École D'ÉTÉ 2026 SUMMER school

RESTAURATION DE LA VISION

VISION RESTORATION

RÉSUMÉS
des présentations étudiantes et des stagiaires postdoctoraux

***

ABSTRACTS
for student and postdoctoral fellows' presentations

1. Évaluation de la répartition géographique et de l'accès aux spécialistes de la cornée au Canada. L'offre répond-elle à la demande?

Chaire Suzanne Véronneau-Troutman

Adam Harrak[1], Ouissam Aitssi[2], Anas Abu Dieh[2], Taha Amkadou[2], Melanie Hébert[2], May Griffith[1], Marie-Claude Robert[1], Ali Dirani[2], Ralph Kyrillos[2]

[1]Faculté de Médicine, Université de Montréal, QC, Canada [2]Faculté de Médicine, Université Laval, Québec, QC, Canada

Introduction : Les spécialistes de la cornée sont des ophtalmologistes ayant une formation avancée en maladies de la surface oculaire. Ils jouent un rôle essentiel dans les greffes de cornée et la prise en charge des pathologies cornéennes complexes. Comme pour les ophtalmologistes généralistes, l'accès à ces surspécialistes est devenu plus limité au Canada comme aux États-Unis. Au Canada, l'étendue du territoire complique davantage la répartition équitable, ce qui peut entraîner des inégalités d'accès aux soins. Cette étude vise à évaluer la répartition et l'accessibilité des cornéologues au Canada.

Méthodes: Des bases de données publiques ont été consultées afin d'identifier les ophtalmologistes en exercice dans chaque province et territoire canadien. Les sources comprenaient notamment les répertoires du Collège des médecins du Québec et des Colleges of Physicians and Surgeons de l'Ontario et des autres provinces. Les données recueillies incluaient le nombre de cornéologues actifs, leur lieu de pratique et leur sexe. La répartition géographique et les zones desservies ont été cartographiées afin d'évaluer l'accessibilité. Pour estimer la demande, une revue de la littérature et une analyse conjointe avec Héma-Québec, la Société canadienne du sang et l'Institut national canadien pour les aveugles ont permis d'estimer la prévalence des pathologies cornéennes nécessitant une greffe au Canada. L'offre et la demande ont ensuite été comparées statistiquement pour évaluer l'adéquation entre la disponibilité des services et les besoins des patients.

Résultats: Au total, 133 spécialistes de la cornée ont été identifiés au Canada, avec une forte concentration dans les régions métropolitaines. Le Grand Toronto, qui compte 6,2 millions d'habitants (16,7 % de la population canadienne), regroupe 28 spécialistes (21 % du total). La région de Montréal, avec 4,2 millions d'habitants (11,3 %), compte 21 spécialistes (15,7 %), et celle de Vancouver, avec 2,6 millions d'habitants (7,2 %), compte 16 spécialistes (12 %). À l'inverse, les villes des territoires nordiques avaient accès à moins de 2 % des spécialistes du pays. Dans les Maritimes, qui totalisent plus de 2,4 millions de résidents (6,5 %), on ne retrouvait que 15 spécialistes (11,3 %). Pour la greffe de cornée, plus de 85 % des interventions étaient réalisées dans les grandes villes canadiennes, alors qu'environ 60 % seulement des patients greffés résidaient dans la ville de traitement.

Conclusion: La répartition des spécialistes de la cornée au Canada est inégale et contribue à des disparités d'accès aux soins, qui pourraient s'accentuer avec le vieillissement de la population.

2. Effects of early blindness on odor discrimination and cortical activity in mice

Vanessa Bordonaro[1], Matthew Loukine[1, 2], Stuart Trenholm[1]

[1]Montreal Neurological Institute, McGill University, Montreal, QC, Canada [2]Mila, Montreal, QC, Canada

Background: Loss of a sensory modality often leads to compensatory changes in the remaining senses, a phenomenon known as cross-modal plasticity. While much work has focused on how early vision loss can affect tactile and auditory systems, much less is known about how vision loss affects olfactory processing. Previous work from our lab indicates that blind mice rely more heavily on olfaction to orient and navigate in their environment. The goal of this project is to determine the extent to which vision loss alters olfactory perception and how the brain processes olfactory signals in the absence of vision. Specifically, here we examine how congenital blindness alters odor discrimination and cortex-wide sensory activity in head-fixed mice.

Methods: Sighted and congenitally blind mice ($GNAT^{1/2}$ mutants) were trained on a two-alternative forced-choice task to discriminate between two odors, and mixtures of the two odors. Mice initiated each trial by holding a spinning wheel still with their front paws and, after odor presentation, mice report the dominant odor by steering the wheel either leftward or rightward. In addition, widefield calcium imaging was performed over dorsal cortex in mice expressing the calcium indicator GCaMP8s. Brain activity was measured during passive presentation of odors and visual stimuli, as well as during the odor discrimination task.

Results: Both groups successfully learned the odor discrimination task. Among animals that reached criterion performance, blind mice showed faster learning rates and improved discrimination of odor mixtures. Preliminary widefield imaging data show that odor presentation drives widespread cortical activity in blind mice, including regions not typically associated with olfactory processing, including visual areas.

Conclusions: These findings suggest that early vision loss is associated with enhanced olfactory discrimination and may lead to significant cortical reorganization of odor processing. Ongoing experiments aim to compare cortical activity during task performance and causally test the role of cross-modal cortical activity in driving the improved behavioral performance observed in blind mice. This work will provide insight into how sensory systems reorganize following sensory loss and contribute to our understanding of the neural mechanisms underlying cross-modal plasticity.

3. NCAM1 Regulates Photoreceptor Axon Guidance and Synaptic Targeting During Retinal Development

Victor Pham Truong[1, 2, 3], Akshay Gurdita[1, 2, 3], **Jaeeun Lee**[1, 2, 3], Camille Lavoie[1, 2, 3], Valerie Wallace[1, 2, 3, 4, 5]

[1]Laboratory of Medicine and Pathobiology (LMP), [2]University of Toronto, ON, Canada [3]UHN Vision Science Research Program (VSRP), [4]Donald K Johnson Eye Institute, [5]Krembil Research Institute

Goal: Photoreceptor (PR) transplantation is a promising therapeutic strategy for degenerative retinal diseases such as macular degeneration and genetic retinopathies, which cause permanent PR loss and visual deficit. However, its success is limited by poor donor PR-host synaptic integration. Although the molecular composition of PR synapses is well characterized, the mechanisms coordinating PR axon outgrowth, laminar targeting, and transition to synaptic terminals remain poorly understood. This study aims to identify molecular regulators of PR axon guidance, focusing on Neural Cell Adhesion Molecule 1 (NCAM1) as a candidate temporal cue controlling rod axon targeting and synaptic connectivity.

Methods: NCAM1 was selected as a candidate gene based on its cell surface localization from bulk and single-cell PR RNA sequencing datasets, known roles in axon guidance, and temporal expression during development. RNAscope validated spatial and temporal expression patterns in murine retina at postnatal day 0 (P0), P7, and P14. Functional analysis of NCAM1 was performed using subretinal injection and electroporation of overexpression (OE) constructs or short hairpin RNA (shRNA) knockdown (KD) vectors at P0. Retinas were collected at P6 and P21, and analyzed by immunohistochemistry for axon targeting, synaptic organization, and terminal morphology. Quantitative analyses included outer plexiform layer (OPL) thickness and terminal phenotype classification (n = 2-4 animals per condition; Student's t-test). Ongoing work includes cell-type-specific Cre-mediated deletion of NCAM1 in rods, horizontal cells, and retinal progenitors to assess cell-autonomous roles in PR development.

Results: Previous work from our group validated temporally regulated expression of photoreceptor connectivity genes using RNAscope, establishing a framework to evaluate candidate regulators. Using this approach, NCAM1 exhibited dynamic isoform-specific expression, with transmembrane isoforms (Ncam140/180) predominating during axon extension and a shift toward the GPI-anchored Ncam120 isoform during synaptogenesis. Functionally, Ncam140 OE did not affect PR targeting or synapse formation. In contrast, Ncam120 OE significantly increased OPL thickness as assessed by VGLUT1 staining at P21 and induced ectopic horizontal and rod bipolar cell processes to extend into the outer nuclear layer ($p < 0.05$; n = 2-4). NCAM1 KD altered PR terminal morphology, producing enlarged pedicle-like terminals and axon branching (~10% of electroporated cells). At P6, NCAM1-deficient rods exhibited pronounced targeting defects, extending axons beyond the OPL and displaying displaced somas, consistent with impaired axon termination. Building on these findings, current work focuses on defining the cell-autonomous role of NCAM1 using conditional knockout approaches.

Conclusion: These findings characterize NCAM1 as a candidate regulator of rod photoreceptor axon targeting and terminal morphology, with isoform-specific roles across developmental stages. We propose that NCAM1 mediates adhesive interactions that signal precise axon termination within the OPL and stabilization of synaptic architecture. Elucidating these mechanisms may inform strategies to improve donor photoreceptor integration and enhance the efficacy of retinal cell replacement therapies.

4. Müller Glia-Mediated Light Transmission as a Potential Trigger for Cone Planar Cell Polarity in Mice

Melissa Villarreal Morales[1, 2], Michael Housset[2], Michel Cayouette[1, 2, 3]

[1]Université de Montréal, [2]Institut de Recherches Cliniques de Montreal, [3]McGill University, Montreal, QC, Canada

Background: Sensory organs often rely on coordinated spatial organisation to optimise function and neural output. Patterning of cellular asymmetries within the plane of a tissue is known as planar cell polarity (PCP).

Methods & Results: Recently, we discovered PCP in cone photoreceptors of mouse retinas, showing that their light sensitive cilium is systematically oriented towards the optic nerve head. Intriguingly, we found that this PCP is established by a non-canonical pathway requiring light exposure at the time of eye opening (P14). Because cones are located deep within the layered retina, it remains unclear how light reaches them to instruct PCP. A promising mechanism involves Müller glial cells, which span the full retinal thickness and have been proposed to act as optical waveguides. As Müller glia associate with cones in a stereotypic 1-to-1 fashion in mice, we hypothesize that they are responsible for patterning light transmitted to cones, thereby triggering PCP. To test this, we will emit light exclusively from Müller cells in dark-reared mice at P14 using bioluminescent tools. Conversely, we will disrupt Müller glia light transmission in light-reared mice by inducing melanin production. We predict Müller glia-driven photon emission will rescue PCP in their associated cones in dark-reared mice, whereas blocking transmission will prevent PCP despite normal light exposure.

Conclusions: If confirmed, this would demonstrate that sensory input takes part in mammalian development and identify light as a non-molecular morphogenic cue.

