The Centre for Vision Research &
Centre for Integrative and Applied Neuroscience

The Brain and Integrative Vision

JUNE 17-19, 2025
SECOND STUDENT CENTRE
YORK UNIVERSITY

The conference logo was designed by Phoebe Mae Ching

Jointly held by the Centre for Vision Research and the Centre for Integrative and Applied Neuroscience

Centre for Vision Research

CIAN

Centre for Integrative and Applied Neuroscience

Centre pour l’Intégration et l’Application des Neurosciences

CVR-CIAN Conference 2025:

The Brain and Integrative Vision WhatsApp Group

Please scan this QR code to join the conference WhatsApp group.
The group is a place to hear all the latest announcements and where you can ask questions of the organizers.

WELCOME!

Welcome to the 2025 Centre for Vision Research (CVR) / Centre for Integrative and Applied Neuroscience (CIAN) international conference, 'The Brain and Integrative Vision'. This year's conference brings together CVR's mission to pursue world-class, interdisciplinary research and training in visual science and its applications with CIAN's mission to integrate and mobilize York's neuroscience research and training resources to address worldwide applications in health, education, industry, and beyond. Specifically, the conference program will focus on the many ways in which vision is integrated with other neural systems to support perception, cognition, and behavior. The CVR has held biennial conferences since 1991, each on a different multidisciplinary topic, while this is CIAN's first international conference. The 2025 conference is presented in partnership with the Vision: Science to Applications (VISTA) program and celebrates the success of this signature research program, funded by the Canada First Research Excellence Fund. The conference features a series of seminars from a stellar cast of international neuroscientists and scholars, as well as an exciting array of poster presentations from local and visiting researchers. Immediately preceding the conference, we are excited to host a free, trainee-focused Canadian Action and Perception Satellite meeting. We thank the program committee (led by Drs. Denise Henriques and Jeff Schall) and conference committee for curating such an exciting and intellectually stimulating program. We also thank our staff (Irit Printz and Fernando Rouaux) for the hard work needed to realize the program committee's 'vision'. Finally, special thanks to our sponsors at York University: the office of the Vice President for Research & Innovation, The Faculty of Health, and the Vision: Science to Applications (VISTA) program. We are also most grateful to HDR, the architects of the new Neuroscience Extension, plus BritaMed, FHC, NeuroNexus, Plexon, Psychometric Society, and Techniplast for providing their support for this conference.

We hope you enjoy the conference and your time in Toronto!

Robert Allison
CVR Director

Centre for Vision Research

Doug Crawford
CIAN Director

CIAN Centre for Integrative and Applied Neuroscience
Centre pour l'Intégration et l'Application des Neurosciences

CONFERENCE COMMITTEE

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Peter Jes Kohler
Associate Professor, Psychology

