI-compatible, 10-primary spectral stimulation device. We present preliminary findings from a functional magnetic resonance imaging (fMRI) study designed to explore the blood oxygen level dependent (BOLD) response to monocular and binocular melanopic light stimulation. The study used a 30 s on/off design with three 'ocularity' conditions (binocular-low, monocular-high, binocular-high) and two classes of targeted photoreceptors (melanopsin and LMS cones). Throughout each scan, subjects (N=18) also responded to brief, cone-directed sinusoidal modulations of varying intensity. We report that binocular vs. monocular melanopsin stimulation induced significant BOLD activation in SCN but that this effect was not seen for cone-directed stimulation. This is consistent with the binocular facilitation effect described by Spitschan and Cajochen (2019) and provides the first direct evidence of melanopsin-driven activation and binocular facilitation in human subcortical nuclei.

Funding: BBSRC (BB/V007580/1)

Optica Fall Vision Meeting YIA Scoring Sheet

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Vincent, Joris

Coauthors: Marianne Maertens

Email: joris.vincent@tu-berlin.de

Institution: Technische Universität Berlin

Title: Combining spatial and quantitative models to account for the relationship between luminance, context and brightness

Abstract: The apparent brightness of a target region is determined not only by its local luminance, but also by its surrounding context. This is well demonstrated by the many illusions where some surround context causes two physically identical targets to appear different in brightness (e.g. White's (1979) illusion). Here we use perceptual scales from Maximum Likelihood Conjoint Measurements to test the predictive power of computational brightness models as a function of surround context and local luminance. While the qualitative relationship between target brightness and surround context (i.e. direction of effect) is captured well by image-computable models of the spatial filtering type (e.g. Blakeslee and McCourt, 1997), these do not predict the quantitative aspects of that relationship (i.e. magnitude of effect). A different class of models (e.g. Whittle, 1992) makes quantitative predictions of brightness as a function of luminance, but requires labeling of target and background (i.e., is not image-computable), thus cannot by itself account for the spatial context. Hence we combine Whittle's model with spatial mechanisms to account for both spatial context and local luminance. A combined model using multiscale spatial filtering and calculating brightness at every spatial scale is able to provide both a correct qualitative prediction of direction of effect, as well as a quantitative prediction of apparent brightness that can be tested against perceptual scales for different stimuli.

Funding: German Research Foundation DFG MA5127/5-1 to M. Maertens

Optica Fall Vision Meeting YIA Scoring Sheet

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Chang, Kelly

Coauthors: Xiyan Li;Kimberly Meier;Kristina Tarczy-Hornoch;Geoffrey M. Boynton;Ione Fine

Email: kchang4@uw.edu

Institution: University of Washington

Title: Non-rivalrous interocular contrast integration across the human visual cortex hierarchy

Abstract: Here, using functional MRI, we measured interocular interactions as a function of contrast presented to each eye under non-rivalrous dichoptic viewing conditions. Methods: Activity was measured from early visual cortex (V1 – V3) while participants (n = 5) viewed dichoptic gratings (2-cpd) that independently varied in contrast over time in each eye at 1/6 and 1/8 Hz. We fit a model $[((L^{m+R}m))/2]\hat{}(1/m)$ to quantify how the neural response was driven by the contrast in each eye (L and R), where m = 1 represents simple averaging, and as $m \rightarrow \infty$ the model shifts towards a max rule, where responses are driven by the eye presented with highest contrast. Results: Across all visual areas, responses were much closer to a max than a mean model, suggesting that neural responses were primarily driven by the eye presented with highest contrast. Within V1, similar findings have been described using a normalization model (Moradi & Heeger, 2009). The magnitude of m increased across the visual hierarchy (V1: m = 1.82; R2 = 0.32; V2: m = 12.94, R2 = 0.28; V3: m = 13.31, R2 = 0.27). Conclusions: The neural response integrating signals from each eye approaches a simple maximum as the contrast signal propagates from V1 through V3. This is consistent with previous behavioral data showing that visually typical observers tend to report perceiving the maximum contrast presented to each eye (Meier et al., 2023).

Funding: Knights Templar Eye Foundation, Research to Prevent Blindness, UW Center for Human Neuroscience, Unrestricted grant from Research to Prevent Blindness to UW Department of Ophthalmology

Optica Fall Vision Meeting YIA Scoring Sheet

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Kitakami, Kotaro

Coauthors: Suguru Saito;Keiji Uchikawa

Email: koo@img.cs.titech.ac.jp

Institution: Tokyo Institute of Technology

Title: Measuring luminance CSFs from the fovea to far peripheries

Abstract: We measured luminance contrast thresholds for three subjects in the visual field of the left eye up to 56, 49, 84, and 63 degrees in nasal, superior, temporal, and inferior directions, respectively. The stimulus was a cosine-Gabor of 10 deg diameter. The stimulus size was constant for all eccentricities. The average luminance of the background was 31cd/m2. The stimulus duration was 0.5sec with 0.5sec increasing and decreasing temporal slopes. The thresholds were measured with the psi procedure of two temporal alternative forced choice. The results showed that although at small eccentricities no significant differences in thresholds were found among directions, the differences were prominent at large eccentricities beyond 40 degrees in all frequencies. Most previous peripheral CSFs were based on data measured within certain ranges of eccentricity, and extrapolated outside these ranges. We optimized the parameters of the previous CSFs using the present results within these limited ranges, and confirmed that the previous CSFs fitted the present results. Then, we applied the present results in all eccentricities to the previous CSFs. It was found that the previous CSFs tended to be higher than the present results beyond 60 degrees in temporal and beyond 40 degrees in other directions in all frequencies. This would indicate that the previous CSFs at large eccentricities were not correctly inferred by extrapolation using data measured at small eccentricities.