5. Exploring the Use of Artificial Intelligence Technologies Among Individuals Who Are Blind or Low Vision: Preliminary Findings from a Scoping Review

Razan Eltayeb[1], Mahboubeh Esmati[1], Sally Bailes[2, 3], Laura Creti[2, 3], Alice Havel[4], Eva Libman[2, 3], Natalina Martiniello[1, 5, 6]

[1]School of Optometry, Université de Montréal, QC, Canada [2]Jewish General Hospital, [3]Department of Psychiatry, McGill University, [4]Dawson College, [5]CRIR/Institut Nazareth et Louis-Braille du CISSS de la Montérégie-Centre, [6]CRIR/Centre de réadaptation Lethbridge-Layton-Mackay du CIUSSS du Centre-Ouest-de-l'Île-de-Montréal

Background & Goal: Artificial intelligence (AI) is increasingly embedded within appliances, applications, assistive technologies and accessibility solutions for individuals with disabilities, including those with visual impairments (VI). While there is evidence of the use of AI-based tools to facilitate diagnosis or assessment within vision rehabilitation, little remains known about the extent to which AI-based solutions are used by people with VI to facilitate personal, educational or employment related tasks. The goal of this scoping review is to synthesize existing research on the AI-based tools used by individuals with VI, the use of these tools across personal, educational and employment related tasks, and the factors influencing these decisions.

Methods: In accordance with the 2005 Arksey and O'Malley scoping review framework and the PRISMA-ScR guidelines, a comprehensive search of articles was conducted in PubMed, CINAHL, PsycINFO, SAGE Journals, ACM Digital Library, and ERIC databases in February 2026. Eligible articles include peer-reviewed primary studies published in English as of 2020 that explore the use of AI-based tools and their daily living applications among individuals with VI. Articles are screened independently by two researchers.

Results: Overall, the initial search resulted in 1978 articles, with 303 from PubMed, 50 from CINAHL, 82 from PsycINFO, 162 from SAGE Journals, 997 from ACM Digital Library, and 332 from ERIC. Title and abstract screening has been completed, with articles screened independently by two reviewers demonstrating high agreement (91.9%), a conflict rate of 8.2%, and substantial agreement beyond chance (Cohen's $\kappa = 0.62$). Full text screening and thematic content analysis is ongoing.

Conclusion: Emerging themes and their implications for practice will be presented. Results will highlight strengths and gaps in current AI research and will provide direction for future research that prioritizes user-centered design and accessibility. Moreover, findings will be used to inform vision rehabilitation practice and policy by clarifying how emerging AI-based accessibility tools are selected and integrated into training to better support the needs of clients with VI.

Funding: This study is supported by funding provided by the Social Sciences Humanities Research Council (SSHRC).

6. Single-Cell RNA-Seq Reveals Mechanisms of a Novel Therapy for Age-Related Macular Degeneration

Mohammed Ayan Chhipa[1], Anbukkarasi Muniyandi[2], Xierzhatijiang Sulaiman[2], Kamakshi Sishtla[1, 2], Gabriella Hartman[2], Jun Wan[2], Mark Kelley[2], Timothy Corson[1, 2]

[1]University of Toronto, Toronto, ON, Canada, [2]Indiana University, Indiana, IN, USA

Purpose: Age-related macular degeneration (AMD) is a leading cause of vision loss in older adults. Given the limitations of current anti-VEGF therapies, including invasive delivery and the incomplete efficacy of treatments across patient populations, novel treatments are needed. We have characterized APX2009, a small-molecule inhibitor of apurinic/apyrimidinic endonuclease 1/reduction-oxidation factor 1 (APE1/Ref-1), which modulates transcription factors involved in angiogenesis, inflammation, and cell growth. Our aim is to better understand the molecular pathways impacted by Ref-1 inhibition to enable the development of novel, less invasive treatments for AMD.

Methods: We performed single-cell RNA sequencing (scRNAseq) in the laser-induced choroidal neovascularization (L-CNV) mouse model, which recapitulates key features of neovascular AMD. Following L-CNV induction, 25 mg/kg APX2009 was given i.p. b.i.d. for 7 days. To validate differentially expressed genes, human retinal endothelial cells (HRECs) and choroidal endothelial cells (CECs) were treated with APX2009 followed by qPCR and immunoblot. Whole-mount L-CNV choroids were stained with isolectin B4 (IB4) and vimentin to assess neovascularization and fibrosis.

Results/Discussion: Immunofluorescent staining of L-CNV choroidal flatmounts revealed the expected significant decrease in IB4, as well as reduced vimentin staining, following treatment with APX2009. The expression of several genes was significantly altered in the choroidal endothelial cells of mice treated with APX2009 compared to sham (no L-CNV, no APX2009) and vehicle (L-CNV, no APX2009) controls. **Conclusion:** APX2009 treatment induces differential expression of genes and proteins important for the suppression of angiogenesis, both known and novel. To further investigate the anti-angiogenic roles of the targets identified in our scRNASeq data, we are using functional assays to study the impact of their knockdown on Ref-1 inhibitor treatment in CECs.

7. Cognitive State Modulates the Effect of Optogenetic Perturbation on Visual Perception

Amira K. Fadl[1], Jackson Cone[1]

[1]University of Calgary, AB, Canada

Goal: Visual perception depends not only on sensory input but also on the viewer's cognitive state at the time of visual stimulation. The primary visual cortex (V1) and superior colliculus (SC) have traditionally been thought to contribute to distinct aspects of visual processing (i.e., feature perception vs. orienting behaviours). However, a wealth of recent data suggests the role of SC may be more nuanced than previously thought. To further parse the respective roles of V1 and SC in perception and behaviour, we investigated whether the perceptual impact of optogenetic perturbations of V1 and SC is influenced by cognitive state.

Methods: We used a white-noise optogenetics technique previously developed by our team. Brief (25 ms), temporally randomized optical pulse trains were delivered to V1 or SC of mice expressing ChR2 in GABAergic interneurons while they performed a challenging visual detection task. This technique enables precise causal interrogation of *when* neuronal perturbations influence perception of visual stimuli. To uncover hidden structure in task performance, we applied a Hidden Markov Model (HMM) - a probabilistic method that infers hidden recurring states from sequential behavioural data - across all animals and sessions to identify discrete latent behavioural states. For each state, a Gaussian process Bayesian framework estimated the temporal kernel linking optogenetic stimulation patterns to visual stimulus detection with millisecond resolution. A sequential Bayes factor inclusion criterion filtered animals with unreliable optical fiber placement or weak signal, improving sensitivity across the large multi-animal dataset.

Results: We found that the impact of optogenetic inhibition on visual detection varied in a state-dependent manner. V1 and SC exhibited divergent patterns of state modulation. The impact of SC inhibition on performance was larger in one state compared to others, suggesting detection depended more strongly on SC activity in this state. In contrast, while task performance was strongly state-dependent in the V1 data, the impact of V1 inhibition did not appear to vary across states. Ongoing analyses will compare the impact of inhibition aligned to behavioural responses, where SC contributions to sensorimotor coordination are likely to differ from V1.

Conclusion: Our findings show that a subject's cognitive state is a key determinant for how neuronal signals from different early visual areas contribute to stimulus detection, with V1 and SC showing functionally distinct sensitivity profiles. The SC's role as a subcortical visual pathway, one that preserves direct retinal input even when cortical processing is impaired, makes these state-dependent dynamics particularly relevant for vision restoration. As optogenetic and other circuit-level interventions move toward clinical application, our results suggest that internal brain state is a critical variable in determining the efficacy of natural and artificial perception, as the same stimulus may yield profoundly different perceptual outcomes depending on the brain's current mode.

8. Dorsomedial higher visual cortex is a locus for visual attention in mice

Julia Forestell[1], Niklas Brake[1], Jonas Lehnert[2], Kuwook Cha[1], Sinan Shariff[3], Erik Cook[1, 2, 3], Arjun Krishnaswamy[1, 2, 3]

[1]Department of Physiology, McGill University, [2]Quantitative Life Sciences, McGill University, [3]Integrated Program in Neuroscience, McGill University, Montreal, QC, Canada

Background & Goal: Visual attention enhances detection of stimuli most relevant to the task at hand. Consistent with this view, electrophysiological work in non-human primates shows that attention improves visual neural sensitivity to cued stimuli. It is widely believed that such improved sensitivity is driven by modulation signals from higher cortical regions. However, the identity of such higher cortical areas and their targets in posterior visual cortical areas are poorly defined.

Methods & Results: To address this issue, we widefield imaged GCaMP6f signals from the entire dorsal cortex while mice visually searched for vertical bars presented at cued locations within checkerboard noise. By correlating GCaMP6f signals across the cortex to stimulus features at various screen locations, we found cue-dependent gain to vertical stimulus energy in a patch of dorsomedial higher visual cortex. The improved sensitivity to cued stimuli in this area appeared with training and was not present in untrained mice. Although primary visual cortex showed orientation tuning, it showed no measurable cueing effects. Ongoing optogenetic and anatomical tracing experiments aim to determine the necessity of this region for visual attention and to identify its inputs.

Conclusion: Overall, these results establish a cortex-wide imaging paradigm to identify attentional sources and sinks in the mouse cortex, and identify novel areas involved in attentional computations.

9. Multicellular Signaling Networks and Glycocalyx Remodeling in Proliferative Diabetic Retinopathy: A Single-Cell Transcriptomic Analysis

Carlos Freytas Palomo[1], Sergio Crespo-Garcia[1]

[1]School of Optometry, University of Montreal, QC, Canada

Objectives: The endothelial glycocalyx is a proteoglycan and glycoprotein layer covering the inner surface of blood vessels. In diabetic retinopathy (DR), glycocalyx undergoes shedding and remodelling, yet these mechanisms are largely unexplored. This project studies glycocalyx-associated signalling alterations in DR and intercellular communication networks that contribute to disease progression.

Methods: Various human retina single-cell RNA-seq datasets (~122,000 cells) were integrated with Harmony and annotated with CellTypist. We analysed 557-gene glycocalyx panel derived from MSigDB, literature curated gene sets and interactome resources. Differential expression and ligand-receptor interactions were assessed with DESeq2 and LIANA to reconstruct multicellular signalling networks.

Results: PDR exhibits a coordinated shift towards a pro-angiogenic and matrix-remodelling microenvironment, with endothelial activation, altered extracellular matrix composition and enhanced stromal-vascular communication. Glycocalyx-associated pathways, particularly the HSPG2-integrin axis, emerge across endothelial, perivascular and fibroblast populations. Collagen-integrin interactions indicate basement-membrane reorganisation, while VWF-mediated signalling and DLL4-NOTCH activation highlights tip-cell programmes driving pathological angiogenesis.

Conclusion: Glycocalyx remodelling functions act as a multicellular signalling hub beyond endothelial biology and integrate extracellular matrix dynamics and stromal crosstalk in PDR driven by perivascular cells. Collectively, these notions suggest that coordinated disease-associated networks relevant to glycocalyx remodelling could have potential therapeutic relevance in DR beyond VEGF signalling.