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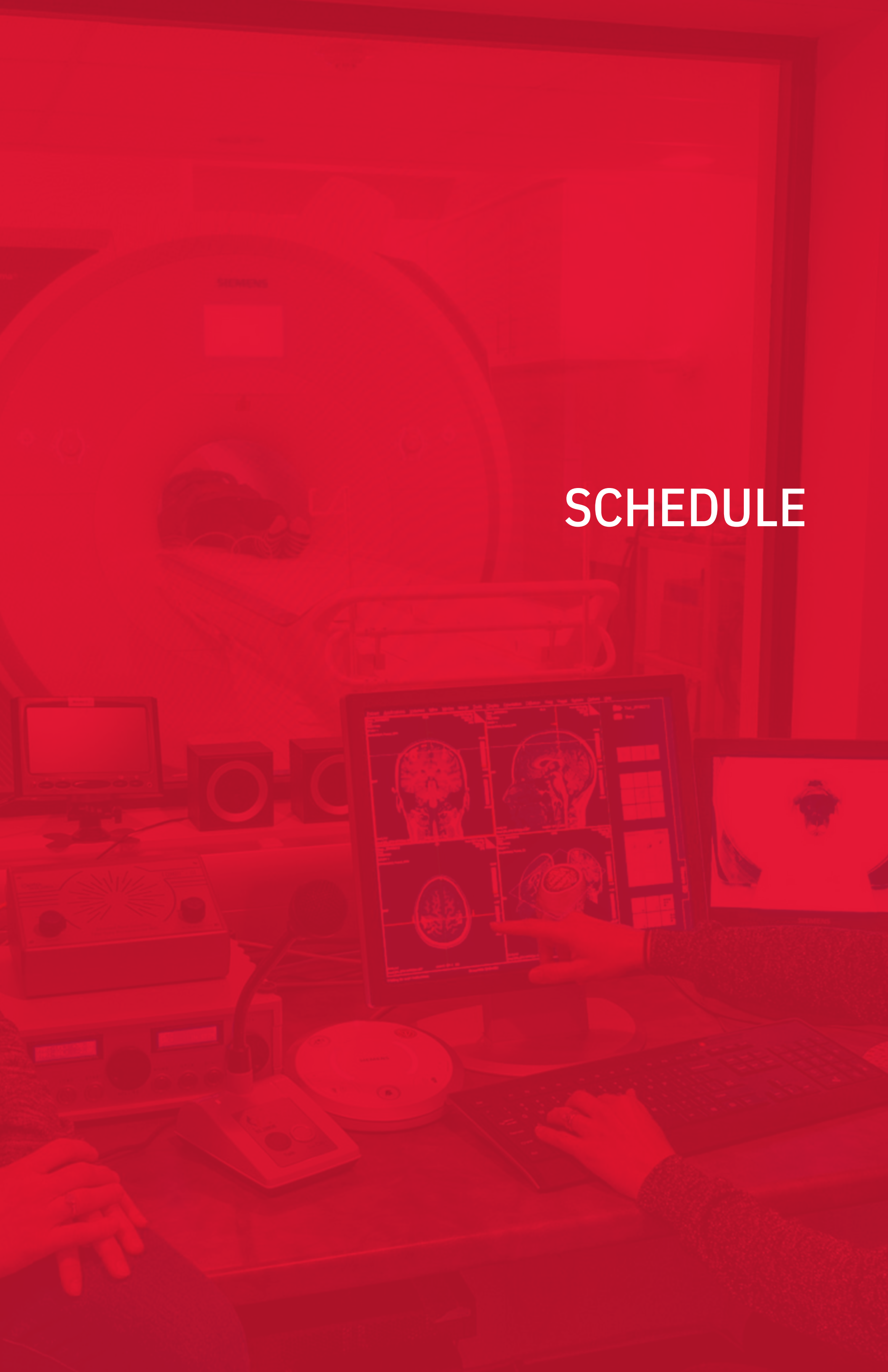

TUESDAY, JUNE 17

8:30 am	Breakfast/coffee/registration
9:30 am	**Welcome**
10:00 - 10:50 am	Marlene Behrmann - University of Pittsburgh *Topographic maps of high-level vision, their hemispheric organization, development, and plasticity*
10:50 - 11:40 am	Buddhika Bellana - York University *The matter of meaning in episodic memory*
11:40 am - 12:40 pm	Lunch
12:40 - 2:40 pm	**Poster Session 1**
2:40 - 3:30 pm	Judith Burkart - University of Zurich *What's in a gaze? Cooperative breeding and the evolution of cooperative signaling*
3:30 - 4:20 pm	Frank Bremmer - Marburg University *Visual and non visual aspects of self-motion processing in primates*
6:30 - 10:00 pm	Pub Night Goodman Pub and Kitchen, 207 Queens Quay W. We will meet at the York University subway station at 5:20pm to travel to the pub together.

WEDNESDAY, JUNE 18

9:00 - 9:50 am	Jennifer Chandler - Queen's University *Inferring mental states from brain data: ethico-legal questions about social uses of brain data*
9:50 - 10:40 am	Jim DiCarlo - MIT *Do contemporary, machine-executable models of primate sensory systems unlock the ability to non-invasively, beneficially modulate high level brain states?*
10:40 am -12:40 pm	**Poster Session 2**
12:00 - 1:00 pm	Lunch
1:00 - 1:50 pm	Monica Castelhano - Queen's University *Integrative vision: uncertainty and the prioritization of visual processing*
2:00 - 4:00 pm	**Poster Session 3**
3:30 - 5:30 pm	**Lab Tours and Demos**

