INTERACTIONS IN VISION

A Centre for Vision Research at York University

CONFERENCE

Wed June 26 – Fri 28 June, 2013

Toronto, Ontario, Canada

WELCOME to the 2013 YORK CENTRE FOR VISION RESEARCH CONFERENCE

We are very pleased to welcome you to the 2013 CVR conference at York University at which we will celebrate the research careers of two esteemed CVR members, Drs. Hugh Wilson and Marty Steinbach. We have a stellar line up of speakers along with many interesting poster presentations. Our excitement this year is tinged with sadness at the passing of our founder, Dr. Ian Howard on the 1st June. Ian was always passionate about the CVR biennial conferences and was responsible for the format, which we have retained for many years, in which speakers are given time to develop their ideas and there is plenty of time for socializing and mixing with colleagues. Many of you will have attended previous CVR conferences and remember the legendary parties that were thrown at Ian and Toni Howard's house. Alas, there can be no such party this year but we hope still to entertain and engage you as we lead off the 2013 CVR conference.

We would like to take this opportunity to show our thanks and appreciation of Teresa Manini for organizing and preparing for this event.

On behalf of the CVR steering committee and all the CVR members, we wish you a wonderful conference

Laurence Harris
Director of the Centre for Vision Research

INTERACTIONS IN VISION

CVR CONFERENCE

Wed June 26 – Fri 28 June, 2013

WEDNESDAY - Lassonde Building

Arrival and reception

6pm-7pm KEYNOTE Colin Blakemore (Oxford)

THURSDAY (Hugh's Day) - Lassonde Building Lecture Hall B

9:00 Laurence Harris, introductory remarks

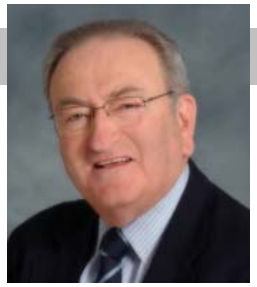
SESSION 1 Shape perception; interactions between cues

9:30-10:15 Anitha Pasupathy (U Washington)
10:15-11:00 Gunter Loffler (Glasgow Caledonian)
Coffee + posters
11:30 – 12:15 Vince Ferrera (Columbia)
12:15 - 1 Fran Wilkinson (York)
LUNCH 1-2

SESSION 2 Stereo and Binocular Rivalry; interactions and inhibition between the eyes

2-2:45 Randolph Blake (Vanderbilt)
2:45-3:30 Julie Harris (St Andrews)
Coffee + posters
4:30-5:30 Hugh Wilson (York)
6:30 Dinner at Black Creek Pioneer Village

FRIDAY (Marty's day) - Lassonde Building Lecture Hall B



9:00 Laurence Harris, introductory remarks

SESSION 3 Proprioception and eye position; interactions in determining eye position

9:30-10:15 David Zee (Johns Hopkins)
10:15-11 Doug Crawford (York)
Coffee + posters
11:30 – 12:15 Harold Bedell (U Houston)
12:15- 1 Richard Krauzlis (NIH)
LUNCH 1-2

SESSION 4 Macular degeneration; interactions between basic science and clinical practice

2-2:45 Mary Lou Jackson (Harvard/MEEI)
2:45-3:30 Gordon Legge (Minnesota)
Coffee + posters
4:30-5:30 Marty Steinbach (York)
6:30 Dinner at Schulich Dining Hall, York University

International Conference on Interactions in Vision

Conference Speakers

1. Shape Perception: Interactions between Cues

Less than Meets the Eye: Shape Encoding under Partial Occlusion in the Primate Brain
Dr. Anitha Pasupathy, Department of Biological Structure and NPRC , University of Washington

In my talk I will present results that reveal how context provided by partial occlusion modulates the encoding of object contours in area V4, an important, intermediate stage of form processing in the primate brain. I will discuss how the weakened encoding of "accidental" contours at the junction between the occluding and occluded objects could mark the first step of image segmentation along the ventral visual pathway. I will also briefly describe our recent efforts to investigate whether, how and when the activity of contour-selective V4 neurons might contribute to shape recognition under partial occlusion.

Detection and Discrimination of Global Shapes
Dr. Gunter Loffler, School of Health and Life Sciences, Glasgow Caledonian University

Perception of object shape is essential for virtually all visual tasks. Two paradigms were invoked to study the mechanisms underlying human shape processing: (i) a shape discrimination task, in which observers were required to discriminate between closed contours and (ii) a shape coherence task, measuring the minimum number of elements required to detect a contour embedded in noise. Results for both tasks support the existence of a range of mechanisms tuned to different shapes that integrate information widely across space, consistent with intermediate stages of visual processing. When presented in the periphery, a lower visual field advantage is evident for these shapes but not for their constituent parts. This suggests a lower field preference at intermediate levels. Processing at intermediate levels appears to be particularly vulnerable to damage: applying shape tests to clinical populations (migraineurs, children born pre-term and children with Cortical Visual Impairment) reveal deficits that cannot be accounted for by low level processes.

Neural Activity in Prefrontal Cortex and Dorsal Striatum during Flexible Decision-Making
Dr. Vincent Ferrera, Departments of Neuroscience and Psychiatry, Columbia University

The ability to rapidly adapt decisions under different rules or contexts is a component of flexible behavior and likely involves neural circuits in prefrontal cortex and basal ganglia. The frontal eye field (FEF) is a region of prefrontal cortex that is involved in linking visual stimuli to oculomotor responses. The dorsal striatum, including the caudate nucleus, receives input from prefrontal cortex, as well as from midbrain neurons that signal behavioral outcomes. To investigate the role of these structures in flexible decision-making, we trained monkeys to categorize the speed of a

moving dot stimulus using different learned criteria. We found that FEF neurons were sensitive to stimulus speed and that their response gain was modulated depending on the criterion used to classify the stimuli. Caudate neurons were also responsive during the task, but their activity occurred after the decision. These post-decision responses nevertheless carried information about the stimulus and decision criterion, which could be useful for evaluating the behavioral outcome. The results suggest that FEF and caudate have distinct roles in decision formation and outcome evaluation during flexible categorization.

From Gratings to Faces: A Twenty Year Voyage up the Ventral Pathway
Dr. Fran Wilkinson, Centre for Vision Research, Department of Psychology, York University

The human face is an enormously complex visual stimulus that conveys many kinds of information about the individual. In this talk I will focus on the use of synthetic faces as a tool to explore one component of the information that contributes to face perception – facial geometry. In doing so, I will consider Wilson's earlier work on visual channels, and how this led to the development of this stimulus set. I will then provide an overview of the studies that we and our students have carried out using these patterns to examine issues concerning facial identity, viewpoint, age cues in faces, changes to face processing in aging and prosopagnosia, and other aspects of face perception. Finally, I will touch on ongoing work in our lab looking at how face prototypes are acquired.

2. Stereo and Binocular Rivalry: Interactions and Inhibitions between the Eyes

Reconciling Rival Ideas about Binocular
Dr. Randolph Blake, Centennial Professor, Vanderbilt University

Hugh Wilson's impressive roster of research accomplishments includes empirical and theoretical work on binocular vision. My talk will focus on one aspect of binocular vision, namely the breakdown in stable, 3D perception provoked when the two eyes view dissimilar images: binocular rivalry. It is widely believed that the fluctuations in perception characterizing rivalry arise from competition among neural representations of the two conflicting images, but there is debate about where within the visual hierarchy that competition transpires. This talk highlights findings - including Hugh's seminal contributions - that have shaped this debate.

Binocular depth and surface perception in complex scenes
Dr. Julie Harris, School of Psychology and Neuroscience, St Andrews

Research in binocular vision has typically focused on understanding how binocular disparity is used for depth perception in simple displays, where left and right eye points are matched, and surfaces are smooth or flat. Binocular vision in the real world is much more complex, where there can be abrupt changes in depth, and many scene regions that are only visible to one eye. In this talk I will discuss the geometry of binocular vision in complex scenes, describing the challenges faced by the visual system in representing the three-dimensional (3D) complexity of the world. I will then

describe studies in which we have explored the visual system's ability to meet these challenges, both in terms of how information is integrated across monocular and binocular regions of scenes, and how depth is represented in scenes containing many abrupt variations in binocular disparity. This work seeks to link our current knowledge of early binocular visual processing to the richness and complexity of perception in real environments.