10. Genetic rescue restores visual function in a mouse model of CSNB2A

Jiashu Liu[1, 2], Xinyan Liang[3], **Milena Russo**[2], Sowmya Lokappa[3], Rikard Frederiksen[4], Alana Madura[3], Kasey Rose[3], Ruitong Li[5], Annabelle N. Tran[4], Alapakkam P. Sampath[4], Baohua Liu[2, 5], Jeannie Chen[3]

[1]Department of Anesthesiology, Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine, China, [2]Department of Cell & Systems Biology, University of Toronto, ON, Canada, [3]Department of Physiology and Neuroscience, Zilkha Neurogenetic Institute, Keck School of Medicine, University of Southern California, CA, USA, [4]Department of Ophthalmology, Jules Stein Eye Institute, University of California, LA, USA, [5]Department of Biology, University of Toronto, ON, Canada

Background & Aim: Congenital stationary night blindness type 2A (CSNB2A) is an inherited retinal diseased characterized by visual impairments such as night blindness, decreased visual acuity, and mildly impaired photopic vision. This disorder is caused by mutations in the *Cacna1f* gene, which encodes the pore-forming subunit of Cav1.4. Without functional Cav1.4, glutamate release by rod and cone photoreceptor cells does not occur, leading to functional degradation of the synapse accompanied by stereotypical anatomical changes like axon retraction, formation of ectopic contacts and gliosis. While gene therapy has shown promise in recent years to treat inherited brain and eye diseases, it is unknown whether anatomical changes in neural circuits can support functional recovery after the repair or rescue of genes in affected neurons.

Methods & Results: Here, we developed a novel conditional rescuable *Cacna1f* knockout (FLEX-*Cacna1f*-KO) mouse model of CSNB2A, which allows for inducible expression of *Cacna1f* uniformly across the retina at desired ages. Using immunofluorescence, we first show that FLEX-*Cacna1f*-KO mice lack Cav1.4 expression, impeding synaptic assembly. Next, we used the optokinetic reflex (OKR) to assess the visual functions of these mice. We found that FLEX-*Cacna1f*-KO mice had severely compromised OKR under scotopic conditions and mildly affected OKR under photopic conditions, a phenotype that recapitulates common symptoms of many CSNB2A patients. Next, to initiate genetic rescue, we crossed our FLEX-*Cacna1f*-KO mice with an inducible ubiquitously expressed Cre mouse line, *Cre-ER*. Upon administration of tamoxifen, the full-length *Cacna1f* transcript was generated, Cav1.4 expression was restored, and molecular assembly of synaptic protein ensued, forming functional synapses, even at ectopic locations. To examine whether such synaptic assembly could support the recovery of visual functions, we measured OKR of these mice after administering tamoxifen and observed a striking recovery in scotopic and photopic OKR such that their visual functions were reinstated to wild-type levels. Finally, to assess whether genetic rescue can still effectively restore visual functions in older animals, we induced *Cacna1f* rescue in mature adult mice and late middle-aged mice by supplying tamoxifen at these ages. Notably, the visual impairments in all age groups were substantially alleviated, though the extent of recovery gradually declined with age.

Conclusion: Overall, our study provides compelling evidence that genetic rescue can recover the functional phenotypes of *Cacna1f* KO mice from young adulthood to middle age. This highlights the promise of gene therapy for restoring vision in CSNB2A and other inherited retinal diseased characterized by remodeled neural circuits.

11. Role of cofilin1 in regulating photoreceptor synaptic transmission and its implications for retinal function

Sydney Lin[1], Alecia Gross[1]

[1]Department of Neurobiology, Heersink School of Medicine, University of Alabama at Birmingham, Birmingham, AL, USA

Purpose: Cofilin1 (CFL1) regulated actin dynamics, play a critical role in maintaining photoreceptor structure and function. We have observed rhodopsin mislocalization in transgenic *Xenopus laevis* rod CFL1 phosphomutants. Here, we investigate compensatory mechanisms that provide the observed recovery phenotype in rod-specific CFL1 knockout (r*Cfl1*$^{-/-}$) mice.

Methods: We are evaluating rod-specific CFL1 knockout (r*Cfl1*$^{-/-}$), heterozygote (r*Cfl1*$^{-/+}$), and wild type mice at 3-weeks, 6-weeks, and 12-months of age. We have performed electroretinograms (ERGs) to evaluate functional deficits within the retina. Immunohistochemistry on retinal cryosections was performed to assess the localization of rhodopsin; synaptic proteins, including bassoon and ribeye; as well as markers of actin dynamics including as phalloidin, gelsolin, and destrin. Rod ultrastructure is being examined using transmission electron microscopy to visualize changes in outer segment nascent discs and synaptic ribbon morphology. Additionally, actin pool assays are being utilized to quantify the F-actin and G-actin ratios at 3-weeks, 6-weeks, and 12-months of age. Quantitative western blot analyses are being performed to reveal potential upregulation of other actin-severing proteins, such as gelsolin, profilin, severin, and destrin. Data-independent acquisition massspectrometry-based proteomics was performed on whole retinal tissue to identify compensatory mechanisms with the loss of CFL1.

Results: ERGs in 3-week-old r*Cfl1*$^{-/-}$ mice showed diminished scotopic and photopic amplitudes, which are resolved to that of wild type by the age of 6-weeks-old, and diminished by 12-months-old. We have observed mislocalization of rhodopsin in the outer nuclear layer at 3-weeks-old that resolves by 6-weeks-old. There is also an increase in an alternative actin severing protein, gelsolin, in the r*Cfl1*$^{-/-}$ mice first observed at 3 weeks and sustained at 6 weeks. We have ongoing experiments which will provide insights into structural, functional, and molecular adaptations at the photoreceptor synapse. We expect to see significantly higher F-actin to G-actin ratios at the 3-week time point in r*Cfl1*$^{-/-}$ mice which resolve to that of wild type mouse levels as well as increased expression of alternative actin-severing proteins by 6 weeks. Additionally, we expect mislocalization of critical proteins such as ribeye and bassoon at the photoreceptor synaptic ribbon and an altered presence of synaptic vesicles.

Conclusions: This study highlights the essential role of CFL1 in maintaining photoreceptor synaptic function and retinal signaling. The transient decrease and subsequent recovery of ERG amplitudes in r*Cfl1*$^{-/-}$ mice suggest the activation of compensatory, actin-dependent mechanisms. Our findings are anticipated to reveal key dynamic changes in actin cytoskeleton remodeling and key rod structural components, advancing our understanding of retinal homeostasis and the adaptability of photoreceptor synaptic architecture.

12. Intelligence artificielle pour la navigation intérieure des personnes ayant une déficience visuelle au Canada: une étude de co-conception participative et interdisciplinaire de la plateforme Edge A Eye

Soutongnoma Safiata Kaboré[1,2], Deborah Annan[1,2], Prajjol Raj Puri[1,2], Sergio Mejia Romero[1], Kim Khoa Nguyen[5], Hassane Alami[3,4], Joseph Paul Nemargut[1,2,6,7]

[1]École d'optométrie, Université de Montréal, Montréal, QC, Canada, [2]Centre de Recherche Interdisciplinaire en Réadaptation du Montréal métropolitain, Montréal, QC, Canada, [3]École de santé publique, Université de Montréal, QC, Canada, [4]Centre de recherche en santé publique, Montréal, QC, Canada, [5]École de technologie supérieure, ÉTS, Montréal, QC, Canada, [6]Institut Nazareth et Louis-Braille du Centres Intégrés de Santé et de Services Sociaux de la Montérégie-Centre, Longueuil, QC, Canada, [7]Centre de Réadaptation Lethbridge-Layton-Mackay du Centrés Intégrés Universitaires de Santé et de Services Sociaux du Centre-Ouest-de-l'Île-de-Montréal, Montreal, QC, Canada

Objectif: Co-concevoir un système de navigation intérieure autonome, accessible et sécuritaire reposant sur l'intelligence artificielle, afin de soutenir le déplacement des personnes en situation de handicap visuel (PSHV) au Canada. L'objectif central est de développer une technologie inclusive, adaptée aux environnements intérieurs complexes, et fondée sur les besoins réels exprimés par les utilisateurs.

Méthodologie: Une étude qualitative, participative, intersectorielle et centrée sur l'utilisateur a été menée entre mai 2024 et mai 2026 auprès de 55 membres d'un consortium de co-design. Les participants incluaient des PSHV, des professionnels de la réadaptation visuelle, des chercheurs en sciences de la vision, des concepteurs technologiques et des partenaires industriels. Les données ont été recueillies à travers : 1) des entretiens semi structurés (n = 2) ; 2) des groupes de discussion (n = 12) ; 3) des ateliers de co conception (n = 21) ; 4) des scénarios réels de navigation intérieure (n = 13) ; 5) des sessions de navigation avec la plateforme Edge A Eye (n = 7). L'analyse thématique, soutenue par une triangulation rigoureuse des sources, a guidé l'interprétation des données en respectant les critères de scientificité, les principes de recherche participative et les considérations éthiques liées à la collaboration avec des PSHV.

Résultats: Les PSHV, engagés comme co chercheurs, ont joué un rôle déterminant dans la définition des priorités de conception, la spécification des modalités d'interaction, la validation des résultats et l'évaluation de l'utilisabilité en contexte réel. Les besoins identifiés sont hétérogènes, multidimensionnels et interreliés, dépassant largement le simple guidage directionnel. Ils incluent : 1) l'accessibilité physique; 2) l'accessibilité virtuelle ; 3) la confidentialité et la sécurité. Le système intelligent de navigation intérieure développé intègre plusieurs fonctionnalités clés : activation intuitive par commande vocale, instructions séquentielles claires, interface accessible, réorientation spatiale rapide par secouement du dispositif, et modes de navigation adaptés aux préférences des utilisateurs. Dans une dynamique d'amélioration continue, les ajustements sont récurrents avec l'intégration d'autres fonctionnalités.

Conclusion: La participation active des PSHV en tant que co-chercheurs renforce la pertinence clinique, fonctionnelle et sociale des exigences de conception. Cette approche intersectorielle dépasse les modèles technocentrés de développement en IA et favorise des solutions plus acceptables, utilisables et ancrées dans les réalités quotidiennes. Les résultats confirment le potentiel de la plateforme Edge A Eye ainsi que les ajustements nécessaires pour garantir une navigation intérieure véritablement inclusive. Le projet illustre la valeur d'une innovation responsable et participative pour faire progresser les pratiques de réadaptation, l'accessibilité et la conception inclusive de l'intelligence artificielle.

13. The OPTN N51T Variant Increases Retinal Ganglion Cell Vulnerability to Ocular Hypertension

Lydia Aizel[1], Barbara Morquette[1], Nicolas Belforte[2], Adriana Di Polo[2], Yukihiro Shiga[1]

[1]Department of Ophthalmology, Maisonneuve-Rosemont Hospital Research Centre, Université de Montréal, Montreal, QC, Canada, [2]Neuroscience Division, Centre de recherche du Centre Hospitalier de l'Université de Montréal (CR-CHUM), Montreal, QC, Canada

Goal: Optineurin (OPTN) is a highly conserved adaptor protein involved in mitochondrial quality control and cellular stress responses. Pathogenic OPTN variants have been implicated in normal-tension glaucoma (NTG), including the well-established E50K mutation and the N51T variant recently identified by our group. Although lowering intraocular pressure (IOP) remains the only evidence-based therapy even in NTG, the mechanisms underlying its protective effect remain poorly understood. We therefore tested whether OPTN mutations alter retinal ganglion cell (RGC) susceptibility to ocular hypertension and whether IOP lowering can rescue mutation-dependent vulnerability.