THURSDAY, JUNE 19

9:00 - 9:50 am	Kalanit Grill-Spector - Stanford University *The future of human vision: a cognitive computational neuroanatomical approach to study the human visual system*
9:50 - 10:40 am	Josh McDermott - MIT *New models of human hearing via machine learning*
10:40 am - 12:40 pm	**Poster Session 4**
12:40 - 1:40 pm	Lunch
1:40 - 2:30 pm	Ueli Rutishauser - Cedars Sinai Hospital *Probing human memory and decision making at the single-neuron level*
2:30 - 3:20 pm	Andrew Pruszynski - Western University *Planning while moving*
3:20 - 3:50 pm	Coffee Break
3:50 - 4:40 pm	Daniel Wolpert - Columbia University *Computational principles underlying the learning of sensorimotor repertoires*
6:00 pm	**Banquet**

SPEAKERS & ABSTRACTS

SPEAKERS

Marlene Behrmann

University of Pittsburgh

Marlene Behrmann holds the John and Clelia Sheppard Chair in the Department of Ophthalmology at the University of Pittsburgh. She studies the psychological and neural bases of visual processing, with specific attention to the mechanisms by which the signals from the eye are transformed into meaningful percepts by the brain. She adopts an interdisciplinary approach combining computational, neuropsychological and neuroimaging studies with adults and children in health and disease. For example, she has mapped the cortical visual system in patients following childhood hemispherectomy, elucidating the potential for cortical reorganization. Dr. Behrmann is a member of the Society for Experimental Psychologists, the National Academy of Sciences, and American Academy of Arts and Sciences. Among her awards are the Presidential Early Career Award for Engineering and Science, the APA Distinguished Scientific Award for Early Career Contributions and the Kavli Distinguished Career Contributions in Cognitive Neuroscience Award from the Cognitive Neuroscience Society.

Topographic maps of high-level vision, their hemispheric organization, development, and plasticity

To the naked eye, the two cerebral hemispheres look rather similar in structure, aside from small anatomical differences. Decades of research, however, attest to substantial functional distinctions between the hemispheres. Whereas one view conceptualizes the cortical organization as discrete components with discrete functions, an alternative view is of continuous gradations of function that tile cortex. Implicit in the former view is that the organization may be innately prespecified and largely immutable, whereas, on the latter account, the topography emerges from more subtle constraints that play out over experience. These views are evaluated in the context of complex pattern recognition (e.g., faces and words) which are perceived by adults with remarkable speed and accuracy. Much prior research has favoured a binary separation of faces and words, with the right and left hemispheres specialized for the representation of faces, and words, respectively. Close scrutiny of the data, however, suggest a more graded and distributed hemispheric organization for faces and words but also a more global organization that extends beyond high-level vision. Detailed behavioral, structural and functional imaging findings and intracranial recordings reveals how the distribution of function both within and between the two cerebral hemispheres emerges over the course of development, and a computational account of this mature organization is offered and tested. Provocatively, this mature profile is remarkably malleable, as revealed by cross-sectional and longitudinal data from individuals with hemispherectomy. Together, the findings support a view of cortical visual organization (and perhaps, the organization of other functions too) as plastic and dynamic, both within and between hemispheres.

Tuesday, June 17, 10:00 - 10:50 am

Buddhika Bellana

York University

Buddhika Bellana is an assistant professor in Psychology at the Glendon Campus of York University and principal investigator at the Memory & Meaning Lab. His research focuses on the cognitive neuroscience of episodic memory – our ability to remember past events.

In particular, his research program examines the interdependence between episodic memory and sense-making. To this end, he leverages an interdisciplinary approach – drawing from the fields of psychology, neuroscience, natural language processing, and narratology. To learn more, please visit his website: https://www.bellanalab.com/.

The matter of meaning in episodic memory

The study of human episodic memory has a long tradition of using highly controlled experimental paradigms, often relying on sequences of unrelated words or images as memoranda. While this approach continues to provide invaluable insights into our memory system, it also separates the act of understanding from holding an experience in mind. In this talk, I will highlight recent work in my lab that has leveraged more naturalistic memoranda – stories – to examine properties of human memory and spontaneous thought. First, I will use stories to highlight how some of our experiences can carry “momentum”, shaping the content of our unconstrained thoughts for minutes after reading. Second, I will highlight brand new work demonstrating that our memory system ‘unscrambles’ incoherent experiences increasingly over time. These findings serve as an example of how re-introducing “meaning” into our experiments, at the expense of some experimental control, may be an effective route towards productive insights into episodic memory.