Binocular Fusion, Rivalry, and Decisions
Dr. Hugh Wilson, ORDCF Professor of Spatial and Computational Vision, Departments of Biology, Psychology, Mathematics, and Computer Science, York University

The binocular visual system evolved to combine the two monocular images to extract depth information, yet rivalry ensues when the monocular images are too different. I will present a model that produces fusion and depth, binocular brightness matching, and rivalry under appropriate stimulus conditions. Generalizations of the rivalry model will be developed as potential vehicles for understanding decision processes higher in the brain.

3. Proprioception and Eye Position: Interactions in Determining Eye Position

Controlling Eye Position: Unexpected Effects of Magnetic Fields in MRI Machines and with Transcranial Magnetic Stimulation (TMS)
Dr. David Zee, Professor of Neurology, The Johns Hopkins School of Medicine

Here we report two unexpected effects of magnetic fields on the brain's ability to control eye position. All normal subjects in an MRI machine develop nystagmus from the effects of Lorentz forces that lead to a fluid pressure that pushes on the cupula of the labyrinth leading to a false sensation of motion and an inappropriate "compensatory" nystagmus. There is no such thing as resting state MRI. Single pulse TMS induces a startle response that perturbs eye position from the nonspecific effect of the startle itself, rather than being a direct focal effect on the underlying cerebral cortex. Beware!

Why does the visual system need to know eye position?
Dr. Douglas Crawford, Professor of Psychology, Biology, and Kinesiology & Health Sciences, Centre for Vision Research, York University

One of Marty Steinbach's enduring contributions to vision science has been to educate us on the importance of 'inflow', i.e., the proprioceptive sense of eye orientation (e.g., Steinbach Vision Res. 1987). From a neurophysiological standpoint, eye position modulations are ubiquitous in cerebral cortex, and recent physiological experiments have born out the notion that they are derived, at

least in part, from inflow. However, all this begs the question; why should we (and the visual brain) even care about eye orientation, if vision largely depends on the relative locations of proximal retinal stimuli? For those of us interested in the implications of three-dimensional (3D) eye orientation, the answer is obvious, if not simple: many visual and visuomotor problems can only be solved through a precise knowledge of 3D eye orientation and its (often unexpected) influences on the information content of retinal input. I will attempt to show this through three examples, illustrating the need for internal knowledge of eye (and head) orientation in saccade generation, the monocular programming of open-loop reach movements, and the binocular calculation of absolute depth for reach plans.

Eye-Specific Signals for the Determination of Head-Centric Visual Direction
Drs Harold Bedell & Deepika Sridhar, College of Optometry, University of Houston

The perceived head-centric direction of a visual target can be constructed from the location of the image on the retina and information about the position of the eyes in the head. During binocular fusion, information about the locations of the retinal images seen by the two eyes is combined. Similarly, the Wells-Hering laws of visual direction specify that eye-position information represents the average positions of the two eyes. The relative contributions of the retinal information from each eye can be assessed from judgments of perceived alignment between fused disparate and non-disparate visual stimuli. Such measurements show that the weighting of retinal information from the two eyes is unequal in some individuals. Similar weighting is observed for visual targets with horizontal and vertical retinal image disparities, indicating that the weighting of retinal information is not influenced by perceived depth. Differences in the weighting of eye-position information from the two eyes can be determined from open-loop pointing to visual targets, viewed during asymmetric vergence. Results indicate that the individual differences in eye weighting are similar for eye-position and retinal information. Observers who exhibit unequal weighting of eye-position information during asymmetric vergence also exhibit a systematic shift in open-loop pointing with changes in symmetric vergence, suggesting that the combined signal for eye position is derived, at least in part, from the separate positions of the two eyes. Previously, the relative visibility of the targets seen by each eye was shown to affect the weighting of retinal information. We find that unequal target visibility also influences the relative weighting of the eye-position signals from the two eyes. The results described here are consistent with a model of head-centric direction, in which the relative weighting of retinal and eye-position information is determined at a common brain locus. Although eye-position information generally is thought to be available only in cortical areas beyond the site of binocular retinal combination, recent data imply that eye-specific retinal information exists also in higher cortical areas.

Fixation, Microsaccades, and the Equilibrium Hypothesis
Dr. Rich Krauzlis, Laboratory of Sensorimotor Research, National Eye Institute

The equilibrium hypothesis is an extension of the classic idea that saccades are controlled by a population code in the superior colliculus (SC). This principle relies on the fact that the SC contains aretinopicmap, and that the activity of each SC neuron amounts to a “vote” based on its position in that map. Evidence accumulated over the past decade shows that this principle also applies to the

foveal part of the SC map, and helps explain the control of fixation and microsaccades. For example, neurons in the foveal SC neurons are active during fixation, but also during microsaccades, small regular saccades, and smooth pursuit: foveal SC activity represents the retinotopic location of the target, rather than a command for a specific motor outcome. When foveal SC neurons are inactivated, eye position shows systematic and stable offsets from the actual target position, consistent with the idea that reading out activity from a distorted population code provides a biased estimate of where to aim the eyes. More generally, this theory suggests that visual fixation is an equilibrium condition established by target position signals issued bilaterally from the SC, and that saccades are triggered when this equilibrium is disturbed, in order to restore balanced activity.

4. Macular Degeneration: Interactions between Basic Science and Clinical Practice

Vision Rehabilitation for Individuals with Macular Degeneration: Addressing the Whole Person

Dr. Mary Lou Jackson, Massachusetts Eye and Ear Infirmary, Harvard Medical School Department of Ophthalmology

Over the recent decades we have learned that age-related macular degeneration is a complex disease involving an interaction of the individual's genetic susceptibility, their environment and the aging process. Research is addressing such areas as cell death pathways, angiogenesis, inflammation, immune responses and genetic factors. This increasing knowledge has impacted our discoveries of new treatments and new techniques for evaluation.
Vision rehabilitation is an important therapy for patients with macular degeneration. This presentation will outline how visual function of individual patients is assessed and then, present clinical scenarios to outline how unique goals of each patient are addressed with devices, strategies and training.

Training Peripheral Vision to Read

Dr. Gordon Legge, Distinguished McKnight University Professor in the Department of Psychology, University of Minnesota

Central-vision loss is often a consequence of advanced macular degeneration, and results in severe reading difficulty. How effectively can people use their peripheral vision to replace foveal function in reading? Can peripheral vision be "trained" to enhance reading performance? Could such training be useful in reading rehabilitation for people with macular degeneration? I will discuss research examining the capabilities and limitations of peripheral vision for pattern recognition and reading. An important constraint on peripheral reading performance is the size of the visual span, the number of adjacent text letters that can be recognized reliably without moving the eyes. The visual span decreases in size in normal peripheral vision and in macular degeneration, with an associated decrease in reading speed. Research in my lab and elsewhere has shown that a perceptual training protocol (a form of "perceptual learning") enlarges the visual span in peripheral vision and results in improved reading performance.

Improving Vision: Translating Basic Research into useful Outcomes for Low Vision Patients

Dr. Martin J. Steinbach, Distinguished Research Professor Emeritus, York University.
Professor of Ophthalmology and Director of Eye Research, University of Toronto and Toronto Western Hospital

Our research for the past 40 years has been based on human patients with visual and ocular motor disorders. Initially, we studied patients with eye misalignments (strabismus) and pediatric cancers (retinoblastoma) but for the past decade we have focused on those mostly elderly patients who have lost central vision. Age-related macular degeneration patients form the largest group we have studied using our laboratory-honed psychophysical and eye movement recording techniques. With a gifted team of basic scientists and clinician collaborators, we have been able to help many of these patients regain visual function using parts of their retinas that are not damaged. Our skills as scientists are profoundly important for translating basic research findings into helping those with visual impairment.

Hugh Wilson's Poster Sessions - Thursday June 27, 2013

1. Perceived Stability of Material Objects - Julian Lupo, Michael Barnett-Cowan, The Brain and Mind Institute, Dept. of Psychology, The University of Western Ontario

Since Galileo, it has been shown that objects if different weight fall at the same rate. However, people tend to expect that heavier objects should fall faster. This raises the interesting question as to whether prior expectations about material properties interfere with the brain's representation of physical laws. Participants viewed goblets made of differing materials (e.g. glass, polystyrene) that were defined as being uniformly dense and positioned near a table ledge. The critical angle (CA), the angle at which the goblet is equally likely to fall or right itself, was used as a measure of perceived object stability. The results show no significant difference in the perceived CA acrosse materials, while at the same time perceived and true material density are positively correlated. This suggests that the brain can reasonably represent density from material properties, but this does not interfere with the representation of physical laws which govern falling objects.