Methods: OPTN E50K and N51T knock-in mice were generated using CRISPR/Cas9 genome editing. Ocular hypertension was induced by microbead occlusion of the iridocorneal angle. Experiments were performed in adult six-month-old mice, an age at which mutant animals showed no baseline RGC loss.
RGC survival was quantified in retinal flat mounts by counting Brn3a-positive cells using a Python-based automated pipeline with StarDist deep-learning segmentation. Quantification was performed four weeks after ocular hypertension, when significant RGC loss occurs in wild-type mice. Agreement between automated and manual counting was evaluated using the intraclass correlation coefficient (ICC). The investigator was blinded to genotype and treatment during the analysis.
Visual function was assessed using the optokinetic response (OKR). Visual acuity was measured at baseline and four weeks after ocular hypertension, and the change in spatial frequency thresholds was calculated for longitudinal analysis. In a subset of animals, the clinically used carbonic anhydrase inhibitor, brinzolamide, was administered topically once daily starting two weeks after injury and continued until four weeks after induction, to determine whether IOP lowering rescues mutation-dependent susceptibility. In parallel, integrated bulk RNA sequencing and metabolomic analyses are planned to investigate molecular mechanisms underlying increased pressure sensitivity.

Results: Automated RGC quantification using the StarDist pipeline showed excellent agreement with manual counting (ICC = 0.992), confirming the high reliability and reproducibility of the automated analysis. Following microbead-induced ocular hypertension, N51T mice exhibited significantly greater RGC loss compared with littermate wild-type controls, whereas E50K mice did not show a significant difference relative to wild-type animals. Strikingly, treatment with brinzolamide significantly reduced RGC loss in N51T mice, with RGC density comparable to that observed in wild-type mice subjected to ocular hypertension. Functional assessment showed a similar pattern: N51T mice exhibited a greater decline in visual acuity after ocular hypertension than wild-type controls, whereas brinzolamide treatment prevented this additional loss of visual function.

Conclusions: The OPTN N51T mutation increases retinal ganglion cell vulnerability to ocular hypertension. Lowering IOP effectively rescues both structural and functional deficits associated with this mutation. These findings suggest that an OPTN mutation can modulate neuronal sensitivity to pressure stress, providing insight into mechanisms underlying glaucoma susceptibility and the continued benefit of IOP-lowering therapy in NTG.

14. A Parameterizable Light-Dark Box for Studying Light Avoidance and Screening Vision Loss/Restoration

Matthew Loukine, Aude Villemain, Mingyu Wan, Keila Rojas Garcia, Brune Bettler, Stuart Trenholm

Montreal Neurological Institute, McGill University, Montreal, QC, Canada

Goal:

Methods:

Results:

Conclusion:

15. Coségrégation des haplotypes BMP2 et JAG1, deux gènes candidats comme modificateurs de l'âge d'apparition du glaucome sur le chromosome 20p12, dans une grande famille canadienne-française atteinte de la forme autosomale dominante de la maladie

Inass Yasmi[1, 2], Philippe Morneau-Cartier[1, 2], Patrick Laplante[1], Audrey-Anne Lapierre[1, 2], Félix Plamondon[1, 2], Kristina Bushila[1], Pascal Belleau[3], Rose Arseneault[1], Micheal A. Walter[4], Vincent Raymond[1, 2]

[1]Centre de recherche du CHU de Québec-Université Laval, Québec, QC, Canada, [2]Faculté de Médecine, Université Laval, Québec, QC, Canada, [3]Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, USA, [4]School of Medicine, University of Alberta, Edmonton, AB, Canada

But : Le glaucome est une maladie génétique dont la sévérité est modulée par des interactions gène-gène. Dans la grande famille canadienne-française CA, la mutation *MYOC*^{K423E} du gène *Myociline* cause un glaucome primaire à angle ouvert (GPAO) autosomique dominant. Toutefois, les porteurs hétérozygotes *MYOC*^{K423E} présentent des âges d'apparition très variables pour la maladie. Cette variabilité suggère l'existence de gènes modificateurs de l'âge d'apparition du GPAO. Une cartographie du génome humain a identifié sur le chromosome 20p12 un locus de 10 cM, nommé *MOG2*, susceptible de contenir un gène modificateur. Comme les gènes *BMP2* (sentier BMP/TGF-β) et *JAG1* (ligand Notch) sont situés à proximité dans *MOG2*, nous avons émis l'hypothèse qu'un de ces deux gènes pourrait influencer l'âge d'apparition du GPAO. Pour tester notre hypothèse, notre objectif fut de déterminer si *BMP2* et/ou *JAG1* portaient des haplotypes compatibles avec le rôle de modificateur. Nous avons examiné si les variants single nucleotide polymorphisms (SNPs), qui définissent les haplotypes à *BMP2* et à *JAG1,* coségrégeaient ensemble ou s'ils ségréguaient de façon indépendante.

Méthode : Le séquençage Sanger de *BMP2* et *JAG1* a été réalisé chez 110 membres du pedigree afin d'identifier des SNPs informatifs. Ces SNPs ont été phasés manuellement pour reconstruire les haplotypes de chaque gène au sein des noyaux familiaux. Les haplotypes *BMP2* et *JAG1* ont ensuite été comparés à l'échelle du pedigree afin d'évaluer leur coségrégation ou la présence de recombinaisons. Les haplotypes discordants ont été validés à l'aide des bases de données UCSC et Ensembl.

Résultats : Nous avons identifié 34 SNPs dans *BMP2* et 119 SNPs dans *JAG1*, majoritairement situés dans des régions non codantes, sans variant affectant la séquence protéique. Au total, 220 chromosomes couvrant la région 20p12 ont été phasés. Aucune recombinaison n'a été observée dans 217 des 220 haplotypes. Parmi les trois recombinaisons détectées, deux étaient localisées entre *BMP2* et *JAG1* et une dans l'intron 4 de *JAG1*. Ainsi, 99 % des haplotypes *BMP2* coségréguaient avec ceux de *JAG1*, un résultat conforme aux probabilités attendues pour une région de 4 cM couvrant environ 3,8 Mb. Des haplotypes d'intérêt ont également été identifiés dans des régions conservées des 3'UTR de *BMP2* et *JAG1*, suggérant un rôle potentiel dans la stabilité des ARNm.

Conclusion : Ces résultats démontrent une forte coségrégation des haplotypes de *BMP2* et de *JAG1* dans le locus *MOG2*. Cette observation est compatible avec un rôle modificateur de ces deux gènes candidats sur l'âge d'apparition du glaucome lorsque la maladie est causée par une mutation du gène *MYOC*.

16. Clinicopathological Correlation of Neoplastic Epithelial Lesions of the Conjunctiva

Mehdi Ledjiar[1], Raphael Macaron[1], Sabrina Bergeron[1], Coralie Lefebvre[1], Emilia Olivier[1], Eduardo Ballalai Bordon[1], Massimo Mazza[1], Miguel Noel Burnier[1]

[1]MUHC-McGill University Ocular Pathology and Translational Research Laboratory, Montreal, QC, Canada

Goal: Conjunctiva is the second most common site of benign and malignant ocular lesions. Premalignant and malignant conjunctival epithelial lesions are important due to the risk of malignant transformation, invasion, progression and recurrence. This study aims to characterize the demographic distribution and the clinicopathological characteristics of such lesions.

Methods: From 10 905 ocular lesions, analyzed at the MUHC-McGill University Ocular Pathology and Translational Research Laboratory, from 2006 to 2023, 1572 conjunctival lesions were reviewed. Of this total, 112 premalignant and malignant conjunctival epithelial lesions were characterized. Age, sex, laterality, lesion type, clinical and pathological diagnosis was analyzed.

Results: Of the 1572 conjunctival lesions, 112 (7.12%) were premalignant and malignant. Out of the 112, 82.1% (n=92) were premalignant and 17.9% (n=20) malignant. The mean patient age was 66.2 years (range 29-92), 66 (29-89) years for premalignant, 67 (34-92) years for malignant lesions. Conjunctival intraepithelial neoplasia (CIN) Grades I to III, represented most premalignant lesions (89.1%, n = 82) while squamous cell carcinoma (SCC) was the most common malignant tumor (90%, n = 18). Equal sex representation (55 males: 56 females) with a male predominance in malignant lesions (60%; n =12) and actinic keratosis (AK) (80%, n=8/10). Most CIN Grade I's were seen in females (66.7%; n= 24/36). Most malignant lesions occurred in the left eye (65%; n = 13). In CIN cases, the average age increased with CIN grade: 62.9 for CIN I (n=36), 66.7 for CIN II (n=21) and 70.6 for CIN III.Overall, accurate clinicopathological correlation was found in 67.9% with the lowest seen in AK (20%) and the highest in CIN I (80.6%). Of the 5 SCC cases under 45, 3 cases had a diagnosis of HIV/AIDS.

Conclusions: CIN and SCC were the most common premalignant and malignant lesions, with age rising alongside CIN grade. SCC cases in patients ≤45 years were linked to HIV/AIDS, supporting the role of immunosuppression in early-onset malignancy. Clinicopathological correlation is essential for the final diagnosis. This study highlights the clinical challenges of these lesions and support the need for histopathological confirmation of all conjunctival lesions, particularly the ones with malignant potential.

17. DOCK-Mediated Photoreceptor Axon Guidance in Drosophila

Eman Abdulla[1], Yong Rao[1]

[1]Integrated Program in Neuroscience, McGill University, Montreal, QC, Canada

Background & Aim: Precise axon guidance is essential for the formation of functional neural circuits. In *Drosophila melanogaster*, photoreceptor neurons rely on tightly regulated molecular pathways to reach their correct targets in the medulla. While cytoskeletal regulators such as DOCK are known to play a role in axon guidance, their interaction with adhesion molecules like Chaoptin remains poorly understood. This study investigates the role of DOCKP1 in photoreceptor axon targeting and examines whether Chaoptin expression is modulated in response to DOCKP1 disruption.

Methods: Third instar larval eye-brain complexes and eye discs were dissected from wild-type and dockp1 mutant flies. Confocal microscopy was used to assess photoreceptor axon targeting within the medulla. Gene expression levels of chaoptin were quantified using quantitative polymerase chain reaction (qPCR), with RPL32 and Act5C serving as reference genes. Comparative analyses were conducted between wild-type and mutant samples, between eye disc and eye- tissues, to evaluate both structural and molecular differences.