Funding: JSPS KAKENHI Grant Number JP18H03247

Optica Fall Vision Meeting YIA Scoring Sheet

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Pirog, J.T.

Coauthors: Vickie Kuo;William S. Tuten

Email: jpirog@berkeley.edu

Institution: Herbert Wertheim School of Optometry and Vision Science, University of California Berkeley

Title: Effect of flicker adaptation on perception of small spots presented with AOSLO

Abstract: Previous work suggests the detection of small spots is mediated by a mixture of chromatic and achromatic mechanisms. We tested whether exposure to spatially-uniform chromatic or luminance flicker affected detection thresholds for 543 nm increments delivered through an AOSLO. Heterochromatic flicker photometry was used to determine isoluminant settings for the red and green primaries of a DLP display; this isoluminant red-green mixture provided the 2.1° background upon which 23 arcmin (N=4) or 3 arcmin (N=2) stimuli were presented for 100ms. The projector background was modulated to produce isoluminant chromatic flicker or isochromatic luminance flicker at 3.75 or 30 Hz. The time-averaged luminance and chromaticity for all adaptation conditions were equivalent. For each condition, data collection was preceded by 2 minutes of preadaptation, followed by alternating windows of stimulus delivery (1 sec, steady background) and top-up adaptation (3 sec). Thresholds for all flicker conditions were compared to data obtained on a static background. For 23 arcmin spots, we found reduced sensitivity in the 3.75 Hz chromatic and luminance flicker conditions, but no adaptation effect was observed for 3 arcmin flashes or for 30 Hz flicker of either type. Our data suggest that raster-scanned, AO-corrected stimuli are susceptible to flicker adaptation, but that proximity to a flickering edge may be an important factor governing the effects of contrast adaptation on small spot detection.

Funding: National Institutes of Health: R01EY023591, T35EY007139-30; Air Force Office of Scientific Research: FA9550-21-1-0230, FA9550-20-1-0195; Hellman Fellows Program; Alcon Research Institute

Optica Fall Vision Meeting YIA Scoring Sheet

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Ressmeyer, Ryan

Coauthors: Jacob Yates;Gregory Horwitz

Email: ryanress@uw.edu

Institution: Department of Bioengineering, University of Washington

Title: Digital dual-Purkinje-image eye tracking enables precise determination of visual receptive fields in fixating macaques

Abstract: Understanding the relationship between visual stimuli and neural activity is a fundamental goal in visual neuroscience. However, the study of visual neurophysiology in awake primates is complicated by the constant occurrence of eye movements, even during periods of nominal fixation. To address this challenge, we adapted a recently developed high-resolution digital dual-Purkinje-image (dDPI) eye tracker (Wu et al., 2023) for use with macaque monkeys. In addition to tracking the Purkinje images, we simultaneously estimate the pupil center and size: a first for video eye tracking. We then sought to evaluate the efficacy of dDPI eye tracking for studying visual processing in fixating macaques by recording single neurons from the lateral geniculate nucleus while a spatially-correlated noise stimulus was displayed. Our analyses show that, as a result of properly accounting for eye movements post-hoc, the predictive performance of generalized linear models improves and the estimates center radii contract to values equal to or smaller than those reported in the literature. Notably, correcting for eye movements using the locations of the pupil center and corneal reflection—the standard method in video eye tracking—yielded worse model fits and larger receptive field sizes. This finding implies that the pupil center is an inaccurate reporter of small eye movements, while the Purkinje images may be veridical during fixations.

Funding: The research was supported by NIH grant EY032900 to GDH and an NSF predoctoral fellowship to RKR

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Rodriguez, Raul

Coauthors: Jorge Otero-Millan

Email: raul.rodriguez@berkeley.edu

Institution: University of California, Herbert Wertheim School of Optometry and Vision Science

Title: Dissociation of torsional eye movements and perception during optokinetic stimulation by visual cues of gravity

Abstract: An optokinetic stimulus rotating about the naso-occipital axis drives torsional eye movements and causes a bias in perception of upright measured with a subjective visual vertical (SVV) task. In addition, a static image with tilted visual cues of gravity orientation will induce optostatic torsion and biases SVV. We posit that a visual gravity cue provided by a frame combined with a torsional optokinetic stimulus would increase measured torsion and further bias SVV. We use a VR headset with eye-tracking to place the subject in a virtual room with circles forming either a rectangular room (frame condition) or a tubular room (no-frame condition). We place a fixation point at the center of the room while the subject performs a SVV task. The room either rotates about the naso-occipital axis at 0.05 Hz, 0.1 Hz, or 0.2 Hz, with an amplitude of ±20°, or has a static tilt of 0° or ±30°. Static frame conditions had the expected bias of SVV and optostatic torsion compared to the control no-frame condition. In sinusoidal rotation conditions, for SVV, there was a significant difference in the amplitude of the response between the frame (5.4 ± 2.6°; mean ± std) and no-frame (3.0 ± 1.3°) condition, while there was no significant difference for torsion, frame (0.8 ± 0.6°) and no-frame (0.7 ± 0.6°). Our results indicate that while perception integrates a moving visual cue into its estimation of upright orientation, the ocular motor system is only affected by those cues when they are static.