2. Awareness of Arm Position Alignment with Visual Stimuli Influences the Effect of Tactile Input on Binocular Rivalry - Amanda M. Beers1, Ryan M. Peters1, Allison B. Sekuler1,2, & Patrick J. Bennett1,2 1. Department of Psychology, Neuroscience & Behaviour, McMaster University 2. Centre for Vision Research, York University

A tactile stimulus can influence binocular rivalry. We examined whether this effect depends on the perceived alignment of the visual and tactile stimuli. Subjects received a tactile grating stimulus on the dominant index finger while viewing a dichoptic display consisting of two orthogonal gratings. The tactile grating's orientation was varied across conditions; the visibility and orientation of the stimulated hand/arm were randomized between participants. Rivalrous percepts were recorded by having subjects press buttons corresponding to the grating orientations. We found that the visibility of the arm influences the effect of tactile input on rivalry, especially for the misaligned arm positions.

3. Sound cues to self-orientation - Michael J. Carnevale, Laurence R. Harris, Centre for Vision Research, York University

The perceived direction of up depends on visual, gravity, and body cues, each of which is given a weighting by the brain (Dyde et al., 2006). Here we assess the possible contribution of sound to perceived orientation by adding sound cues to gravity (via loudspeaker) while participants lay on their side. The perceptual upright (PU), the direction in which a character is most easily recognized, was assessed using the Oriented Character Recognition Test (OCHART) implemented with a QUEST adaptive staircase. During presentation of the OCHART probe, sounds were presented in the experimental condition and changes in the PU were recorded. We conclude that sounds can contribute to the perception of upright.

4. Grouping Disrupts Depth Magnitude Percepts from Stereopsis - Lesley Deas, Laurie M. Wilcox, Department of Psychology, CVR, York University

Stereoacuity for two vertical lines can be very precise, but is reduced when the lines are connected to form a closed figure. Here, we extend this paradigm to a suprathreshold task to evaluate the role of disparity averaging. Perceived depth magnitude was measured between line stimuli with different figural interpretations (isolated lines, within-figure, between- figures). We found a strong reduction in the amount of depth estimated within a figure relative to the isolated lines. Furthermore, this loss was eliminated in the between-figure condition. We discuss these data in terms of a simple model of disparity averaging.

5. Edge-based versus region-based texture perception: does the task matter? - Cassandra Diggiss and Frederick A. A. Kingdom, McGill Vision Research unit, Department of Ophthalmology, McGill University

Studies of texture segregation have suggested that some textures are processed by 'edge-based' and others by 'region-based' mechanisms. We investigated directly whether the nature of the task determines the type of mechanism involved. Stimuli consisted of textures modulated in either orientation, contrast or luminance. Each modulation type was defined by sine-(SW), square-(SQ), and cusped-(CS) waves. Subjects performed two tasks; a detection task where the stimulus containing the modulation was selected and a discrimination task where subjects indicated the texture containing leftward-oriented bars. At low texture spatial frequencies threshold amplitudes in the detection task followed the rule SQ <SN <CS suggesting the task was region-based. For the discrimination task the order was SQ˜CS<SN, suggesting edge-based processing. We conclude that a change in the task from detection to discrimination can cause texture processing to switch from being region- to edge-based.

6. Shape statistics and psychophysics - Ingo Fründ & James H Elder, Center for Vision Research, York University

We study a class of models that capture statistical regularities in the curvature of object boundaries. The model was fit to 391 closed contours from photographs of animals. Generating samples from such a model is challenging because samples should be closed, non-intersecting contours that match the natural contours with respect to their local curvature statistics. Here, we use Markov chain Monte Carlo to sample from our model. We analyzed statistical and psychophysical properties of the resulting shapes. Surprisingly, we find that variance in curvature captures nearly all of the local shape structure to which humans appear sensitive.

7. Implicit learning of principal components in visual objects - Xiaoqing Gao & Hugh R. Wilson, Centre for Vision Research, York University

Humans have the ability to implicitly learn the central tendency of a group objects (the prototype effect, Posner & Keele, 1968). While learning the prototype facilitates the representations of

objects at a group level, it is not clear what kind of statistical regularities are learned to facilitate the representations at an individual level. Using faces and dot patterns, we demonstrated that feature correlations that capture the most significant variations among a group of visual objects as defined by principal components were learned implicitly. Learning the principal components provides an efficient way of encoding visual objects at an individual level.

8. Cortical representation of Radial Frequency visual motion trajectory shape - Diana Gorbet, PhD., Frances Wilkinson, PhD., & Hugh R. Wilson, PhD. - Centre for Vision Research, York University

Radial frequency (RF) motion trajectories are a class of visual stimuli that consist of a spot moving along a closed trajectory defined by a sinusoidal variation of the radius relative to a circular path. Using fMRI, we show that the shape of RF trajectories can be distinguished by the spatial patterns of voxel activity within visual regions V2, V3, and MT. The patterns of activity in these regions likely represent the processing of local differences in trajectory curvature rather than global shape. In contrast, the data suggest that activity within parietal and frontal cortical regions is involved in processing and conscious recognition of overall trajectory shape.

9. Shape-Induced Distortions of Spatial Judgements - Galina Goren & James H. Elder, Centre for Vision Research, York University

Here we explore bias in length judgement in a plane induced by shape. Observers are presented with a triplet of points, in proximity to the outline of an animal shape. Each triplet forms an isosceles triangle with a horizontal/vertical long side. Although the two oblique sides are equal, observers are asked to judge which appears shorter. A significant distortion that grows larger nearer the contour was found. This result was significant for all subjects and animal shapes tested. The results show that shape outlines can induce distortions in the image. These distortions may be artifacts induced by cortical mechanisms for shape representation, or illusions based on 3D perceptual interpretation of the image.

10. Effects of head orientation on the perceived tilt of a static line and global motion - Pearl S. Guterman, Robert S. Allison, James E. Zacher, York University, Toronto, Canada

Tilted observers perceive a vertical (or horizontal) line as tilted. We investigated whether a similar shift occurs with global motion displays and visually-induced self-motion (vection). Observers stood or lay left side down while viewing tilted-from-vertical stimuli: line, 2D or 3D global motion. Apparent stimulus tilt and vection direction were measured. Tilt bias, as measured by PSE shifts in the psychometric functions, was smaller for global motion than the line. When vection was elicited the shifts were larger than with equivalent motion displays evoking object motion. The results suggest global motion processing may play an important role in sensory integration.

11. Phase Doesn't Matter for Blur Adaptation - Andrew M. Haun & Eli Peli, Schepens Eye Res. Inst. / Mass Eye and Ear, Harvard Medical School

To address the question of whether or not blur adaptation involves mechanisms sensitive to cross-frequency phase correspondences, we measured blur adaptation under two conditions: in one condition, the adaptor was blurred with an ordinary flat-phase Gaussian filter; in the other condition, the adaptor was blurred with a zero-amplitude space-local phase distortion filter. Blur perception was measured by obtaining blur-matching functions for Gaussian-blurred test images. We found strong blur adaptation effects when the adaptor had attenuated contrast, and no blur adaptation at all when the adaptors had locally disrupted phase but no contrast attenuation. Blur adaptation appears to depend entirely on adaptor contrast amplitude.

12. Interpolation of illuminant cues across space and time, using a mixture of a proximal and a collimated light source - Minjung Kim, Friederike Schüür and Laurence T. Maloney, Department of Psychology, New York University

Can we interpolate lighting information over empty space, and if so, can we retain it over time? In Experiment 1, we rendered and presented (750ms) a diamond-shaped target and white, blobby flankers, separated by a vertical gap, floating against a black background. We lit the scene with a blue and a yellow sources (simulated distances: infinity and 1.15m, respectively), thereby varying target shading with its orientation and position. In Experiment 2, we presented the flankers alone (750ms), then immediately, the target alone (300ms). In both experiments, participants correctly judged the target paint colour at different orientations, but not at different positions. Our experiments show that, for small separations in space or time, the visual system can interpolate lighting information.