Results: DOCKP1 mutants exhibited clear defects in photoreceptor axon targeting, with axons failing to properly innervate their designated medulla layers. Structural analysis revealed disorganization in photoreceptor projections compared to wild-type controls. qPCR results demonstrated an upregulation of chaoptin expression in dockp1 mutants, suggesting a potential compensatory or regulatory response. Additionally, differences in expression patterns between eye discs and eye-brain complexes indicated tissue-specific regulation of chaoptin.

Conclusions: These findings suggest that DOCKP1 plays a critical role in photoreceptor axon guidance and may influence or interact with adhesion molecules such as Chaoptin. This study contributes to a deeper understanding of the molecular mechanisms underlying neural circuit formation. Elucidating these pathways may provide broader insights into neurodevelopmental processes and inform future research in neural repair and regenerative strategies.

18. Temporal Inhomogeneity in Processing Effectiveness: Oscillatory Visual Mechanisms in Amblyopia Revealed by Random Temporal Sampling

Sevi Parr[1], Alexandre Reynaud[1]

[1]McGill University, Montreal, QC, Canada

Background & Aim: Amblyopia is a neurodevelopmental disorder of the visual cortex characterized by (most commonly) unilateral reduction in visual acuity arising from atypical visual experience during the critical period of early childhood. Unlike conditions rooted in structural ocular pathology, amblyopia reflects aberrant cortical processing, wherein competitive interactions between the two eyes result in sustained suppression of input from the affected eye. While established treatment modalities, including optical correction (glasses or surgery), occlusion therapy (patches), and pharmacological penalization of the fellow (unaffected) eye, are means to try to reduce the suppression, the underlying perceptual processing in amblyopic individuals remain poorly understood.
Converging evidence suggests that visual perception, like broader neural function, is fundamentally oscillatory in nature, arising from periodic synchronized neuronal firing that manifests as rhythmic fluctuations in perceptual effectiveness. Prior research has established that spatial attention operates at 5-8 Hz, driven by oscillatory activity in the high-theta and low-alpha frequency bands. We extend this framework to the domain of visual processing efficiency, hypothesizing that perceptual effectiveness is similarly periodic and that this periodicity can be characterized through random temporal sampling; this is a paradigm in which stimulus presentation frequency is varied systematically to identify the temporal windows during which perception is most effective.

Methods: In the present study, we adapt the random temporal sampling paradigm, previously applied exclusively to participants with normal or corrected-to-normal vision, for use with amblyopic populations. Participants were presented with brief lexical stimuli (six letters or fewer) drawn from a 800-item pool spanning four semantically distinct categories and were required to categorize each word under conditions of varying signal-to-noise ratio. Stimulus presentation frequency varied across trials at up to 72 Hz via a random flickering function, and threshold was determined through a staircase procedure anchored at 50% correct performance, well above the 25% chance baseline. Testing was conducted separately for the amblyopic eye, the fellow eye, and both eyes combined across three blocked conditions.

Results: We hypothesize that mapping perceptual accuracy against temporal frequency will reveal oscillatory "heat maps" of processing effectiveness, and that these maps will differ systematically between the amblyopic and fellow eyes, as well as between amblyopic participants and controls, a pattern not previously documented in the literature. Analyses will assess both intra- and inter-participant reliability, with particular attention to whether the temporal profiles observed generalize across individuals as robustly as prior work with non-clinical populations has suggested.

Conclusion: These findings would provide novel evidence for eye-specific differences in the temporal architecture of visual processing in amblyopia, with potential implications for understanding cortical suppression and refining rehabilitative interventions.

19. The effects of gender-affirming hormone therapy on the function and structure of the eyes

Xin Yi Li[1], Charlotte Bertrand[1], Juliette Boucher[1], Marie-Lou Garon[1], Sergio Crespo-Garcia[1]

[1]School of Optometry, University of Montreal, QC, Canada

Goal: Biological sex is a systemic variable largely influenced by the levels of sex hormones. The receptors for sex hormones are ubiquitously expressed in all tissues, including the eye. However, optometric guidelines have traditionally relied, almost exclusively, on cisgender data and overlooked the unique physiological profiles of trans individuals undergoing gender-affirming hormonal therapy (GAHT). This project will examine ocular biometrics in trans-persons and whether these shift away from cisgender baselines.

Methods: We assessed ocular biometrics in transgender individuals following masculinizing (N=10) and feminizing (N=8) hormone therapy for ≥2 years. Age- and sex-matched cisgender men and women without hormonal therapy are recruited as control (N=18). We performed a comprehensive optometric exam and quantified intraocular pressure, central corneal thickness, tear film and osmolarity, and dry-eye disease severity (using OSDI-6). Retinal function was examined with scotopic and photopic ganzfeld electroretinography (ERG), and retinal structure is studied with optical coherence tomography angiography (OCT-A).

Results: Despite we observed some sex-driven differences in ERG, our preliminary dataset was not sufficient to detect clear differences in other ocular parameters between trans- and cis-gender individuals.

Conclusions: Given the small sample sizes, future studies should investigate ocular parameters with more participants, and we will correlate ocular parameters to the levels of sex hormones in the saliva. Our results, even if negative, are necessary to validate current cisgender guidelines and their applicability to persons undergoing GAHT.

20. Le donepezil prévient la réduction de densité des filets périneuronaux autour des interneurones exprimant la parvalbumine dans le cortex visuel primaire suivant une lésion rétinienne

Odile Désaulniers[1], Abdel-Rahamane Kader Fofana[1, 2], Elvire Vaucher[1]

[1]École d'optométrie, Université de Montréal, [2]Département de Neurosciences, Université de Montréal, QC, Canada

Introduction et but : La potentialisation cholinergique via l'inhibiteur de l'acétylcholinestérase donepezil (DPZ) améliore la plasticité corticale et l'apprentissage perceptuel lors d'entraînements visuels, impliquant possiblement les interneurones inhibiteurs à parvalbumine (PV+) et leurs filets périneuronaux associés (PNNs). Ces structures jouent un rôle clé dans la régulation de la plasticité corticale en contrôlant la balance excitation-inhibition, et leur intégrité est essentielle au maintien d'une connectivité fonctionnelle corticale normale. Notre étude examine si le DPZ module l'intégrité de ces circuits inhibiteurs en contexte de déficit visuel, via des modifications structurelles des cellules PV+ et des PNNs dans le cortex visuel primaire.

Méthodes : Un déficit rétinien a été induit unilatéralement par photocoagulation au laser dans le quadrant dorso-temporal de souris adultes C57BL/6, afin de provoquer une néovascularisation choroïdienne (CNV). Les animaux ont reçu, ou non, un traitement quotidien de DPZ (0,3 mg/kg, sous-cutané). Les effets ont été examinés dans le cortex visuel primaire à deux et sept jours post-lésion. Les modifications de densité des PNNs et des interneurones PV+ ont été analysées par immunohistochimie et quantifiées à l'aide de modèles de détection basés sur l'apprentissage profond. La récupération visuelle a été évaluée de façon comportementale par le test de la falaise visuelle.

Résultats : À deux jours post-CNV, une réduction significative de la densité des PNNs ainsi que des cellules doublement marquées PV+/PNN+ a été observée chez les souris non traitées, un effet aboli par l'administration de DPZ. Ces changements étaient les plus prononcés dans les couches corticales 2/3 et 5, tandis que la couche 4, couche thalamorécipiente primaire, n'a pas été affectée. Cette dissociation laminaire suggère que la perte d'influx rétinien affecte préférentiellement le traitement cortical de haut niveau plutôt que la transmission thalamocorticale directe. À sept jours post-lésion, des effets similaires ont persisté, mais se sont restreints à la couche 2/3. Par ailleurs, une réduction de la densité des interneurones PV+ a également été observée à sept jours post-CNV, reflétant possiblement une régulation adaptative de l'expression de la parvalbumine en réponse à la perte prolongée d'influx sensoriel. Sur le plan comportemental, les souris traitées au DPZ ont présenté une meilleure récupération visuelle ainsi que de meilleures performances lors du test de la falaise visuelle.

Conclusion : Ensemble, ces résultats suggèrent qu'une réduction de l'influx rétinien perturbe la connectivité fonctionnelle interlaminaire dans le cortex visuel, particulièrement au sein des couches supragranulaires. La potentialisation cholinergique induite par le DPZ, via l'augmentation de la disponibilité synaptique de l'acétylcholine, pourrait préserver cette connectivité en stabilisant l'organisation des circuits inhibiteurs, notamment en maintenant l'intégrité structurelle des PNNs entourant les interneurones PV+. Ce mécanisme influencerait ainsi la balance excitation-inhibition dans les couches supragranulaires et favoriserait l'intégration corticale lors de la récupération visuelle.

21. A comparison of methods for assessing detection and discrimination of depth in tasks of local and global stereopsis

Tara Nichols[1], Alex Baldwin[1]

[1]Department of Ophthalmology and Visual Sciences, McGill University, Montreal, QC, Canada

Goal: Some individuals with clinically normal vision show selective deficits in stereopsis tasks, particularly when required to discriminate the direction of depth rather than simply detect its presence. This phenomenon, often referred to as stereoanomaly, has been reported in previous studies, with prevalence estimates ranging from approximately 2% to 30%, depending on the task and stimuli used. Prior work has employed stimuli that preferentially engage either local stereopsis (monocularly identifiable edges or shapes) or global stereopsis (random-dot patterns). There has been little work comparing performance (to identify stereoanomaly) between tasks using these two stimulus types. There has been little work comparing performance (to identify stereoanomaly) between tasks using these two stimulus types. Additionally, differences in stimulus presentation methods (such as anaglyph glasses versus interleaved-line stereoscopic displays) may influence measured stereopsis thresholds and contribute to variability across studies. The goal of the present study was therefore to compare stereopsis performance across local and global detection and discrimination tasks and to examine whether the prevalence of stereoanomalous performance differs depending on the display method used.

Methods: Participants with clinically normal visual acuity and no known binocular vision disorders complete four stereopsis tasks: local detection, local discrimination, global detection, and global discrimination. The inclusion of four tasks allows us to examine whether individual differences in stereopsis performance are more strongly influenced by stimulus type (local vs. global) or by task demands (detection vs. discrimination). In addition to comparing task types, the experiment incorporates test-retest measurements across three dichoptic presentation methods. The first method uses interleaved-line stereopsis presented on a CRS display viewed through polarized lenses. The second method uses red-green anaglyph glasses presented on the same monitor as the interleaved-line condition. The third method uses a tablet-based version of the task employing anaglyph presentation on an iPad, designed to replicate the procedures used in a previous study.

Results: Preliminary results indicate that performance on the local discrimination task diverges from the other three tasks. Specifically, some participants who performed well on detection tasks and on global discrimination showed reduced performance when required to discriminate depth direction in the local stimulus condition, suggesting that this task may rely on partially distinct perceptual mechanisms. In contrast, a strong relationship was observed between global detection and global discrimination performance. This agreement appears stronger than that reported in some previous studies, although additional participants will be required to confirm the magnitude of this relationship.

Conclusions: The relationships among these four tasks suggest that they may provide a minimal set of complementary measurements capable of characterizing the stereopsis phenotype of an individual by probing different components of stereoscopic processing. Importantly, evaluating performance across multiple display methods may further refine this characterization.