Funding: nan

Optica Fall Vision Meeting YIA Scoring Sheet

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Sadeghi, Roksana

Coauthors: Jorge Otero-Millan

Email: roksana.s.sadeghi@berkeley.edu

Institution: Herbert Wertheim School of Optometry and Vision Science, University of California, Berkeley

Title: Characteristics and coordination of microsaccades in 6 Dimensions

Abstract: The study of microsaccades, the small and rapid eye movements that occur during fixation, has focused on horizontal and vertical movements, while their torsional component remains relatively uncharted territory in vision research. We used video eye tracking to investigate microsaccades binocularly with horizontal and vertical movements tracked by pupil and corneal reflection and torsion by iris pattern. Five participants looked at a central dot for 20 trials of 20 seconds while seated, and their heads rested on a chin rest. For each microsaccade (N=2040), we measured the displacement of the eye along each dimension, and defined version as the average and vergence as the difference between the motion of the left and right eye. The average horizontal vertical and torsional components were 0.7, 0.3, and 0.1 deg for version and 0.1, 0.1, and 0.1 deg for vergence, respectively. Next, we measured the correlation between each component pair. We found that when the eyes moved to the left or right together, they also rotated by 0.3 deg (top towards the same side) for each degree of horizontal movement ($R = 0.94$, $p < 0.01$). When the eyes moved up (down), for each degree of vertical movement, they diverged (converged) 0.08 deg horizontally ($R = -0.53$, $p < 0.01$) and rotated 0.09 deg outward (inward; $R = -0.47$, $p < 0.01$). There was no strong correlation between other combinations. These results show that microsaccades follow similar kinematics at a minute scale as larger saccades.

Funding: NEI R00EY027846 and NSF 2107049

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Bartuzel, Maciej Marcin

Coauthors: Ewelina Pijewska;Krzysztof Dalasinski;Szymon Tamborski;Ravi S Jonnal;Robert J Zawadzki;Maciej Szkulmowski

Email: mmbartuzel@ucdavis.edu

Institution: Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University in Torun, Poland; Center for Human Ophthalmic Imaging Research (CHOIR), UC Davis Eye Center, Sacramento, CA 95817, USA

Title: LissEYEjous Tracker - precise fundus tracking device based on ultrafast Lissajous scanning

Abstract: Retinal eye tracking has emerged as a promising alternative to conventional video-based trackers, offering direct access to retinal coordinates with refined spatial and temporal resolutions. These attributes make them attractive for applications ranging from image stabilization in advanced ophthalmic imaging to identifying biomarkers of neurological or ophthalmic disorders that affect eye motility. Existing retinal tracking method however face challenges related to reliance on reference frames and non-uniform sampling either in space or time. In this work we present a new approach for retinal tracking, which is based on imaging small retinal patches (~1.5—3°) using self-repeating Lissajous scanning patterns. Pattern repetition rates close to 4kHz are achieved with an optical design that employs two MEMS microscanners with closely matching resonant frequencies, working in mutually perpendicular dimensions. Several examples of fundus images acquired with different Lissajous patterns are presented. Based on this, eye trajectories may be extracted. Future works will further investigate tracking resolution and dependence on Lissajous pattern spatial density and repetition rate.

Funding: National Science Centre, Poland (2023/48/C/ST7/00164); National Institutes of Health (R01-EY-033532, R01-EY-031098, R01-EY-026556, P30-EY-183 012576)

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Tyson, Terence

Coauthors: Dennis Perez;Tiffany Lau;Jorge Otero-Millan

Email: terencetyson@berkeley.edu

Institution: Herbert Wertheim School of Optometry and Vision Science, University of California, Berkeley; Human Systems Integration Division, NASA Ames Research Center

Title: Distortion of perceived visual space after eccentric gaze holding

Abstract: Previous studies have shown that rebound nystagmus can be a behavioral probe into the adaptive properties of the gaze-holding mechanism, showing that after prolonged eccentric gaze holding and upon return to central gaze the eye tends to drift towards the previously held position. It is not known whether perception of visual space is also affected by similar adaptation mechanisms. The current study seeks to elucidate if eccentric gaze holding changes the perception of space in a relative spatial judgment task. To measure their spatial bias, twelve subjects were asked to report which among two short vertical lines flashed to the left or to the right of the display was closer to a third central line. Perception was assessed after holding eccentric gaze at 40 degrees towards the left or right and compared with control trials without eccentric gaze holding. Subjects showed a significant difference in spatial bias between the leftward and rightward gaze holding conditions ($p = 0.04$), suggesting that the visual space changes differently with respect to the side where gaze was held. While we did not observe an overall bias ($p = 0.327$) under no gaze holding we did observe a significant correlation between handedness and spatial bias ($r2 = 0.4$, $p = 0.04$). We conclude that gaze holding temporarily distorts the perception of space in a mechanism that may be related to the adaptation of the gaze holding mechanism.