13. Cross-orientation masking in human color vision: application of a two-stage model to assess monocular, dichoptic and binocular sources of suppression - Yeon Jin Kim, Mina Gheiratmand, and Kathy T. Mullen, McGill University

Cross-orientation masking (XOM) is thought to reveal the suppressive effects mediating contrast normalization. Medina and Mullen (JOV, 2009) reported that XOM was greater for chromatic than achromatic stimuli under equivalent conditions. Here we address whether this greater suppression in binocular color vision originates from a monocular or interocular site, or both. We fit a two-stage model of gain control (Meese & Baker, 2009) to monocular and dichoptic XOM functions for chromatic and achromatic contrast. We show that monocular suppression is greater for color than achromatic contrast, whereas dichoptic suppression is similar for both. These two suppressions together can account for chromatic binocular masking. We conclude that the greater chromatic XOM has a monocular origin, transferring through to the binocular site.

14. Edge Classification: Reflectance or Illumination? - Ying Li & James H. Elder, York University

Human can distinguish reflectance edges from illumination edges easily. But it remains challenging for computer vision. Notable examples are the removal of a shadow from the image, which is a simplified task of the recognition of illumination edges. Extensive visual experiments have grown out of attempts to identify the features that have been used by human for fulfilling this purpose. This work sheds light on the role that colors and textures play in the edge discrimination, especially on identification of reflectance and illumination edges. Various classifiers are exploited to accomplish this demanding task.

15. Are we blind to three-dimensional acceleration? - Arthur Lugtigheid, Robert Allison & Laurie Wilcox, Centre for Vision Research, York University

Detecting changes in the speed of 3D motion is important, as approaching objects are unlikely to maintain constant velocity. Interestingly, evidence from the interception literature implies that observers are insensitive to 3D acceleration, but this possibility has received little empirical attention. We assessed thresholds for 3D velocity changes under binocular and monocular viewing conditions. We interleaved three average velocities. If observers judge 3D acceleration, there should be no shift in the PSE. Conversely, we find a velocity-dependent shift, indicating that observers are unable to judge 3D acceleration directly. Expressing our data in terms of a range of different variables we show that observers may use correlates as an approximation.

16. The Influence of Allocentric Spatial Cues on Memory-Guided Head Free Gaze Shifts - R.A. Marino, Wang, H., Yan, X., Crawford JD. , Centre for Vision Research, York University

It is unknown how the nervous system utilizes allocentric information (locations of objects relative to other objects) when performing memory-guided gaze shifts. To address this we developed a novel memory-guided gaze task with interleaved allocentric cuing trials. During cued trials, an allocentric cue was presented proximal or distal to the flashed memory target. On a subset of trials, the allocentric cue was surreptitiously shifted 4° to the left or right. A visual mask was presented in order to prevent the subject from perceiving the shift in the cue. Results show that stable allocentric cues reduce endpoint variability and shift gaze endpoint in their direction. Shifted allocentric cues bias gaze endpoint in the direction of the shift.

17. Abnormal visual system development and morphology - Larissa McKetton & Keith Schneider, Department of Biology, Centre for Vision Research, York University

Albinism is a genetic condition of hypopigmentation in which melanin pigment synthesis cause melanin and melanocyte depletion. The lack of melanin development has severe impacts associated with the development of the eye and visual system. The result includes a variety of ophthalmic deficits such as reduced visual acuity and an abnormal decussation pattern of the optic

chiasm. Our findings confirmed and quantified morphological differences in the optic nerves, optic chiasm, optic tracts, and in the lateral geniculate nucleus (LGN) using high-resolution magnetic resonance imaging (MRI), with the aim of better understanding brain development and plasticity.

18. From Formlets to Single View Reconstruction - Paria Mehrani & James H. Elder, Centre for Vision Research, York University

Reconstructing the 3D shape of an object from a single 2D image has been a long-lasting problem in computer vision with diverse applications such as creating novel views from a photograph, converting 2D movies into 3D, etc. Single View Reconstruction is ill-posed in nature as infinitely many 3D models can give rise to the same 2D image. This problem has been studied from different views: shape from shading, shape from texture, shape from contours, etc. In this work, we address the problem of shape from contour by iteratively deforming an embryonic 3D shape such as a sphere. As only a 2D contour of the object is available, the deformations are chosen so that the projection of the model gets closer to the observed contour.

19. Hippocampal oscillations during memory-driven visual exploration in the macaque - Rodrigo Montefusco-Siegmund (Dep. Psychology), Thimothy K. Leonard (Dep. Psychology, CVR), Emily F. Murphy (CVR), Kari L. Hoffman(Dep. Psychology, CVR)

The hippocampal formation is critical for memory of one's environment. To address how hippocampal oscillations might contribute to memory during visual exploration, we recorded the local field potentials (LFP) in the macaque during a modified visual search task. Memory was determined by the speed of detection of a target located in the scene. During target detection, the highest of these frequency bands (~20-35 Hz) was consistently stronger on remembered than on forgotten trials. The lower, theta-range band (~4-14 Hz) showed weaker synchronization on remembered than on novel or forgotten trials. The spectral profile in the hippocampus therefore revealed correlates of novel-trial search (theta band) and memory-guided target detection (high beta band).

20. The effects of dyslexia on the spatial and feature---based attentional modulation in the human subcortical visual nuclei - Scott Munro1, John P. Hegarty II2, and Keith A. Schneider3,4 1Department of Psychology, York University;. 2Department of Psychological Sciences, University of Missouri – Columbia; 3Centre for Vision Research, York University; 4Department of Biology, York University.

Dyslexia is a prevalent reading disorder. The magnocellular hypothesis of dyslexia suggests that deficits in the magnocellular processing stream may account for some of the symptoms associated with the disorder. In the human lateral geniculate nucleus (LGN), magnocellular neurons are segregated into eye---specific layers and are disjoint from the parvocellular layers. This constitutes the only location in the human visual system where the magnocellular and parvocellular streams are spatially disjoint. Recently we found a reduction of the LGN size in dyslexics compared to IQ matched controls. Here, we functionally examine using functional magnetic resonance imaging, the

modulation of spatial and feature---based attention in the LGN, superior colliculus and pulvinar. We observed differences in the spatial and feature---based modulations of attention between the subjects with dyslexia and controls.

21. Examining Interocular Suppression from the Contralateral Surround Using Reverse Correlation -David Nichols and Victoria Godwin, Roanoke College

When rivalrous images are presented to the two eyes, portions of one image are alternately perceived over another, even if not overlapping physically. Interocular suppression of a monocular center grating, as examined by randomly changing the state, i.e. presence/absence, independently for an ipsilateral and contralateral surround annulus, required the presence of the contralateral surround though reappearance was differentially associated with it across state durations. For rivalrous centers, the suppression of one center was related to the presence of the contralateral surround whereas the visibility of a center grating was slightly related to the absence of the contralateral surround for I sec state durations but unrelated by 3 sec state durations.

22. Masking, crowding or something new in fine spatial discriminations - Lynn A. Olzak and Mingliang Gong, Department of Psychology, Miami University of Ohio

Fine spatial judgments made on a center sinusoid with an annular “mask” are poorer than controls. Meta-analyses across previous experiments suggest that underlying mechanism(s) yield some results similar to masking experiments, but in other ways shares properties of crowding. In the current experiments, we performed a “critical test” (Petrov, Poppel, and McKee, 1997) to distinguish between masking and crowding in periphery: placement of a mask. Crowding effects are asymmetric, with an outward mask yielding poorer performance. Pure masking shows no difference. Our results indicate individual differences; either no asymmetry is found, or performance is poorer with the inward mask.

23. Common fate versus cast shadows as influences on perceived motion direction and depth - Marouane Ouhnana, Frederick A. A. Kingdom McGill Vision Research, McGill University

Aim: Manipulation of an object's cast shadow has been shown to alter the object's perceived depth and motion direction in both static and dynamic displays (Mamassian et al., 1998 Trends Cogn. Sci. 2:288–95). However the effect holds even if the cast shadow looks unrealistic, for example by deforming its shape. Our aim is to test the possibility that something other than ‘shadowness’ is driving the percept. Method: We employed a variant of the ball-in-box stimulus used by Kersten et al. (1994 Max-Planck-Institut fuer biologische Kybernetik, Technical Report no 6) in which a floating test sphere recedes diagonally into the background over a checkered surface. Instead of a shadow, we introduced a second sphere below the first and moved it either diagonally or horizontally in temporal synchrony with the test sphere. Result: The test sphere appeared to move either diagonally or to rise up in the frontal plane depending on the movement of the second sphere, similarly to the effect of a shadow. Although compared to the shadow, the sphere had a weaker influence. Conclusion: We suggest that the different percepts implicate a form of common fate. As

both spheres move in synchrony, the visual system groups them as a unitary entity. The second sphere serves to disambiguate the motion of the floating sphere by locking its motion into one of two planes, a diagonal plane in which the two motion directions are the same, and a frontal plane in which they are different. This suggestion expands on the common fate principle and may be an example of the broader range of common fate phenomena that Wertheimer had in mind (Wagemans et al., 2012 Psychology Bulletin, 1172:1217).