Tuesday, June 17, 10:50 - 11:40 am

Judith Burkart

University of Zurich

Judith Burkart is a professor at the Department of Evolutionary Anthropology of the University of Zurich, and head of the department's primate station that houses a large colony of marmosets and tamarins. To understand the evolutionary origin of the human mind, her group identifies both similarities and differences between human and nonhuman primates. They are particularly interested in how social, motivational and cognitive processes interact in the "big-C" contexts in which humans excel: Cooperation, Communication, Cognition and Culture. A main focus of the group centers on developing and testing the cooperative breeding model of human evolution. This research highlights marmosets and other callitrichid monkeys, as they are the only primates besides humans that exhibit cooperative breeding.

What's in a gaze? Cooperative breeding and the evolution of cooperative signaling

Human eye gaze is a spectacularly rich phenomenon and the bedrock of human social cognition. For evolutionary anthropologists, investigating how nonhuman primates process and use eye gaze therefore has high priority for understanding the evolutionary origin of cognition. I will present recent results from detailed studies on marmosets, and comparative analyses across primates more broadly, on eye morphology, gaze aversion, using and understanding gaze as communicative cues, perspective taking, as well as the role of mutual gaze during joint action and communication. Across primate species, the cooperatively breeding marmoset monkeys show a striking lack of gaze aversion and appear particularly adept at using gaze to coordinate joint actions, which goes hand in hand with a remarkably complex vocal communication system. Since besides marmosets, humans are the only other cooperative breeders among primates, this pattern of findings suggests an important role of cooperative breeding in the emergence of cooperative signaling and eventually language.

Tuesday, June 17, 2:40 - 3:30 pm

Frank Bremmer

Marburg University

Frank Bremmer is a Professor of Applied Physics and Neurophysics at the University of Marburg, where he has worked since 2001. He studied physics at the University of Marburg and earned a PhD in biology from Ruhr-University Bochum in 1994. Following postdoctoral research at the Collège de France in Paris, he completed his Habilitation in Neurobiology in 2000. His research focuses on systems neuroscience, particularly the multisensory representation of space and motion and spatial perception during movement. Bremmer has held numerous leadership roles, including speaker of the DFG-funded RTG NeuroAct (2004–2009) and the German-Canadian IRTG/CREATE The Brain in Action (2013–2023). He has been active in major collaborative research consortia and, since 2021, has served as co-speaker of The Adaptive Mind cluster project.

He was the founding director of two interdisciplinary centers: the Graduate Center for Life- and Natural Sciences (2008) and the Center for Mind, Brain and Behavior – CMBB (2018). He also served as Vice President for Research at the University of Marburg (2010–2013) and has held national and international advisory roles, including with the DFG and the European University Association. Since 2024, he serves on the DFG Senate- and Grants-Committee for Research Training Groups.

Visual and non visual aspects of self-motion processing in primates

The perception and control of self-motion is a central task in everyday life. It relies on the integration of visual and nonvisual signals across multiple sensory domains. In this talk, I will present recent findings from studies in humans and macaques that illuminate how primates process self-motion signals in complex, dynamic environments.
Visual motion cues, particularly optic flow, play a dominant role in heading perception. However, our data show that this processing is far from static. For instance, we could show that saccadic eye movements compress visual heading representations in humans and monkeys, highlighting the dynamic nature of spatial coding during active vision. Beyond heading, neurons in the ventral intraparietal area (VIP) of macaques encode egocentric distance, indicating that the brain integrates visual flow with depth-related information. Importantly, nonvisual signals also shape self-motion perception. In behavioral studies in human observers, we showed how tactile flow modulates perceived distance and heading, underscoring the importance of multisensory integration. This result was further supported by (human and monkey) EEG and human fMRI studies revealing predictive coding mechanisms in heading perception and multisensory path integration.

Altogether, these studies provide converging evidence that primates rely on a flexible, multisensory representation of self-motion, integrating visual and nonvisual cues depending on behavioral context and environmental demands. Our work is supported by the German Research Foundation (DFG), the Hessian Ministry of Science (HMWK) and the EU.

Tuesday, June 17, 3:30 - 4:20 pm

Jennifer Chandler

Queen's University

Jennifer A. Chandler studies the legal and ethical aspects of biomedical science and technology, with a focus on the intersection of the brain sciences, law and ethics. She also works on legal policy related to organ donation and transplantation, and mental health law and policy. She is the coordinator of the Hybrid Minds project (www.hybridminds.org), which brings together researchers from Switzerland, Germany and Canada to examine the implications of incorporating artificial intelligence in neuroprostheses. In 2024 she was awarded the International Neuroethics Society's Steven E Hyman Award for Distinguished Service to the field of Neuroethics.