Funding: nan

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Wang, Mengxin

Coauthors: Allie C. Hexley;Alexander J. H. Houston;Jiahe Cui;Daniel Read;Hannah E. Smithson;David H. Brainard

Email: mengxin.wang@psy.ox.ac.uk

Institution: Department of Experimental Psychology, University of Oxford

Title: Vernier thresholds of a Poisson-noise-limited computational observer with and without fixational eye movements

Abstract: Vernier acuity is a fundamental measure of spatial vision. We modeled how stimulus encoding by the cones limits Vernier acuity. We determined Vernier thresholds for a computational observer that had access to the Poisson-distributed cone photopigment excitations. The observer also had access to the cone mosaic layout and the stimulus possibilities on each trial. We varied stimulus contrast (100%, 50%, 22%, 11% Michelson contrast) and duration (2, 4, 9, 18 stimulus frames; frame duration 8.33 ms) while fixing other stimulus properties (foveal viewing; two achromatic vertical bars; length 6.2 arcmin; width 1 arcmin; vertical gap 0.1 arcmin). When the retinal image is stationary, Vernier thresholds depend jointly on contrast and duration through contrast energy: squared contrast times duration. Introducing fixational drift eye movements impairs performance, when the information about eye path is not accounted for by the computational observer. When the path of fixational drift is made available and used ideally, there is no noticeable difference with the stationary case. The lack of improvement when the path of fixational drift is known exactly may reflect the high-density of foveal cones relative to the optical point spread function and the fact that we did not introduce temporal filtering by the visual system. Our results suggest the possibility of a rich interaction between optics, cone sampling, fixational eye movements, post-receptoral filtering and visual performance.

Funding: This work was supported by the Engineering and Physical Sciences Research Council [grant number EP/W023873/1].

Optica Fall Vision Meeting YIA Scoring Sheet

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Wise, Mackenzie V.

Coauthors: Gideon P. Caplovitz;Michael A. Crognale

Email: mackenziewise@nevada.unr.edu

Institution: University of Nevada, Reno

Title: Comparison of tripolar and traditional electrodes: Waveform morphology

Abstract: The waveforms of visual evoked potentials (VEPs) recorded by tripolar electrodes are different from those recorded by traditional electrode arrays. Traditional arrays record potentials using both an active and a reference electrode. The location of this reference will affect the waveform amplitude and shape. Conversely, tripolar electrodes measure the surface Laplacian across three concentric rings housed within a single electrode surface. These differences may influence the morphology of evoked responses. We compared these two modalities by recording pattern-reversal VEPs to two sizes of checkerboard. Visual inspection of the VEPs suggest that the signals recorded by the tripolar system have attenuated higher frequencies and increased latency of the major waveform components. Root-mean-square comparison of the two signal types confirm attenuation at the higher frequencies in the tripolar recording. Additionally, there is a cumulative delay present within both the large and small check conditions, such that each subsequent component recorded by the tripolar electrodes is shifted increasingly later in time compared to the same components recoded by the traditional electrodes. Such latency shifts may be indicative of a difference in the physiological sources that are measured by the two EEG systems.

Funding: nan

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Young, Dave

Coauthors: Jasmine F. Awad;Ione Fine;Dina V. Popovkina

Email: dyoun200@gmail.com

Institution: Department of Psychology, University of Washington

Title: Divided attention in Sign Language Recognition

Abstract: Previous work suggests that the brain has a limited ability to process multiple visual stimuli during divided attention: for example, people can recognize only one word at a time (White, Palmer, & Boynton, Psych Science 2018). Here, we examine whether American Sign Language (ASL) experience affects divided attention for stimuli: do signers & non-signers differ in their ability to process two signs at once? In a probe recognition paradigm, participants were presented with two letter signs, one or both of which were pre-cued as relevant (single- and dual-task conditions, respectively), and then responded whether a probe sign matched the cued sign(s). The dual-task deficit is the difference in performance between the single- and dual-task conditions and measures the cost of dividing attention. Preliminary data show that hearing non-signers and signers had a similar dual-task deficit (11.8% $\pm$ 2.2%, n = 5 vs. 11.4% $\pm$ 1.5%, n = 6), with no significant difference between the groups (t(7.27) = 0.18, p = 0.86). The magnitude of these divided attention effects is consistent with processing limits observed for object judgments (e.g. Popovkina, Palmer, Moore, & Boynton, JoV 2021). Thus, these preliminary results suggest that the attentional demands of ASL sign processing are similar in signers and non-signers.

Funding: Mary Gates Endowment, Arc of Washington Trust Fund, University of Washington, Special Diversity Fellowship, Bolles Dissertation Funds

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Fri at 1530**

Author: Shi, Yangyi

Coauthors: Rhea Eskew

Email: shi.yang@northeastern.edu

Institution: Psychology Department, College of Science, Northeastern University

Title: Criterion effects in maximum likelihood difference scaling: Similar is not always the opposite of different

Abstract: Maximum Likelihood Difference Scaling (MLDS) is an efficient method of estimating perceptual representations of suprathreshold physical quantities (Maloney & Yang, 2003), such as luminance contrast. In MLDS, observers can be instructed to judge which of two stimulus pairs are more similar to one another, or which of the two pairs are more different from one another. If the same physical attributes are used for both the similar and dissimilar tasks, the two criteria should produce the same perceptual scales. We estimated perceptual scales for suprathreshold achromatic square patches. Increments and decrements on the mid-gray background were estimated separately. Observers judged which pair of stimuli were more similar in half of the sessions, and more different in the other half sessions. For most observers, the two tasks produced the same perceptual scales: a decelerating curve for increment contrasts and a cubic curve for decremental contrasts (cf. Whittle, 1992). These scales predicted forced-choice contrast discrimination thresholds for both increments and decrements. However, for a subset of observers, the 'more different' judgments produced scales that accelerated with contrast for both increments and decrements; these scale shapes do not predict their discrimination thresholds. Our results suggest that, even with these simple stimuli, observers in an MLDS experiment may attend to different aspects of the stimulus depending on the assigned task.