22. Examining Interocular Delays as a Marker of Binocular Dysfunction in Amblyopia

Brooke Lim[1], Alexandre Reynaud[1, 2]

[1]McGill Vision Research, Department of Ophthalmology and Visual Sciences, McGill University, [2]Centre for Digital Brain Therapies, BRaIN Program, Research Institute of the McGill University Health Centre, Montreal, QC, Canada

Background & Aims: Many everyday visual tasks depend on binocular vision, which requires precise timing of signals from both eyes. In amblyopia, binocular integration is impaired and often includes suppression of the amblyopic eye. Recent work from our lab has demonstrated that visual information from the amblyopic eye can be delayed by up to 40 ms compared to the fellow eye. However, it remains unclear whether these interocular delays reflect a core marker of binocular dysfunction in amblyopia. **We hypothesize that interocular delay is a marker of binocular imbalance in amblyopia and should therefore be related to established measures of binocular function and remain stable over time.**
To test this hypothesis, we addressed two aims:
Aim 1: Determine whether interocular delay correlates with established clinical and psychophysical measures of binocular function, specifically stereoscopic depth perception and suppression.
Aim 2: Evaluate the stability of interocular delays over time.

Results: Interocular timing was measured using a monocular tracking task in which participants continuously tracked a moving target, providing an estimate of relative processing speed between the eyes. Stereoscopic depth perception was assessed using a rotating structure-from-motion cylinder, where binocular disparity was systematically varied. Suppression strength was measured using a dichoptic contrast-ordering task, thereby providing an index of each eye's contribution to binocular perception. The stability of these measurements was also assessed by retesting a subset of the same participants after three months.

Results: Preliminary results show that individuals with amblyopia exhibit poorer depth perception, greater interocular suppression, and slower visual processing in the amblyopic eye compared with controls. Interocular delay correlated with suppression strength, suggesting that differences in temporal processing may reflect binocular imbalance. Across sessions, interocular delay, suppression, and depth perception measures showed good stability.

Conclusion: Together, these findings suggest that interocular delay may reflect a stable feature of binocular dysfunction and could provide a useful complementary measure for characterizing amblyopia. Understanding how differences in temporal processing relate to suppression and stereoscopic perception may help identify more sensitive markers of binocular imbalance and guide the development of targeted binocular therapies.

23. Repair Task-Based Walking Interviews to Reveal Context-Specific Navigation Requirements for Assistive Technologies for People with Visual Impairments

Prajjol Raj Puri[1, 2], Deborah Annan[1, 2], Soutongnoma Safiata Kabore[1, 2], Nathalie Gingras-Royer[1, 3], Sergio Mejia Romero[1], Kim Khoa Nguyen[4], Joe Nemargut[1, 2, 3]

[1]École d'optométrie, Université de Montréal, [2]Centre de Recherche Interdisciplinaire en Réadaptation du Montréal métropolitain, Montreal, QC, Canada, [3]Institut Nazareth et Louis-Braille, CISSS Montérégie-Centre, Longueuil, QC, CA, [4]École de technologie supérieure (ÉTS), Montréal, QC, Canada

Background: Navigation remains a major challenge for people with visual impairment (PVI) as many assistive technologies (AT) fail due to limited contextual relevance and insufficient involvement of end-users during development. Traditional AT evaluation tools often miss the real-time, situational needs experienced during dynamic, everyday tasks.

Objective: This study evaluated a mixed-methods framework combining task-based walking interviews with environmental scene metrics to capture real-time, context-dependent navigation needs of PVI. Findings were used to inform the design of our indoor navigation prototype, Edge A-Eye.

Methods: Thirteen adults with visual impairments completed eight sequential indoor navigation tasks during a simulated optometry visit. Participants wore Pupil Labs Neon glasses while performing tasks and provided immediate verbal feedback after completing each task. Luminance, contrast, edge density, and spatial entropy were extracted from video recordings to objectively characterize the scene. Multiple-choice responses were analyzed using descriptive statistics and correlations, while open-ended responses underwent thematic analysis.

Results: Navigation needs varied substantially by context. Participants preferred early notifications (6-8 m) for entrance doors, but on-command cues for stairs, elevators, and exits. Across tasks, users consistently requested concise, actionable information such as door type, handrail position, or chair location rather than continuous descriptive narration. While human assistance remained preferred in complex areas, many participants expressed willingness to use AI-based guidance if reliability could be ensured. Descriptive comparisons across tasks indicated that higher environmental luminance and stronger object contrast were observed in scenarios where participants with low vision demonstrated higher navigation success.

Conclusions: Task-based walking interviews combined with scene analysis provide ecologically valid insights into navigation behavior and user preferences. This methodology supports the development of adaptive, personalized assistive technologies and offers a scalable framework for future AT evaluation.

24. Neuroretinal and Vascular Effects of Alkyl Nitrites Potentiated by Ritonavir and Sildenafil

Víctor David Ayala Rivera[1], Pedro De la Villa[1], Cecilia Fernandez[1], Sergio Crespo Garcia[2]

[1]Motor and Visual System Neurophysiology Lab, Faculty of Medicine, University of Alcalá, Spain., [2]École d'optométrie, Université de Montréal, QC, Canada

Objective: Alkyl nitrite-associated maculopathy represents the most prevalent form of recreational toxic retinopathy in Europe and has become a growing visual health concern in the context of chemsex practices. This condition, characterized by disruption of the foveal ellipsoid zone on optical coherence tomography (OCT), has been increasingly reported in individuals who concomitantly use inhaled alkyl nitrites ("poppers"), sildenafil, and ritonavir—drugs commonly involved in sexualized drug use among men who have sex with men (MSM). The aim of this study was to investigate the pharmacological basis of this emerging retinal toxicity by testing the hypothesis that chemsex-related multidrug exposure induces synergistic neuroretinal damage.

Methods: An experimental model using 96 eyes from C57BL/6 mice was employed, with approval from EU animal ethics committees. Animals were assigned to five treatment groups, including a key experimental group receiving a combination of isopropyl nitrite (an exogenous nitric oxide donor), sildenafil (a phosphodiesterase type 5 inhibitor), and ritonavir (a cytochrome P450 inhibitor commonly prescribed in HIV therapy). Retinal function was assessed using full-field electroretinography (ffERG), while structural and cellular alterations were evaluated through immunocytochemical labeling of photoreceptors and microglia, complemented by behavioral assessments of visual function.

Results: Photopic ffERG recordings demonstrated a significant reduction ($p < 0.01$) in flicker and a-wave amplitudes exclusively in the chemsex-related drug combination group, compared with all other experimental and control groups. Histological analysis revealed marked microglial activation and photoreceptor disruption in this group, establishing a direct correlation between functional visual impairment and neuroinflammatory retinal damage.

Conclusion: This study provides the first experimental in vivo and in vitro evidence linking chemsex-associated multidrug exposure to synergistic neuroretinal toxicity. While alkyl nitrites act as the primary toxic agent, retinal damage is significantly amplified by the concurrent inhibition of cytochrome P450 and phosphodiesterase type 5 by ritonavir and sildenafil, respectively. These findings identify people living with HIV who engage in chemsex practices as a high-risk population for developing potentially irreversible maculopathy and underscore the urgent need to integrate ophthalmic screening and pharmacological interaction awareness into sexual health and harm reduction programs.

25. At First Sight: Cortical Processing of Restored Vision Following an Extended Period of Vision Loss

Erica Cianfarano[1, 2], Blake Richards[1, 2], Stuart Trenholm[1]

[1]McGill University, [2]Mila - Quebec AI Institute, Montreal, QC, Canada

Background & Aims: All forms of retina-based vision loss remove visual inputs to the brain. In response, the brain adapts, leading to widespread changes in functional connectivity and the reorganization of neural circuits. Various techniques are currently in development to restore visual processing abilities to blind individuals, including retinal prosthetics, and optogenetic therapies. However, little is known about how vision-loss-induced brain plasticity impacts the efficacy of subsequent vision restoration. As a result, it remains unclear how restored retinal signals will be processed by downstream visual circuits following prolonged vision loss, limiting our ability to gauge the feasibility and potential success of many therapeutic strategies.

Methods: To this end, we simulated a) early blindness by dark-rearing animals from P0 to P70 and b) late blindness by subjecting animals to dark-exposure from P35 to P105. We then 'restored vision' by re-introducing mice to light conditions. Prior to, during, and following vision restoration, we performed weekly calcium imaging of layer 2/3 neurons in V1, tracking hundreds of neurons across six weeks and examining spontaneous and visually evoked activity.

Results: We find that 'at first sight', V1 tuning properties in both early- and late-blind groups deviate significantly from age-matched controls. Furthermore, longitudinal tracking of neurons reveals that tuning stability across weeks differs in restored animals compared to sighted controls. Lastly, we observe distinct functional differences between early- and late-blind cohorts.

Conclusion: This work will provide critical insights into how vision loss reshapes visual cortical processing and the extent to which normal visual function can be recovered following restoration. Identifying aspects of visual processing that fail to recover will inform future strategies to improve restored vision, including approaches that combine restoration therapies with plasticity-enhancing interventions.

26. Protocol for the development of international classification of functioning, disability, and health core sets tailored for children and youth with deafblindness

Shirley Dumassais[1], Walter Wittich[1]

[1]École d'optométrie, Université de Montréal, Montréal, QC, Canada

Purpose: This study aims to develop tailored International Classification of Functioning, Disability, and Health (ICF) Core Sets for children and youth with deafblindness. Deafblindness, a combination of hearing and vision impairments, poses unique challenges to physical, cognitive, and psychosocial development. The absence of tools specifically designed to assess functioning and disability in this population limits care and support. The Core Sets will standardize categories that capture functional abilities and challenges, improving understanding and guiding holistic interventions.

Methods: The development will follow a four-phase, structured approach. Phase one involves a systematic literature review to identify functional aspects commonly documented in research on children and youth with deafblindness. Phase two consists of qualitative interviews and focus groups with parents, caregivers, and adolescents with deafblindness to explore personal experiences and challenges in daily life. Phase three will use an international survey targeting professionals working with this population, such as healthcare providers, educators, and therapists, to gather expert perspectives on critical domains of functioning and disability. Phase four involves an empirical multicenter study with healthcare practitioners documenting challenges and support strategies observed in clinical care contexts. Data from all phases will be systematically analyzed and linked to relevant ICF codes.

Results: The Core Sets will establish a standardized language for healthcare providers, educators, and policymakers, supporting holistic rehabilitation through improved assessments, individualized care plans, and interventions. They will also help define eligibility for healthcare and educational services, promote inclusive education policies, and inform healthcare frameworks. Furthermore, the Core Sets will provide clarity on the specific needs of children and youth with deafblindness, fostering better interdisciplinary collaboration. They will also guide research priorities and improve global cooperation.

Conclusion: By developing ICF Core Sets for children and youth with deafblindness, this research will address significant gaps in understanding their challenges and support their well-being, inclusion, and development. The standardized framework will ensure evidence-based, consistent, and adaptable interventions, ultimately enhancing the quality of life for this population.