24. Time-frequency analysis as a new method for investigating in-depth eye movements in stereoscopic displays - Matthieu PHILIPPE, Anne-Emmanuelle PRIOT, Caroline COULOT, Pascaline NEVEU, Corinne ROUMES (I.R.B.A - France)

Stereoscopic displays are used increasingly in cinema, TV or video-games industries, to create an artificial impression of depth. In such devices, vergence and accommodation are not congruent. Thus, conflicting disparities and blur signals drive vergence movements and may affect vergence dynamics. In the present study, subjects experienced stereoscopic viewing of in-depth oscillating target. The path of the virtual fixation point was analyzed in the frequency domain using a Morlet's wavelet. Results showed enhanced activity in a high-frequency (>30 Hz) band when fixation was behind the screen. The nature of these high-frequency eye movements is discussed.

25. Sub-tenons Avastin in the rescue of failing blebs - Zia S Pradhan, Catherine M Birt, Sana Muhsen, Marcelo Stevenson and Christoph Kranemann. Department of Ophthalmology and Vision Sciences, University of Toronto.

The main cause for failure of a trabeculectomy is bleb scarring. Antibodies blocking vascular endothelial growth factor (Avastin) prevent proliferation of fibroblasts and therefore, may help failing blebs. Retrospective, interventional case-series of 31 patients who received sub-tenons Avastin ± suturolysis, needling or 5-fluorouracil injections for wound modulation. Following Avastin, intra-ocular pressure ($p=0.001$) and bleb vascularity ($p<0.001$) decreased significantly. Eyes which received Avastin alone had fewer corneal epithelial erosions than those which received Avastin and 5-fluorouracil ($p=0.027$). Avastin is a useful adjunct in reviving failing blebs and may be especially beneficial in eyes with corneal epithelial instability.

26. Fixational eye movements in strabismic amblyopia - Rajkumar Nallour Raveendran BS (Opt) MSc,Raiju J Babu BS (Opt) MSc PhD, William R Bobier OD PhD, University of Waterloo

Fixational stability (FS) using bivariate contour ellipse area (BCEA) and microsaccadic behavior were quantified in 6 strabismic amblyopes. Binocular integration was enhanced through ocular alignment and interocular suppression attenuation. Improved fixational stability (reduced BCEA) was noted with ocular alignment [$p=0.015$] and with interocular suppression attenuation [$p=0.001$]. However, the improved FS was transient (53.1±19.3 sec). Microsaccadic amplitudes were higher in amblyopic eyes compared to control eyes [$p=0.04$]. However, this difference reduced and became insignificant with ocular alignment [$p=0.273$] and with interocular suppression attenuation

[p=0.119]. The results suggested that fixational stability and behavior of microsaccades appear to briefly improve with binocularity.

27. Processing of compound radial frequency patterns - Gunnar Schmidtmann, Harry S. Orbach Graeme J. Kennedy, Gunter Loftier, Glasgow Caledonian University, Vision Science

Radial Frequency (RF) patterns are frequently used to investigate intermediate stages of shape processing. We aimed to investigate discrimination sensitivity for weighted combinations of two RF components and to test if compound shapes are processed by independent RF shape channels. Discrimination thresholds were measured for various symmetrical and asymmetrical compound shapes (combinations of RF3/RF5; RF3/RF8; RF4/RF7). If the visual system can decompose compound shapes and access the output from independent RF channels, performance should be similar for the compound shape and the components, irrespective of e.g. shape symmetry. Results show that this is the case and therefore indicate that compound shapes are processed by individual RF mechanisms.

28. Convexity in the Assignment of Figural Status in Children and Adult - Michael Slugocki(1), Daphne Maurer(1), Mary A. Peterson(2) and Terri L. Lewis(1), (1)Department of Psychology, Neuroscience & Behaviour, McMaster University (2)Department of Psychology, University

Adults are more likely to perceive as figures regions that are bound by convex rather than concave contours, a likelihood that increases with the number of regions displayed (Peterson & Salvagio, 2008). To test the development of this convexity bias, we examined the strength of convexity as a figural cue in 3-year-olds, 5-year-olds, and adults (n=12/age). Participants were shown displays composed of alternating convex and concave regions that differed in luminance and were asked to identify the colour of the figure in each display. We found that, under the current testing conditions, convexity as a figural cue was adult-like by 3 years of age.

29. Visual bandwidths for face orientation decrease during early development - Mark Vida (McMaster University), Hugh Wilson (York University) & Daphne Maurer (McMaster University)

Young children are less accurate than adults in matching facial identities across face views. We investigated whether this difference could reflect broader bandwidths for face orientation in children. Adults and 8-year-olds (n=20/group) were adapted to a frontal face view or a left/right side view, then judged the orientation of a face at or near the frontal orientation. Sensitivity to face orientation was lower and aftereffects were larger in 8-year-olds than adults. A neural model shows that these results can be modelled by broader bandwidths and higher internal noise in 8-year-olds. These differences may contribute to children's lower accuracy in matching facial identities across face views.

30. Above Average? Perceptions of attractiveness in children and adults - Larissa Vingilis-Jaremko, Marlette Ravelo, Daphne Maurer, McMaster University

Adults rate averaged faces approximating the population mean as more attractive than most individual faces. However, adults judge an average created from highly attractive faces to be even more attractive. We created two 'attractiveness dimensions': one of male and one of female faces, each based on the differences between a typical average and an attractive average. Adults selected faces near the attractive average as most attractive. There were similar effects in 5-year-olds except that they were weaker for female faces. The results suggest influences on attractiveness in addition to cognitive fluency for processing average faces emerge early in development. Surprisingly, the results suggest greater maturity on this dimension for male than female faces.

31. Tremotopic Mapping of the Human Thalamic Reticular Nucleus - Joseph Viviano & Keith Schneider, Centre for Vision Research, York University

The thalamic reticular nucleus (TRN) is a layer of GABAergic cells wrapping the thalamus, connected with every sensory modality of the brain. Despite the proposed importance of the TRN in maintaining adaptive brain function, no method is able to functionally define it's sensory sectors in a human. We modified standard retinotopic mapping to simultaneously present various flicker frequencies periodically. Proton density images were used to identify the TRN. We show visual sector isolation in the TRN adjacent to the lateral geniculate nucleus (LGN), and that the flicker frequency response profile is sufficient to delineate between the TRN and LGN.

32. Representations of planar shape - Alex Yakubovich & James Elder, Centre for Vision Research, York University

Feedback projections from V4 to V1 may provide global shape information in order to control contour grouping. This calls for a generative model that can hypothesize plausible shapes. Oleskiw et al recently proposed a generative shape model based on the composition of localized diffeomorphisms. We present several contributions which build on this representational framework: (1) generalizing the basis to include oriented deformations, (2) optimizing the correspondence between shapes using dynamic programming, and (3) regularizing the inverse problem of finding model parameters. We evaluate our method on the task of completing partially occluded shapes, comparing against another generative shape model as well as more ad hoc methods.