Funding: NSF: BCS-2239456

Optica Fall Vision Meeting YIA Scoring Sheet

Please use a scale of 1 - 5 where **1 is the highest score** and **5 is the lowest score**.

Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Ara, Jawshan

Coauthors: Osman Kavcar;Mackenzie V. Wise;Alireza Tavakkoli;Michael A. Crognale

Email: jawshan@nevada.unr.edu

Institution: Integrative Neuroscience Program, University of Nevada Reno, Nevada, 89557, USA, Department of Psychology, University of Nevada Reno, Nevada, 89557, USA, and, Department of Computer Science, University of Nevada Reno, Nevada, 89557, USA

Title: Alternating orientation of the chromatic pattern VEP improves signal even in the absence of contrast adaptation

Abstract: The visual evoked potential (VEP) to chromatic pattern reversal is greatly reduced compared to VEPs to pattern onsets. Chromatic pattern onsets produce large and stereotypical waveforms that reliably differ from standard achromatic pattern reversal VEP waveforms used in clinical applications. Rapid contrast adaptation for sustained chromatic but not transient achromatic mechanisms has been suggested as one explanation for these observations. Here we first examined changes in the magnitude of response during recordings to reversing and onset grating patterns that preferentially modulate the L-M, S, and achromatic pathways. Given the evidence for both chromatic and achromatic orientation-selective mechanisms, we then hypothesized that contrast adaptation may be reduced by changing the orientation of the pattern for each reversal or onset. VEPs were recorded for 60 s with 2 onsets/reversals per second using both fixed and alternating (horizontal/vertical) orientations. FFT amplitudes for 6-second windows did not reveal evidence of adaptation for chromatic or achromatic onsets or reversal patterns over the 60-second recording period. Despite this, alternating pattern orientation increased the signal for all chromatic but not achromatic conditions. Although alternating the orientation for reversals increased the signal, the onset responses were still larger, even for non-alternating orientations. Mechanisms other than contrast adaptation must be invoked to explain the results.

Funding: nan

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Arthur, Christabel

Coauthors: Osman B. Kavcar;Mackenzie V. Wise;Michael A. Crognale

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Institution: Integrative Neuroscience Program, University of Nevada, Reno

Title: Attentional modulation of the achromatic and chromatic reversal VEP

Abstract: Previous literature has consistently revealed attentional modulation of the Visual Evoked Potential (VEP) response to achromatic pattern reversal stimuli but little to no attentional modulation of the VEP response to chromatic pattern onsets. Magnetic Resonance Imaging (MRI) research, however, has reported modulation of the responses to both achromatic and chromatic pattern reversal stimuli. Numerous methodological differences including mode of presentation, stimulus contrast, and attentional demand, make comparison of these results difficult. In this study, we report the results of experiments using comparable perceptual contrasts, pattern reversals, and a coextensive and highly-demanding, multiple object tracking (MOT) task. Our findings support prior VEP results indicating that although achromatic VEPs are modulated by attention, chromatic VEPs are more robust to attentional modulation, even for highly demanding distractor tasks. We also found that when compared to a non-attentional condition, the attenuation of the VEP when attending to the MOT task was greater in magnitude than the enhancement of the VEP when attending to the VEP stimulus. This supports prior conclusions, that while avoiding active distraction is likely important, insuring an "attentive state" is not always necessary when recording VEPs. Further experiments are underway to investigate why attentional modulation of chromatic signals in early visual cortex are observed in MRI but not VEP recordings.

Funding: nan

Optica Fall Vision Meeting YIA Scoring Sheet

Please use a scale of 1 - 5 where **1 is the highest score** and **5 is the lowest score**.

Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Bun, Luke

Coauthors: Gregory Horwitz

Email: lukebun@uw.edu

Institution: Department of Bioengineering, University of Washington

Title: Color and luminance processing in V1 complex cells and artificial neural networks

Abstract: Object recognition by natural and artificial visual systems benefits from the identification of object boundaries. A useful cue for the detection of object boundaries is the superposition of luminance and color edges. To gain insight into the suitability of this cue for object recognition, we examined convolutional neural network (CNNs) models that had been trained to recognize objects in natural images. Because CNNs are only trained to do a single task, any properties they possess are likely useful for that task. We focused specifically on units in the second convolutional layer invariant to contrast polarity, a useful trait for object boundary detection. Some of these units were tuned for a nonlinear combination of color and luminance, which is broadly consistent with a role in object boundary detection. Others were tuned for luminance alone, but few were tuned for color alone. A literature review reveals that V1 complex cells have a similar distribution of tuning. We speculate that this pattern of sensitivity provides an efficient basis for object recognition, perhaps by mitigating the effects of lighting on luminance contrast polarity. The paucity of contrast polarity-invariant representation of chromaticity alone suggests that it is redundant with other representations.