27. Combinatorial sustained treatment with Fusicoccin-A and Epothilone-B promotes axon regeneration

Elizabeth Mai-Ling Hua[1], David Xinzheyang Li[2], Tristan Simas[1], Molly Sandra Shoichet[2, 3], Alyson Elise Fournier[1]

[1]Department of Neurology and Neurosurgery, Montréal Neurological Institute, McGill University, Montreal, QC, Canada, [2]Institute of Biomedical Engineering, University of Toronto, Toronto, ON, Canada, [3]Department of Chemical Engineering & Applied Chemistry, University of Toronto, Toronto, ON, Canada

Purpose: Promoting functional regeneration in the central nervous system is difficult due to the complex combination of intracellular and extracellular factors that contribute to its poor regenerative abilities.

Methods & Results: We have previously identified the small molecule Fusicoccin-A (FC-A) for its ability to promote nerve regeneration by modifying protein-protein interactions (PPIs) between intracellular 14-3-3 adaptor proteins and their client proteins. Combination of FC-A with microtubule stabilizer Epothilone B (EpoB) further increases outgrowth and regeneration in vitro and in vivo. EpoB alone has also been shown to reduce fibrotic scar formation. We have encapsulated FC-A and EpoB into PLGA nanoparticles that can be embedded into an HA oxime hydrogel and slowly released in vivo for sustained drug delivery following an optic nerve crush injury.

Conclusion: Combinatorial sustained release of FC-A and EpoB after CNS injury reduces some inhibitory components at the scar and promotes axon regeneration.

28. APE1/Ref-1 Redox Signaling Modulates Wnt/β-Catenin Activity and Endothelial Metabolism in Pathological Ocular Angiogenesis

Manu Kattimani[1], Tim Corson[1]

[1]University of Toronto, ON, Canada

Goal: Pathological ocular angiogenesis underlies neovascular age-related macular degeneration (AMD), proliferative diabetic retinopathy, and retinopathy of prematurity — collectively the leading causes of irreversible blindness worldwide. Current standard-of-care anti-VEGF agents partially suppress neovascularization but are limited by a burdensome monthly-to-bimonthly intravitreal injection regimen, with community adherence rates falling as low as 50% within two years. Repeated injections carry risks of endophthalmitis, elevated intraocular pressure, and accelerated macular atrophy. All approved anti-VEGF therapies act on a single downstream mediator without addressing the upstream transcriptional programs sustaining pathological vessel growth thus leaving patients vulnerable to recurrence and without a disease-modifying option. APE1/Ref-1 is a bifunctional protein acting as both a base-excision repair endonuclease (APE1) and a redox signalling effector (Ref-1) that activates key pro-angiogenic transcription factors including HIF-1α, NF-κB, and STAT3, positioning it as a compelling upstream regulator of pathological angiogenesis. APX3330 (first generation Ref-1 inhibitor), when orally administered daily, demonstrated efficacy in clinical trials by preventing diabetic retinopathy progression in the Phase 2 ZETA-1 trial. Prior work from our laboratory demonstrated that Ref-1 redox activity positively regulates Wnt/β-catenin signalling in retinal endothelial cells, with pharmacological inhibition via APX compounds reducing LRP5/6 co-receptor expression and nuclear β-catenin activity at both the mRNA and protein levels. This study aimed to further characterize the Ref-1/Wnt/β-catenin signalling axis and investigate the broader cellular consequences of Ref-1 inhibition in ocular endothelial cells.

Methods: Human LRP5 and LRP6 promoter-driven dual luciferase assays will be performed in human retinal endothelial cells (HRECs) and choroidal endothelial cells (CECs) treated with APX compounds under both normoxic and controlled hypoxic conditions designed to mimic pro-angiogenic environments. Separately, Seahorse metabolic flux assays will be conducted in HRECs and CECs following APX compound administration to assess glycolytic activity and mitochondrial respiration.

Results: APX treatment is expected to produce significantly reduced LRP5/6 promoter-driven luciferase activity across both HREC and CEC cell types under normoxic and hypoxic conditions, confirming that Ref-1 redox activity transcriptionally regulates LRP5/6 co-receptor expression. Seahorse assays will further reveal that APX compound administration reduces both glycolytic activity and mitochondrial respiration in both cell types, demonstrating that Ref-1 inhibition exerts broader metabolic effects on ocular endothelial cells beyond transcriptional regulation alone.

Conclusions: These findings will strengthen the evidence that Ref-1 redox activity is a central upstream regulator of Wnt/β-catenin signalling in ocular endothelial cells and reveal a previously unrecognized role for Ref-1 in endothelial metabolic programming. The precise mechanism linking Ref-1 redox activity to LRP5/6 transcriptional control remains to be elucidated, representing a critical gap whose resolution could establish novel drug targets and position Ref-1 as a disease-modifying therapeutic candidate for ocular neovascular disease.

29. Involuntary attention shifts and inhibition are spared by mild traumatic brain injury, while voluntary shifts are not

Yara Mohiar[1], Jocelyn Faubert[1], Michelle McKerral[1], Aarlenne Khan[1], Geneviève Rodrigue[1], Rémy Allard[1]

[1]Université de Montréal, QC, Canada

Goals: The ability of a person with mild traumatic brain injury (mTBI) to efficiently navigate their surroundings depends on their ability to shift attention in a timely manner. Attention shifts can be voluntary when we choose to direct them to a peripheral location, or involuntary should a salient feature suddenly appear in peripheral vision. To shift attention effectively, the ability to inhibit distractors that grab it, which increases attentional load, must also be intact. The current study explored the impact of mTBI on the time required to shift attention voluntarily and involuntarily, under various levels of attentional load.

Methods: A total of 54 participants were recruited: 27 having sustained a mTBI 1-18 months prior were matched for age and sex with 27 controls. Eight bars distributed evenly around a fixation point were presented on a screen. A bar was indicated at random by either a central or a peripheral cue. The central cue was a line emerging from fixation while the peripheral cue was a circle appearing directly on one of the bars. At a fixed moment, each bar then independently rotated either clockwise or counterclockwise. The target bar for which participants were asked to report the rotation direction of was either the cued bar (pro-shift task) or the one located mirror opposite to it (anti-shift task; to increase attention load). The pro-shift task probed a voluntary shift when the cue was central, and an involuntary shift when the cue was peripheral. In the anti-shift tasks, an initial inhibition of the voluntary (central cue) or involuntary (peripheral cue) shifts of attention was required before reorienting attention voluntarily in the opposite direction. To measure the time needed to shift attention, the cue onset varied relative to the rotation onset of the bars using a staircase procedure (cue-onset asynchrony; COA).

Results: In the anti-shift task and with the peripheral cue, the mTBI group required a larger COA than the control group to correctly discriminate the target's rotation direction. This group effect was similar to that observed with the central cue in both anti- and pro-shift tasks (i.e., with and without inhibition processes). In contrast, no significant difference in COA was observed between groups with the peripheral cue when in the pro-shift task.

Conclusion: The similar group effect with the central cue whether or not inhibition processes were involved suggests an impaired ability to shift attention voluntarily, independent of the need to first disengage from a cued location. The inhibition processes required in anti-shift tasks thus appear to be preserved in mTBI. There was also no evidence of mTBI affecting involuntary shifts of attention. We conclude mTBI impacts voluntary shifts, while involuntary shifts and inhibitory processes remain intact.

30. Pikachurin axonal trafficking and complex formation

Robyn V. McGowan[1, 2], Melina A. Agosto[1, 2, 3]

[1]Retina and Optic Nerve Research Laboratory, Dalhousie University, Halifax, NS, Canada, [2]Department of Physiology and Biophysics, Dalhousie University, Halifax, NS, Canada, [3]Department of Ophthalmology and Visual Sciences, Dalhousie University, Halifax, NS, Canada

Purpose: Rod and cone photoreceptors (PRs) are specialized neurons responsible for the sensory transduction of visual stimuli. The function of photoreceptors and their chemical synapses with downstream neurons, such as bipolar cells (BCs), are critical for normal vision. Pikachurin (PIKA) is a multi-domain heparan sulphate (HS) proteoglycan expressed in PRs and secreted into the synaptic cleft. PIKA knockout mice have structural defects at PR synapses and impaired signal transmission to bipolar cells, and alleles encoding truncated proteins were reported in complete congenital stationary night blindness patients. PIKA forms a trans-synaptic complex with pre-synaptic dystroglycan and post-synaptic GPR179, as well as the post-synaptic cell adhesion molecule LRRTM4.

Methods & Results: Here, we used a combination of *in vitro* and *in vivo* experiments to map the location of PIKA HS modification, identify determinants of binding to LRRTM4, and identify determinants of synaptic localization in rods.

Conclusion: Our findings demonstrate that none of the known functional domains of PIKA are required for LRRTM4 binding, but rather a novel region (a.a. 240-342) with no known function, located between the second FNIII domain and the first EGF-like domain, is required. Consistent with the known HS-dependent binding of LRRTM4, we mapped the location of PIKA HS modification to a single serine residue located at a.a. 244. Deletion of a.a. 240-342 did not abolish colocalization with a synapse marker, suggesting that neither LRRTM4 binding nor HS modification is required for PIKA localization at PR synapses.

31. Développement d'un protocole innovant basé sur le modèle des monocouches de Langmuir pour l'étude des propriétés mucoadhésives des nanoparticules d'or: vers des systèmes de libération de médicaments ophtalmiques plus efficaces

Giulia Elisa Guimaraes Goncalves[1], Élodie Boisselier[1]

[1]CHU de Québec - Université Laval, Québec, QC, Canada

Contexte & Objectifs : La majorité des médicaments ophtalmiques sont administrés sous forme de gouttes sur la cornée. Toutefois, leurs faibles propriétés mucoadhésives limitent leur efficacité. Afin d'améliorer leur rétention à la surface oculaire, des systèmes de relargage mucoadhésifs à base de nanoparticules d'or (AuNP) ont émergé comme une solution prometteuse. Trois protocoles fondés sur des méthodes spectroscopiques ont déjà mis en évidence les propriétés mucoadhésives des AuNP. Néanmoins, ces propriétés restent peu caractérisées d'un point de vue moléculaire.
Nous posons donc comme hypothèse que l'utilisation du modèle des monocouches de Langmuir permettrait d'étudier l'influence des mucines, des lipides ainsi que des paramètres environnementaux sur les propriétés mucoadhésives des AuNP. L'**objectif principal** de ce travail était de caractériser globalement la mucoadhésion en reproduisant l'environnement de la surface cornéenne. Les **trois objectifs spécifiques** étaient de 1) Recréer l'environnement de la surface cornéenne avec des lipides et des mucines, 2) Évaluer le comportement des AuNP en présence des lipides du film lacrymal et 3) Analyser l'influence des lipides sur la mucoadhésion des nanoparticules dans le système ternaire (lipides, mucines et nanoparticules).