Marty Steinbach's Poster Session – Friday June 28, 2013

1. Steinbach Commemorative Poster

2. Proprioceptive recalibration and reach adaptation after training with altered terminal feedback of the hand - Victoria Barkleya,b, Danielle Salomonczyka,b, Erin K. Cressmanc, Denise Y.P. Henriquesa,d (a: Centre for Vision Research, York University, b: Department of Psychology York University, c: School of Human Kinetics, University of Ottawa, d: School of Kinesiology and Health Science, York University)

When reaching with continuous, misaligned visual feedback of the hand, reaches are adapted and proprioceptive sense of hand position is recalibrated to partially match the visual feedback provided. It is unclear if similar adjustments arise after reaching with terminal visual feedback, when there are shorter temporal intervals for participants to experience current visual and proprioceptive feedback. Here, participants reached to a target with either continuous or terminal visual feedback that was gradually rotated 30° clockwise with respect to the hand. Subjects then completed two additional blocks of trials with the 30° rotated cursor. Reach adaptation (aftereffects) and proprioceptive recalibration were similar in magnitude across all three training blocks when continuous visual feedback was available. In particular, subjects recalibrated their movements by 16° and shifted their felt hand position by 7° leftwards. In contrast, reach adaptation was smaller when terminal visual feedback was provided and proprioceptive recalibration increased across training blocks with terminal visual feedback, such that by the end of the third block of trials, proprioceptive recalibration was similar in magnitude to proprioceptive recalibration achieved by the continuous visual feedback training group. Thus, despite the absence of continuous visual feedback, participants demonstrated motor learning and recalibrated their sense of felt hand position with terminal feedback, although more slowly than with continuous feedback.

3. Accommodative behavior of myopic children is not predicted by current models of accommodation and vergence - Bobier, W.R.,OD, PhD. *Irving, E.L. OD, PhD,* Sreenivasan, V BS., PhD., *School of Optometry, University of Waterloo,**School of Optometry, Indiana University**

Introduction: Models based upon adult studies predict that adaptation of accommodation (Adapt) or vergence (Vadapt) reduces the error of each system, and reduces the cross link outputs of accommodative convergence (AC/A) and vergence accommodation (CA/C) respectively. However, when accommodative behavior of young myopes are reviewed, high accommodative adaptation is in fact associated with high AC/A and large static errors. Method: Accommodative and vergence behaviors of 24 myopic and 20 non myopic children aged 7 to 15yrs were measured at 33cm using a Power Refractor and phoria changes respectively in response to binocularly placed -2 and +2D lenses at 33cm and 10pdBO at 4m. Results: Adapt varied directly with AC/A (near phoria, p=0.02) and myopia (p=0.01). Vadapt did not vary with myopia. Conclusion: Accommodative behavior of children differs from adults and is magnified by myopia.

4. What the temporal dynamics of unimodal sensory estimation can tell us about statistically optimal multimodal integration - Patrick A Byrne, Laurence Harris, Centre for Vision Research, York University

The brain combines redundant stimulus estimates (e.g. position of an object provided by vision and haptics) in proportion to their reliabilities. The mechanisms used by the brain to assess reliability of its estimates are not fully understood. Most models make the untested assumption that internal estimates of a property respond rapidly to fluctuations arising from noise. We tested this assumption with a visual stimulus similar to one that has been shown (Byrne and Henriques, 2013) to combine optimally with haptic estimates of position. Our results imply that position estimates are maintained in an "attractor", which takes time to shift when sensory information changes. This is inconsistent with current models of how reliability is computed by the brain.

5. Development of Audiovisual Integration in Event Perception - Yi-Chuan Chen, Terri Lewis, and Daphne Maurer, Department of Psychology, Neuroscience & Behaviour, McMaster University

We measured developmental changes (7-, 9-, and 11-year-olds, and adults) in audiovisual integration utilizing visual fission and fusion illusions induced by sounds. Fission refers to a single flash being perceived as two flashes when accompanied by two beeps, and fusion refers to two flashes being perceived as a single flash when accompanied by a single beep. We also measured the eccentricity effect of fission and fusion by presenting the visual flashes in the central or peripheral visual field. We defined the magnitude of the fission illusion as the frequency of reporting one flash when one flash was paired with one versus two beeps, and the magnitude of the fusion illusion as the frequency of reporting two flashes when two flashes were paired with two versus one beep. The results demonstrated that only the magnitude of fusion decreased with age, while fission did not. Furthermore, fission was larger in the periphery than in the centre, whereas fusion revealed a reversed pattern. These results suggest different developmental trajectories and mechanisms underlying fission and fusion illusions.

6. Neural substrates for egocentric and allocentric representations in memory-guided reaching - Y. CHEN, S. MONACO, P. BYRNE, X. YAN, D. Y. P. HENRIQUES, J. D. CRAWFORD; Centre for Vision Research, York University

We employed an event-related fMRI design to investigate the brain areas that support egocentric or allocentric representations. Twelve participants reached toward a remembered target location in Ego, Allo, or Control condition. We found that during the delay period there was higher response in Ego and Allo vs. Control in bilateral Superior Parietal Cortex (SPC), Intraparietal sulcus, dorsal premotor area (PMd), and left Extrastriate. There was higher activation in bilateral SPC and right PMd to Ego vs. Allo, whereas in Visual Cortex to Allo vs. Ego. Spatial selectivity was observed in occipital cortex, but in frontoparietal cortices during motor execution phase.

7. Automatic Image Rectification from Planar Curves - Eduardo R. Corral-Soto & James H. Elder, Centre for Vision Research, York University

Existing automatic camera calibration methods used for image rectification from a single view typically assume the existence of straight parallel lines from which vanishing points can be computed, or orthogonal structure known to exist in the scene. However, there are many practical situations where these assumptions do not apply. Here we study an important generalization of these methods to scenes known to contain parallel smooth curves. Our method is based upon establishing an association between pairs of corresponding image points lying on the image projection of parallel curves. A least squares estimate of the tilt angle of the camera is then computed from the tangent lines of the associated points which allows an approximate rectification of the image.

8. Computational Modeling of 3-D Head-Free Gaze-Shift Control - Mehdi Daemi, J.D. Crawford, Center for Vision Research, York University

Shifting the line of sight allows us to place selected visual objects in retinal regions specialized for processing different features. This shift is naturally implemented by coordinated movement of eye and head. We are proposing an analytic framework based on the rotational kinematics underlying the three-dimensional head-free gaze shifts. Then, we train a three-layer feedforward neural network based on the tested results of our kinematic model. We analyze the frames of reference and position dependencies of the hidden units to understand the underlying mechanisms they use to implement the reference frame transformations.

9. Tactile consequences of body distortion - Sarah D'Amour & Laurence Harris, Centre for Vision Research, York University

The perceived position of the limbs can be altered by stimulating tendons. If such a misplaced limb holds another body part, its perceived size can be distorted. Here, the arm's perceptual length was modified by holding it with a misplaced limb and perceived waist thickness was modified by stimulating tendons with the arms akimbo. Two-point discrimination and sensitivity thresholds changed when the arm was perceptually lengthened and when the waist was either thickened or made to feel smaller. Fundamental sensory properties are not determined exclusively by peripheral mechanisms but depend on higher-level representations.

10. Reconstructing visual stimuli using population receptive estimates - Kevin DeSimone & Keith Schneider, Dept of Biology, York University

The population receptive field (pRF) model has been used to map the retinotopic organization of multiple visual areas (Dumoulin & Wandell, 2008). The pRF model can be inverted so as to generate a predicted pattern of visual stimulation in combination with the BOLD time-series. We sought to develop a procedure for generating stimulus reconstructions from trained pRF estimates and novel patterns of visual stimulation. Using image similarity metrics (Wang et al., 2004) we were able to

reconstruct the patterns of visual stimuli using ensembles of voxels gleaned from multiple visual areas during passive viewing and while participants engaged in a visual spatial attention task.

11. Reference frame specificity of MT+ during the transsaccadic integration of visual motion - B. T. Dunkley, J. C. Dessing, J. D. Crawford, Centre for Vision Research, York University

The visual system temporally summates motion signals across saccades to form a coherent percept of a moving object. Known as transsaccadic perception (TSP), we investigated whether MT+ is the neural substrate of this process by using TMS. Participants performed a motion discrimination task either spatio- or retinotopically. Results revealed no significant effect of site or condition on motion sensitivity. Additionally, there was no significant effect in the bias for site or condition, although there was a significant difference in thresholds between control versus baseline task. The lack of any TMS effect on the summation of motion suggests TSP might not be confined to a solitary cortical region.

12. Mapping Influences of Saccadic Suppression on Veridical and Illusory Motion Perception - Adam Frost & Matthias Niemeier, University of Toronto.

Oculomotor commands have been shown to impair perisaccadic motion perception. However, the specific time course of suppression is unknown. Here we mapped perisaccadic suppression during horizontal saccades probing veridical motion with a brief 2-frame random-dot motion, where some dots moved coherently up or down among random 'noise' motion. In addition, we employed motion adaptation to induce illusory motion biases. We found that motion sensitivity declined roughly symmetrically +/-50ms around the saccade onset. Our data suggest that saccadic suppression affects motion perception at two or more stages of motion perception and representation.