Funding: This work was supported by EY018849 grants to Gregory D Horwitz and EY07031 to Luke M Bun

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Carter, Alex

Coauthors: Daniel H. Baker;Antony B. Morland;Abbie J. Lawton;Alex R. Wade

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Institution: University of York

Title: SSVEP measurements of color and spatial frequency response in V1

Abstract: Intro: Recent work from our group (Segala et al, eLife, 2023) shows that the rules for binocular luminance signal combination depend on spatial frequency (SF). Structured patterns show strong interocular suppression while unstructured inputs (mean field disks) do not. Here, we used SSVEPs to ask if SF dependence is also found in chromatic pathways. Methods: SSVEPs were recorded from 12 subjects using a canonical V1 template (Poncet & Ales, 2023). Eyes were targeted using shutter goggles and stimuli were contrast-reversing gratings or disks at 5Hz (left eye) and 7Hz (right eye). Experimental factors were stimulus SF (disk, grating 1cpd), chromaticity (LMS, L-M or S-cone isolating) and ocularity (left, right or both). Results: Monocular conditions generated large responses at 2F. In binocular conditions, all 2F responses showed suppression, and significant intermodulation (IM) terms (sums and differences of the inputs - e.g., 2Hz) were present. The magnitude of both suppression and IM in the binocular condition depended on SF and chromaticity; IM amplitudes were higher for gratings compared to disks in the luminance condition, but higher for disks compared to gratings in the chromatic conditions. Overall we found significant differences in the spectral response signatures across all stimulus combinations. Conclusion: All inputs undergo binocular combination in V1 but the rules governing the combination appear to depend on both chromaticity and SF.

Funding: nan

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Chen, Qiang

Coauthors: Norianne T. Ingram;Jacob Baudin;Juan M. Angueyra;Raunak Sinha;Fred Rieke

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Institution: University of Washington

Title: Light-adaptation clamp: A tool to predictably manipulate photoreceptor light responses

Abstract: Computation in neural circuits relies on judicious use of nonlinear circuit components. In many cases, multiple nonlinear components work collectively to control circuit outputs. Separating the contributions of these different components is difficult, and this hampers our understanding of the mechanistic basis of many important computations. Here, we introduce a tool that permits the design of light stimuli that predictably alter rod and cone phototransduction currents - including the compensation for nonlinear properties such as light adaptation. This tool, based on well-established models for the rod and cone phototransduction cascade, permits the separation of nonlinearities in phototransduction from those in downstream circuits. This will allow, for example, direct tests of the role of photoreceptor adaptation in downstream visual signals or in perception.

Funding: NIH grant EY028542

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Horiuchi, Suzuha

Coauthors: Takehiro Nagai

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Institution: Tokyo Institute of Technology

Title: Spillover effects of color discrimination training on color category boundaries and color appearance

Abstract: Perceptual learning refers to the increase in perceptual sensitivity that results from several days of training on a perceptual task. Although perceptual learning has been shown to be effective in a variety of perceptual tasks, few studies have examined perceptual learning in color perception. In this study, we investigated how color discrimination training at a base color affected various aspects of color perception for entire hues. The training consisted of five days of S color discrimination (300 trials/day) at either the negative or positive L-M base color, depending on the observer groups. Before and after the training, three types of color perception tests (color difference, unique hue, and color category boundary) were conducted for colors with various hues to examine the changes in color perception due to the training. The results showed that the color discrimination thresholds in the training decreased as expected with repeated trials. Interestingly, the training also affected the performance of the three types of tests; the perceived color difference around the training color tended to increase, and some of the unique hues and the color category boundaries shifted significantly toward the training color. These results suggest that only a few days of color discrimination training can spill over to the entire color space and induce distortion of the perceptual color space.

Funding: JSPS KAKENHI 21KK0203

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Manfred, Joshua

Coauthors: Corbin Strimel;Cameron Klabunde;Neil Dittmann;Karen Gunther

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Institution: Wabash College

Title: Kandinsky was right: Few do “express bright yellow in the bass notes, or dark lake in the treble”

Abstract: Cross-modal correspondence is a sense of the inherent belongingness between two different senses; in our study these were pitch and color. Our goal was to investigate the confound in previous literature of individual differences in color brightness and pitch loudness. We tested twenty male participants. We determined equal brightness for each participant, across six colors: red, orange, yellow, green, blue, and purple; and equal loudness across seven pitches: 125, 250, 500, 2000, 4000, 8000, and 12,500 Hz. Then participants matched pitch with color in three different conditions: prototypical color hues, gray scale, and isobright colors. Our results indicated that in the prototypical condition, the participants chose yellow for high pitches, and blue and purple for the lowest pitches. In the gray scale condition, they chose white for high pitches and black for low pitches. These findings are consistent with previous research in the literature. However, we found that when controlling for individual differences in brightness, participants still chose yellow with higher pitches. Thus, there appears to be an inherent sense of belongingness between yellow and high pitches, even when controlling for the confounds of individual differences in brightness and loudness.

Funding: nan

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Use the entire scoring range, please!

Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Son, Minwoo

Coauthors: Takehiro Nagai

Email: son.m.aa@m.titech.ac.jp

Institution: Tokyo Institute of Technology

Title: Luminance and chromaticity discrimination sensitivities following a sudden decrease in background luminance

Abstract: When we enter a dark place like a tunnel from a bright exterior, our visual sensitivities take some time to adapt to the lower light level. However, there have been few reports about how quickly our sensitivities of luminance and chromaticity discrimination recover in this situation. This study aimed to quantify the time course of discrimination sensitivity for luminance and chromaticity directions after an abrupt decrease in background luminance. In each trial, the background luminance dropped from 100 cd/m^2 to 1 cd/m^2. Then, one target and three reference stimuli with different colors were presented under four stimulus onset asynchrony (SOA) conditions. The observer was asked to discriminate the target stimulus from the reference stimuli. The results showed that discrimination sensitivity was lowest right after the background luminance change and gradually improved with SOAs. However, sensitivity recovery differed across color directions, with the most improvement in luminance, followed by S, and negligible change in L-M. There was a statistically significant difference between +S and ±(L-M) sensitivities, indicating that the sensitivity recovery after the sudden background luminance change differed between chromaticity directions. Based on the comparison with previous studies, we speculate that both adaptation and masking may contribute to the temporal change of discrimination sensitivities.