Matériel & Methodes:

- **Objectif 1 :** Nous avons déterminé la concentration saturante des mucines ainsi que leurs paramètres de liaison membranaire en présence de lipides de la membrane épithéliale cornéenne par tensiométrie de surface.
- **Objectif 2 :** Après avoir déterminé la concentration saturante des nanoparticules, leurs paramètres de liaison membranaire ont été évalués en présence des lipides de la couche lipidique du film lacrymal.
- **Objectif 3 :** Les paramètres de liaison membranaire du système ternaire ont été comparés à ceux obtenus en présence de mucines seules. Des isothermes de pression de surface cycliques ainsi que l'imagerie des monocouches par microscopie à angle de Brewster ont été réalisées afin de vérifier les changements morphologiques induits par les nanoparticules.

Résultats : Les résultats montrent que les mucines interagissent notamment avec des lipides saturés, tandis que les nanoparticules ne s'associent pas à l'ensemble des lipides testés. Dans le système ternaire, les AuNP ne modifient pas les paramètres de liaison lipide-mucine, mais altèrent la morphologie du système en formant des domaines. De nouvelles approches, telles que l'utilisation de peptides en remplacement des mucines, sont actuellement explorées afin d'optimiser le modèle et d'approfondir la caractérisation de la mucoadhésion.

Conclusion : Ce nouveau protocole de caractérisation de la mucoadhésion, une fois optimisé, contribuera au développement d'AuNP plus efficaces en tant que systèmes de relargage de médicaments oculaires.

32. Functional changes in visual areas during imagination in the blind following vision restoration: Two case studies

Sunyoung Park[1], David Kahn[2], Jeiran Choupan[3], Yonggang Shi[3], Noelle Stiles[1, 4]

[1]Center for Advanced Human Brain Imaging Research, Brain Health Institute, Department of Neurology, Rutgers University, [2]Biology and Biological Engineering, California Institute of Technology, [3]Stevens Neuroimaging and Informatics Institute, Keck School of Medicine, University of Southern California, [4]USC Roski Eye Institute, Department of Ophthalmology, Keck School of Medicine, University of Southern California, CA, USA

Purpose and Goal: The Argus II retinal prosthesis can restore ultra-low vision in the late blind through electrical stimulation of ganglion cells. Our previous study showed that cortical thickness increases following the Argus II device implantation in visual areas, such as cuneus cortex and lateral occipital cortex, suggesting partial reversal of visual cortex atrophy associated with long-term vision loss. However, it remains unclear whether these structural changes are accompanied by increased functional engagement of visual areas during visual tasks. Here, we investigated whether there are any changes in activation in cortical areas during a visual imagery task before and after device implantation in two Argus II patients using fMRI.

Methods: The visual imagery task was used as it has been shown to functionally engage visual areas and the Argus II device cannot be activated inside the scanner. During the task, participants alternated between imagination blocks in which they imagined visual objects or places, and rest blocks in which they did not perform a task. To define task-relevant regions of interests (ROIs) independently from the two case studies, we conducted a group-level analysis on a separate sample of eight Argus II recipients performing the same visual imagery task during fMRI. We computed a thresholded contrast map identifying clusters with greater activation during imagery compared to rest ($Z > 3.0$, cluster-corrected at $p < .05$). Significant clusters included higher-level visual areas, such as bilateral lateral occipital cortex and left inferior temporal gyrus. These clusters were then used as ROIs to extract the univariate activations from the two case study participants before and after implantation.

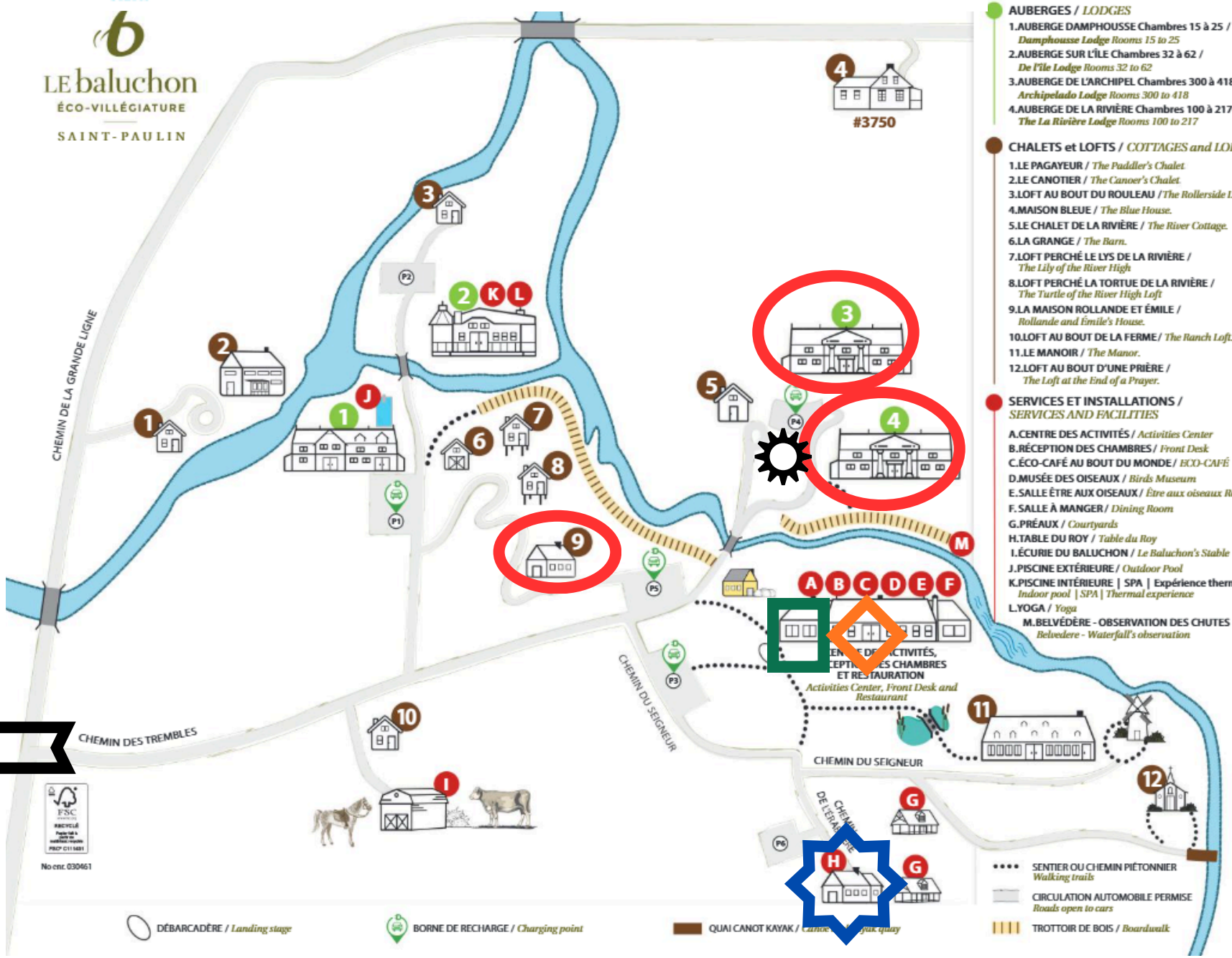
Results: We observed that while the participant with shorter device use (6.5 months) showed decreased activity in the majority of the task-related ROIs following implantation, the participant with longer device use (44.5 months) showed increased activity in the majority of the ROIs relative to the pre-implantation scan. Notably, both participants showed increased activity in the right supramarginal gyrus and decreased activity in the right superior lateral occipital cortex.

Conclusions: These findings suggest that the cortical reengagement following vision restoration may evolve over time, and that both upregulation and downregulation of task-relevant regions may contribute to functional reorganization after visual restoration. Together, our results complement the previous evidence of structural cortical changes by demonstrating functional changes in visual areas following visual restoration in the late blind.

École D'ÉTÉ 2026 SUMMER school — RESTAURATION DE LA VISION / VISION RESTORATION

PLAN DU SITE / *SITE MAP*

LE baluchon
ÉCO-VILLÉGIATURE
SAINT-PAULIN



AUBERGES / *LODGES*

1. AUBERGE DAMPHOUSSE Chambres 15 à 25 / ***Damphousse Lodge*** *Rooms 15 to 25*
2. AUBERGE SUR L'ÎLE Chambres 32 à 62 / ***De l'île Lodge*** *Rooms 32 to 62*
3. AUBERGE DE L'ARCHIPEL Chambres 300 à 418 / ***Archipelado Lodge*** *Rooms 300 to 418*
4. AUBERGE DE LA RIVIÈRE Chambres 100 à 217 / ***The La Rivière Lodge*** *Rooms 100 to 217*

CHALETS et LOFTS / *COTTAGES and LOFTS*

1. LE PAGAYEUR / *The Paddler's Chalet*
2. LE CANOTIER / *The Canoer's Chalet*
3. LOFT AU BOUT DU ROULEAU / *The Rollerside Loft*
4. MAISON BLEUE / *The Blue House.*
5. LE CHALET DE LA RIVIÈRE / *The River Cottage.*
6. LA GRANGE / *The Barn.*
7. LOFT PERCHÉ LE LYS DE LA RIVIÈRE / *The Lily of the River High*
8. LOFT PERCHÉ LA TORTUE DE LA RIVIÈRE / *The Turtle of the River High Loft*
9. LA MAISON ROLLANDE ET ÉMILE / *Rollande and Émile's House.*
10. LOFT AU BOUT DE LA FERME / *The Ranch Loft.*
11. LE MANOIR / *The Manor.*
12. LOFT AU BOUT D'UNE PRIÈRE / *The Loft at the End of a Prayer.*

SERVICES ET INSTALLATIONS / *SERVICES AND FACILITIES*

- A. CENTRE DES ACTIVITÉS / *Activities Center*
- B. RÉCEPTION DES CHAMBRES / *Front Desk*
- C. ÉCO-CAFÉ AU BOUT DU MONDE / *ECO-CAFÉ*
- D. MUSÉE DES OISEAUX / *Birds Museum*
- E. SALLE ÊTRE AUX OISEAUX / *Être aux oiseaux Room*
- F. SALLE À MANGER / *Dining Room*
- G. PRÉAUX / *Courtyards*
- H. TABLE DU ROY / *Table du Roy*
- I. ÉCURIE DU BALUCHON / *Le Baluchon's Stable*
- J. PISCINE EXTÉRIEURE / *Outdoor Pool*
- K. PISCINE INTÉRIEURE | SPA | Expérience thermale / *Indoor pool | SPA | Thermal experience*
- L. YOGA / *Yoga*
- M. BELVÉDÈRE - OBSERVATION DES CHUTES / *Belvedere - Waterfall's observation*

Chambres / *Rooms*

Salle Etre-aux-oiseaux

Éco-Café

BBQ/ Feu/*camp fire*

Entrée / *Entrance*

Bus stop

No enr. 030461

VSRN Vision Sciences Research Network

RRSV Réseau de recherche en sciences de la vision