13. Effects of head orientation on tactile localization - Laurence R. Harris, Lisa M. Pritchett & Michael J. Carnevale, Centre for Vision Research and Department of Psychology, York University

We present a series of studies on the effect of head orientation on tactile localization. Vibration stimuli were presented from an array of tactors attached to the front or back of the torso while participants oriented their head to one side. Participants indicated the perceived location on a visual scale. Systematic errors were found that depended on (a) whether the tactor was on the same side of the body as the head was turned and (b) whether the head was returned to the central position before reporting. We discuss the possibility that (a) reflects lateralization of tactile target representation and that (b) indicates different reference frames depending on the task. Finally, we find that the shifts on the body do not rotate around the front and back, but that they are mirrored, perhaps indicating that the front and back of body space is represented in separate parallel representations, rather than as three-dimensional whole.

14. Use of an eyetracker to uncover performance gains in a Citizen Science/GalaxyZoo classification task - Hiller, David, Musicant, Alan D., Hein, M., Wallin John, Dept. of Psychology, MTSU

As a part of the Citizen Science GalaxyZoo project we utilized an eye tracking system in an attempt to understand how non scientists might classify galaxies into one of four categories. We have verified that the procedure is adequate to undertake this endeavor in that, as participants progress in the classification task, they get faster and that there are fewer saccades and eye blinks that occur. These results are associated with the subjects spending less time on each task. We are analyzing data such as how much time participants spend in the "critical region"/interest area to correctly classify a galaxy and we are also looking at time spent in adjacent (non informative) areas of the view.

15. Reduction of the flash-lag effect in terms of active observation is violated by changing hand movement size - Makoto Ichikawa (Chiba Univerisity), Yuko Masakura (Tokyo University of Technology)

Observer's active control of the stimulus movement by the use of computer mouse has effects to reduce the visual flash-lag effect (Ichikawa & Masakura, 2006, 2010, 2013). We measured the flash-lag effects for different direction and different size conditions for the hand movement. We found the reduction of the flash-lag effect in the active observation in any of the hand movement size conditions, but the reduction disappeared after observer changed the size of hand movement. These results suggest that the proprioceptive signal of hand movement which is stable and consistent with the visual stimulus movement promotes the visual processing.

16. Morphological changes in anterior visual system development following the loss of one eye early in life - 1. Krista R. Kelly, 2. Larissa A. McKetton, 3. Keith A. Schneider, 4.Brenda L. Gallie, 5. Jennifer K.E. Steeves (1-3,5 = CVR, York; 4 = The Hospital for Sick Children)

The lateral geniculate nucleus (LGN) receives information from each eye in separate layers. We investigated LGN development following early monocular enucleation (ME; surgical removal of one eye), which consequently eliminates half of the retinal inputs to the visual system. 40 high-high-resolution proton density-weighted images were acquired on a 3T MRI scanner and then registered and averaged. Raters used the averages to manually identify the LGN. ME participants exhibited an overall decrease in LGN volume compared to controls, however, this decrease was less prominent in the hemisphere contralateral to the remaining eye. These data suggest that the earlier developing crossing retinal fibres may recruit deafferented cells previously allocated to the enucleated eye.

17. Improving visual processing speed reduces stress by remediating reading and attention deficits more than found when improving auditory processing speed - Teri Lawton, Jordan Conway, Kelly Lawton, & Steven D. Edland, Departments of Computer Science and Neurosciences, UCSD

There is no greater educational problem facing our schools than students who have trouble reading. We hypothesize that slow processing speed in both the auditory and visual pathways is a key factor limiting reading performance. To investigate the efficacy of reading interventions designed to improve temporal processing speed, we compared two timing interventions, FastForWord (FFW), targeting the temporal dynamics of the auditory pathway, and PATHtoReading (PATH), targeting the temporal dynamics of the visual pathway. Both interventions, designed to increase the sensitivity and temporal precision of magnocellular neurons in the motion-sensitive dorsal stream, have been shown to be efficacious in randomized trials. This study examined 1) whether PATH or FFW is more effective at improving reading skills, and 2) whether FFW and PATH can be combined into an intervention that results in an even greater benefit. We ran a randomized trial on dyslexic second and third graders in six San Diego Unified School District (SDUSD) elementary schools, comparing business-as-usual (control group), PATH, FFW, PATH+FFW. All students in this study, both those in the control group and those in the other arms did a reading intervention provided by SDUSD called Learning Upgrade. Standardized tests of reading fluency, spelling, working memory, and attention were administered before and after the reading interventions to evaluate improvements in reading skills. ANCOVAs controlling for age, sex, ethnicity, English as a second language status, and school, were used to compare treatment response across groups. Arms that included PATH outperformed other arms in the trial, especially for attention, spelling, phonological awareness, working memory, and reading skills. The more training students had on PATH, the more reading skills improved. These data suggest that training using patterns that bias activity toward visual magnocellular function significantly improves the reading skills of dyslexics, contrary to claims that reading is primarily phonologically-based. Ourworkinghypothesisisthatmagnocellulardeficitsearlyinthedorsalvisualstream disrupt all later processing in the dorsal stream, and impede the development of these processes. Since the dorsal stream's output is input to the Central Executive Attention Network (CEAN), a key network in cognitively challenging tasks, reading improvements could be due to PATH training helping develop the CEAN by improving dorsal stream function. According to our hypothesis, sluggish magnocelluar neurons cause a deficit in attentional focus, preventing the linked parvocellular neurons from isolating and processing information essential for reading, and preventing the CEAN from developing properly. This is supported by our finding that students trained on PATH improved in attention more than did the other arms. Our data suggest that PATH improves speed of processing in the dorsal stream, enabling it to guide the ventral stream and improve CEAN functioning, improving reading skills, as well as attention and working memory. Improving the speed of processing reduces cognitive stress, so children can focus on the task at hand.

18. Venn meets Shannon - quantifying redundancy in visual search behaviour - Timothy Leonard & Kari Hoffman, York University

Here I present a method for quantifying the dispersion or clustering of visual fixations on an image. The method was developed in response to two challenges: 1. comparing visual search patterns

from trials of variable lengths and different numbers of fixations and 2. distinguishing between tightly clustered fixations and widely distributed viewing patterns during trials where a combination of both strategies are employed. The method is applied to gaze data in human and non-human primates as they searched for a changing object in a natural scene. Initial results suggest that the method can be used to identify different search strategies.

19. Role of Early Visual Cortex in Transsacadic Perception of Visual Feature Memory in Humans - Pankhuri Malik (Departent of Biology; Centre for Vision Research, York University); Joost C. Dessing (School of Psychology, Queen's University, Belfast), J. Douglas Crawford (Centre for Vision Research; Departments of Psychology, Biology, and Kinesiology and Health Sciences, York University; The Canadian Action and Perception Network)

Visual information is held in memory and is integrated across saccades to maintain spatial stability via transsaccadic perception (TSP). We investigated the role of the early visual cortex (EVC) in TSP of low-level visual features. Participants were required to discriminate orientation change in a Gabor patch across a memory interval during fixation or across saccade that either maintained the stimulus within the same hemifield or changed to the opposite hemifield. rTMS was applied over retinotopically-defined regions of the right and left EVC (via functional localizers). We found significant TMS effects (n = 8) based on saccade size and direction. Orientation discrimination was inhibited when saccades brought the gaze-centered location of the remembered stimulus in line with the stimulated visual field, implicating EVC in 'remapping' the stimulus attributes. We are also conducting a follow-up study with a higher visual memory load and single-pulse TMS to investigate potential time dependent effects.

20. Audition dominates vision after loss of one eye early in life when the systems are in competition but not when they are integrated - Stefania S. Moro, Laurence R. Harris, Jennifer K.E. Steeves, Centre for Vision Research, York University and The Hospital for Sick Children

We assessed whether the advantage given to audition in people with one eye, when the auditory and visual systems are in competition, might also be found when the systems are integrated together to make unified judgements. Participants were asked to spatially localize perceptually fused audiovisual events in which the auditory and visual components were spatially disparate in order to quantify the relative weightings assigned to each system when the systems were integrated. When localizing bimodal targets, the weightings assigned to each sensory modality in both people with one eye and controls were predictable from their unimodal performance in accordance with the Maximum Likelihood Estimation (MLE) model. People with one eye appear to integrate the auditory and visual components of multisensory events optimally.