Funding: This work was supported by Lotte Foundation Scholarship

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Scorer initials:

Session: **poster session, Sat at 1200**

Author: Takanashi, Mizuki

Coauthors: Takehiro Nagai

Email: takanashi.m.aa@m.titech.ac.jp

Institution: Department of Information and Communications Engineering, Tokyo Institute of Technology

Title: Image features involved in translucency enhancement by chromaticity information

Abstract: Previous studies have reported that chromaticity information in object images enhances perceived translucency. The aim of this study, was to elucidate how color forms image features that contribute to translucency in psychophysical experiments. The stimuli were computer-graphics images of translucent objects with different spectral scattering coefficients (i.e., hues) and various optical and geometrical parameters. Achromatic images with the same luminance as the chromatic images were also created. Perceived translucency was measured using Thurston's pairwise comparison, and the effect of chromaticity or translucency was evaluated by comparing translucency in achromatic and chromatic images. The results showed higher perceived translucency for the chromatic object images than the achromatic ones. Subsequently, we analyzed how different image features correlate with the effects of color on translucency using multiple regression analysis. The result indicated that the luminance- chromaticity correlation, which has been proposed as a potential cue for translucency could hardly explain the color effects. Rather, we found that the change in brightness contrast in the diffuse components modulated by the Helmholtz–Kohlrausch (H-K) effect was strongly and negatively correlated with the color effects. These results suggest that some image features, which covary with brightness contrast brightness contrast, contribute to the color effects on translucency.

Funding: nan

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Puska, Mikayla L.

Coauthors: Michelle M. Giarmarco;Jay Neitz;Maureen Neitz;James A. Kuchenbecker

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Institution: Department of Ophthalmology, University of Washington

Title: Non-degenerating double cone opsin knockout mouse model of blue cone monochromacy

Abstract: Ma et al. (2022) performed opsin gene therapy in a mouse model of blue cone monochromacy (BCM). Treatment was only effective for young animals because the retina degenerated, with a significant reduction in the number viable cones by 3 months. Their mouse was created by mating an Opn1mw knockout with a gene trap inserted in intron 2 of the Opn1mw gene, to an Opn1sw knockout with the neomycin resistance gene inserted in intron 3 of the Opn1sw gene. The Opn1mw knockout was reported as having "greatly reduced" M opsin expression, while the Opn1sw knockout was a severely hypomorphic allele. Their double opsin gene knockout (DKO) mouse is not a good model of BCM, which is typically a stationary disorder with no cone degeneration. We evaluated Opn1mw Opn1sw DKO mice for cone degeneration; these mice were created by Regeneron by deleting both genes using genome editing. Eyes of 1 year old DKO animals were processed for cryosections. Sections were immunostained using antibodies against a variety of cone proteins (S and M opsins, arrestin) and markers for retinal degeneration, then confocal imaged. Despite the absence of both cone opsins, cones remain viable and morphologically normal, and the retina shows no signs of degeneration at 1 year. This DKO mouse model will be a valuable tool for developing gene therapies targeting cone opsins, and also for understanding color vision circuitry in the retina.

Funding: UW Vision Core Grant NIH NEI P30-EY001730, Research to Prevent Blindness

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Zaman, Nasif

Coauthors: Alireza Tavakkoli

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Institution: University of Nevada, Reno

Title: XR-based personalized active aid for color deficient observers

Abstract: In a previous study, Xu et al. (Optics Express, 2022) investigated the efficacy of active aid in the form of personalized image enhancement to increase color discrimination ability in color-deficient observers (CDO). The study parameterized severity of color deficiency, the wavelength shift of cone spectral fundamentals, and the spectral distribution of display primaries. The first parameter was derived by computing the confusion index of the CDO, employing a modified version of the FM-100 test (ZJU50Hue). The second parameter was determined via evaluation of a wavelength-shifted ZJU50Hue test on color-normal observers (CNO). The three parameters were used to model the gamut mapping between CNO and CDO. In this study, extended reality (XR) based modules were developed to acquire these parameters and consequently tailor the headset display to assist CDOs. We chose to implement the Cambridge color test over the ZJU50Hue test as threshold results along the protan, deutan, and tritan lines are more informative than a single confusion index. Preliminary results on a calibrated Varjo XR-3 headset suggest a high correlation between the standard CCT and our XR-based trivector test. As the calibration, simulation and modeling processes all take place in the same HMD, we intend to model the CNO-CDO gamut mapping into a post-process graphics shader to enhance the camera input of the XR-3 and perform a paper-based Ishihara test for evaluation of real-world color discrimination efficacy.

Funding: FA9550-21-1-0207

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Zou, Tianlun

Coauthors: Sara Aissati;Susana Marcos

Email: tzou3@ur.rochester.edu

Institution: Center for Visual Science, The Institute of Optics, University of Rochester

Title: The impact of eye's longitudinal chromatic aberration on visual acuity and accommodation response

Abstract: Chromatic composition of displays might affect vision and accommodation,possibly influencing myopia development.We investigated differences in visual acuity(VA) and accommodative lag(AccL) for steady accommodative demands (up to 5D,1D steps) with visual stimuli illuminated by monochromatic wavelengths (mono- 480,555&630nm,3nm bandwidth) and white light (WL).Data was obtained on 3 young emmetrope using an Adaptive Optics system with a supercontinuum laser,a DMD for stimuli,and a optunable lens to change vergence.Best focus for far was set at 555nm.VA was measured using QUEST(tumbling E).AccL was obtained from the peak shift of through-focus Visual Strehl,calculated from HS aberrometry.All subjects showed myopic shifts in blue consistent with longitudinal chromatic aberration.However,the response to wavelength differed across subjects.S#1 showed a sustained VA across distances(average VA standard deviation 0.054,-0.005logMAR),low AccL(slope:0.3 D/D) and systematic SA negative shift (slope:-0.04um/D),similar across mono- and WL.S#2 showed a more sustained VA,lower AccL and higher SA change in blue (0.09logMAR std,0.3D/D,-0.02um/D) than in WL(0.14logMAR std,0.52D/D,-0.013um/D).S#3 showed a steeper decrease in VA at near and higher AccL for mono- (0.218logMAR std,0.78D/D,on average)than in WL(0.05logMAR std,0.38D/D).Different subjects use chromatic cues in different ways to accommodate,likely affected by the interplay of chromatic blur,depth-of-focus and defocus sign perception.

Funding: Funding: P30 Core Grant EY001319-46, Unrestricted Grant Research to Prevent Blindness (Flaum Eye Institute, University of Rochester NY), Meta Reality Labs, National Institutes of Health-NEI R01 EY35009

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Maddipatla, Reddikumar

Coauthors: Christopher Langlo;Kari Vienola;Maciej Bartuzel;Ewelina Pijewska;Robert Zawadzki;Ravi Jonnal

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Institution: Center for Human Ophthalmic Imaging Research (CHOIR), UC Davis Eye Center, Sacramento, CA 95817, USA; EyePOD Imaging Lab, Dept. of Cell Biology and Human Anatomy, UC Davis, Davis, CA 95616, USA.

Title: Investigating photoreceptor function in disease-affected retinas using optoretinography

Abstract: Assessing the functional response of photoreceptors is vital in understanding retinal disease progression. Traditional subjective methods like visual acuity and visual fields, and objective ones like electroretinography, have limitations. An ideal complement to these techniques is optoretinography (ORG), which images the retina and tests its function at once. ORG utilizes the phase of the optical coherence tomography (OCT) signal to quantify nanometer-scale changes, measuring subtle photoreceptor responses to stimuli. Efforts to observe stimulus-evoked responses in human cone photoreceptors began with adaptive optics (AO) and common path interferometry, enabling the resolution and tracking of individual cells. Advances in OCT systems with cellular resolution through AO or digital aberration correction successfully measured ORG responses from single cones and rods. This method tracks phase differences between outer segment tips (COST or ROST) and the inner-outer segment junction (IS/OS) to assess individual cell responses. A novel velocity-based method recently demonstrated the feasibility of measuring ORG signals with clinical-grade OCT systems. In the present work, we implemented this technique on disease-affected human retinas, revealing lower magnitudes of response compared to healthy retinas, and highlighting its potential clinical applications.

Funding: National Institutes of Health (R01-EY-033532, R01-EY-031098, R01-EY-026556, P30-EY-183 012576)

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Score (circle): 1 2 3 4 5

Scorer initials:

Session: **poster session, Sat at 1200**

Author: Bembry - Colegrove, Briyana

Coauthors: Michelle Giarmarco;Rachel Barborek;Jessica Rowlan;James Kuchenbecker;Dragos Rezeanu;Jay Neitz;Maureen Neitz

Email: bbembry@uw.edu

Institution: Department of Ophthalmology, University of Washington

Title: Intravitreal gene therapy in primate reaches extrafoveal cones

Abstract: Intravitreal delivery of gene therapy vectors to the retina carries lower risk of adverse events versus subretinal injections, but efficiently targeting cones is a challenge. We used a new adeno-associated vector (AAV) to deliver genes to primate cone photoreceptors. The vector carries a cassette directing expression of an engineered 493 nm opsin to long- and middle-wavelength (L/M) cones, and was injected into the vitreous of the left eye of an adult macaque. An identical AAV carrying a fusion of the engineered opsin to green fluorescent protein (GFP) was injected into the right eye. Electroretinograms were performed on the left eye before and after injection to measure isolated 493 nm light responses; 5 weeks post-injection, response increased modestly. A central strip of the right eye was prepared for histology with cryosections; we found ~30% of cones in the fovea had been transduced, with a preference toward L/M cones (see https://iovs.arvojournals.org/article.aspx?articleid=2782955). Upon close examination of GFP in the peripheral retina, we were surprised to find extensive expression in cones across the retina. Here, we report patches of expression from the perifovea to the retinal margin which reaches ~10% of cones. Expression patches appeared stochastically, or in regions containing blood vessels or disrupted Muller cells. This demonstrates that extrafoveal expression is attainable using intravitreal injection of gene therapy vectors in an adult primate.

Funding: UW Vision Core grant NIH NEI P30-EY001730, Research to Prevent Blindness