21. Citizen Science/GalaxyZoo: Determination and cluster analysis of performance by untrained observer's in the classification of galaxies - Musicant, Alan D., Hein, M. Heller, David, Wallin, John, Dept. of Psychology, MTSU

Citizen Science uses the input of many non-scientists to make meaningful contributions to science through the analysis of large datasets. The GalaxyZoo project solicits volunteers to classify galaxy morphologies. In this study, we examine how these volunteers make their decisions in an attempt to understand and potentially improve the overall process. Our study setup uses four classification categories, previously created by experts in the field. We asked college students, with minimal training, to classify a well characterized set of galaxy images. Cluster analysis indicates five distinct groups of people. One group classifies all galaxy types accurately while the other groups' generally classify only one galaxy type well. These latter clusters otherwise respond with random choices to the other galaxy types.

22. Perception of complex motion in humans and pigeons - J. F. Nankoo, C. R. Madan, M. L. Spetch, D. R. Wylie, Department of Psychology, University of Alberta

The ability to integrate local motion signals into global motion is critical for mobile animals. While much is known about this integration process in the primate visual system, little is known about how the avian brain carries out this process. We used random-dots kinematograms to investigate pigeons' ability to detect complex global motion relative to humans. We found that pigeons were least sensitive to radial motion and most sensitive to rotational motion. Threshold for spiral motion were at an intermediate level between radial and rotation thresholds. In contrast, humans were most sensitive to rotation and radial motion. Sensitivity to spiral motion was significantly lower. These findings have important implications for understanding the functions and evolution of the tectofugal and thalamofugal pathways.

23. Classification images reveal decision strategies in signal detection - Lisa M. Pritchett & Richard F. Murray, Centre for Vision Research & Department of Psychology, York University

Two-alternative forced choice (2AFC) designs are frequently used in signal detection experiments because it is widely believed that the procedure reduces bias and eliminates the need for setting a criterion in the decision process. The optimal decision strategy for observers to follow in such tasks is to compare the decision variable obtained on the two intervals and choose the larger one. We present a novel method of using classification images to estimate each observer's decision variable, trial by trial, and thereby provide direct evidence for the decision rules used. We analyzed data from a two-alternative forced choice task where observers identified which of two noisy alternatives contained a contrast increment. Results indicated that a strategy similar to signal detection theory's optimal decision rule (the difference rule) was followed.

24. A case study of topographic disorientation: Behavioral intervention for achieving independent navigation - Josée Rivest, CVR, Baycrest; Eva Svoboda, Jeff McCarthy, & Morris Moscovitch, Baycrest

This is a case study evaluating whether a man who has acquired topographic disorientation (LH) can benefit from a navigation intervention. Utilizing errorless learning methods, we train LH to use a navigation program on his iphone, and use a time-series design ABAB in order to evaluate its effectiveness. Before and after training, LH judges his capacity to navigate from differently familiar places to others, his abilities to use his iphone, and, his performance and satisfaction at achieving his goals of finding his way around and navigating independently. In phase A, he does a navigation assignment during which he must walk to locations while using a printed map only, and in phase B, he has a printed map and his iphone. His navigation efficacy is significantly improved between phases A and B, and all subjective measures were improved by our intervention.

25. Spatiotemporal Evolution of the Response Field of Frontal Eye Field Neurons from Sensory to Movement Representation - Amirsaman Sajad1,2, Morteza Sadeh1,3, Xaiogang Yan1, Hongying Wang1, Douglas Crawford1,2,3 1 Centre for Vision Research, York University; 2 Department of Biology, York University; 3 Department of Kinesiology and Heath Sciences, York University

Macaque Frontal Eye Field (FEF) neurons often exhibit delay activity during memory-guided saccades, where subjects make delayed gaze-shifts to memorized locations. Recent findings suggest that FEF visual and movement activity codes for the location of visual stimulus and final gaze, respectively. However, the nature of the information coded in the delay period is unclear. Preliminary spatiotemporal analysis of the response-field of 15 visuomovement cells reveals a progressive evolution from visual to movement coding during the delay period. This suggests that delay activity is not just retaining target location information, but is involved in transforming information from sensory to motor representations.

26. Functionally imaging the magno- and parvocellular layers of the human LGN during binocular rivalry - Debra W. Soh, MA, Dept. of Psychology & Keith A. Schneider, PhD, Dept. of Biology & CVR, York University

Binocular rivalry occurs when conflicting images are presented to the eyes dichoptically. Rather than being perceived as one cohesive image, the two images compete for perceptual dominance, resulting in the images alternating in perceptual awareness. Our interest was to determine the involvement of the magnocellular (M) and parvocellular (P) processing streams. The lateral geniculate nucleus (LGN) is involved in dominance and suppression of visual input and is the only place in the brain where these streams are spatially disjoint. Previous research has shown that activity in LGN layers, innervated by the suppressed eye, is also suppressed during rivalry, but it is not clear whether both M and P streams are equally involved.

27. Exploring the human cortical face perception network with consecutive TMS and fMRI - Lily M. Solomon-Harris and Jennifer K.E. Steeves, Department of Psychology and Centre for Vision Research, York University

The human cortical system for face perception is comprised of a network of connected regions including the middle fusiform gyrus ("fusiform face area" or FFA) and the inferior occipital gyrus ("occipital face area" or OFA). The functional magnetic resonance imaging (fMRI) response of the right FFA is normally attenuated for face stimuli of the same versus different identities. Previous research has demonstrated that patients with prosopagnosia who have an inability to recognize faces and show right OFA damage do not show the typical release from adaptation in the right FFA. We used transcranial magnetic stimulation (TMS) to temporarily disrupt processing in the right OFA in neurologically intact individuals, then immediately performed fMRI to observe changes in activity across the network in a face adaptation experiment.

28. Effects of TMS over dorsolateral prefrontal cortex on multiple-visual object memory across fixation and saccades - 1,4 Leiko Tanaka, 4,5 Joost Dessing, 6 Steven L. Prime & 1,2,3,4 J.D. Crawford 1.Departments of Psychology, 2.Biology, 3.Kinesiology, 4.Centre for Vision Research, York University, and 5.Queen's University Belfast 6.School of Psychology at Victoria University of Wellington

Previous studies conducted by Prime et al., showed that transcranial magnetic stimulation (TMS) over right PPC (2008) and right FEF (2010) reduces memory capacity during a transsaccadic memory task. Here, we used a similar paradigm to investigate the role of dorsolateral prefrontal cortex (DLPFC). We hypothesized a less saccade-specific role than PPC and FEF. Performance in the fixation task was significantly reduced during TMS over left and right DLPFC. Performance in the saccade task exhibited a significant facilitation of performance for right DLPFC stimulation. The differential effect during saccades seen here, as observed in PPC and FEF, may suggest that the DLPFC plays a unique role in transsaccadic memory.

29. The facing-the-viewer bias in the perception of silhouettes and point light displays: Representational differences - Séamas Weech & Nikolaus F. Troje, Department of Psychology, Queen's University

Point-light displays (PLDs) contain no information about in-depth orientation, yet observers tend to report a facing-the-viewer (FTV) interpretation (Vanrie et al., 2004). There is no consensus regarding the cause of this bias. On the other hand, depth-cue deprived silhouettes do not elicit FTV bias (Troje & McAdam, 2010). In order to isolate the features that drive the bias for PLDs, we manipulated the attributes that differ between the two classes: posture, dynamic vs. static presentation, gender, display type (sticks vs. outline). Stick figures elicited an FTV bias that was not present in any silhouettes. The static, standing stick figure also elicited no bias. Our findings afford an explanation of the FTV bias in terms of local stimulus features.

30. Which emotional cues are most salient for emotional processing? A study investigating how humans perceive emotions using chimeric faces - Sarah R. Zohar and Jennifer K. E. Steeves, Department of Psychology & Centre for Vision Research, York University

Previous studies indicate that happy expressions are more salient than sad expressions but there are inconsistencies regarding which emotion is processed in which hemisphere. This study investigates which cues are most salient for emotional processing using a visual task. Participants briefly viewed chimeric faces where one half of the face portrayed one emotion and the other half portrayed another emotion which was either conflicting or neutral and reported what they perceived. Results suggest that when an individual is viewing a face with conflicting cues, the expression projecting to the right hemisphere is perceived more often than the left, as well as, happiness is perceived more often than sadness.

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