She is a Full Professor of Law, holder of the Bertram Loeb Research Chair, and is cross-appointed to the Faculty of Medicine at the University of Ottawa. She is a member of the Canadian Academy of Health Sciences, and chaired its forthcoming assessment of policy related to fetal alcohol spectrum disorder in Canada. She is the Vice-Dean of Research for the Faculty of Law and leads the neuroethics pillar of the University of Ottawa Brain Mind Research Institute.

Inferring mental states from brain data: ethico-legal questions about social uses of brain data

Neurotechnologies that collect and interpret data about brain activity and/or that modulate that brain activity are already in clinical use, and a range of additional clinical and non-clinical applications are being researched and discussed. Among these are applications that rely upon an inference from brain data to a mental state, such as awareness, mood, or certain cognitive operations. The aim of this presentation is to set out five ethico-legal themes related to inferring mental states from brain data. After sketching out the inferential chain lying between brain data and a mental state, the presentation tackles five main themes. The first is the question of how accurate an inference must be before it can justifiably be used. Second, should we use inferences about current mental states to predict future mental states and behaviour? Third, is there an unfairness in preferring a version of a person's mental states that is derived from brain data over that person's own subjective self-report? Fourth, is mental privacy threatened by technologies that purport to infer mental states from brain data, and if so, what should the scope and form of privacy protection be? And, finally, rather than a right to be free from intrusions into mental privacy, is there a right to have one's "mind read" in certain circumstances?

Wednesday, June 18, 9:00 - 9:50 am

Jim DiCarlo

MIT

Jim DiCarlo joined the McGovern Institute in 2002, and is currently the Peter de Florez Professor of Brain and Cognitive Sciences as well as Director of the MIT Quest for Intelligence. For nearly nine years, DiCarlo was also the head of MIT's Brain and Cognitive Sciences Department. He received his MD and PhD in Biomedical Engineering from Johns Hopkins University in 1998 and did his postdoctoral work at Baylor College of Medicine from 1998 to 2002. He is a past recipient of a Sloan fellowship, a Pew Scholar Award, and a McKnight Scholar Award.

Do contemporary, machine-executable models of primate sensory systems unlock the ability to non-invasively, beneficially modulate high level brain states?

Over the past decade, neuroscience, cognitive science and computer science ("AI") converged to create specific, image-computable, deep neural network models intended to appropriately abstract, emulate and explain the mechanisms of primate ventral visual processing, up to its deepest neural level, the inferior temporal cortex (IT). Because these leading neuroscientific emulation models — aka "digital twins" — are fully observable and machine-executable, they offer predictive and potential application power that our field's prior conceptual models did not. Our team's ongoing work is aimed at asking if current digital twin models might support non-invasive, beneficial brain modulation. In this talk, I will describe a key result: we demonstrate that we can use a digital twin to design spatial patterns of light energy that, when "added" to the organism's retinal input in the context of ongoing natural visual processing, results in precise modulation (i.e. rate bias) of the pattern of a population of IT neurons (where any intended modulation pattern is chosen ahead of time by the scientist).   Because the IT visual neural populations are known to directly connect to and modulate downstream neural circuits (e.g. amygdala) that may underlie psychological affective states (e.g. mood and anxiety), this novel basic science may unlock a new, non-invasive application avenue of potential future human clinical benefit.

This progress and new impact possibilities resulted from convergent brain science and AI engineering efforts in the domain of visual object intelligence.   I will motivate this as just one example of what I believe will unlock in other domains of human intelligence as brain scientists and AI engineers collaborate to develop machine-executable models of the underlying mechanisms of those still-mysterious domains.

Wednesday, June 18, 9:50 - 10:40

Monica Castelhano

Queen's University

Dr. Monica Castelhano is a leading expert in visual cognition, with a particular focus on how scene context and prior knowledge influence attention and eye movement patterns. Her research has advanced the understanding of how people understand, attend and navigate complex visual environments. Dr. Castelhano completed her PhD in Cognitive Psychology at Michigan State University, followed by a postdoctoral fellowship at the University of Massachusetts Amherst, where she worked with renowned researcher Dr. Keith Rayner. Currently, she is a Professor at Queen's University, where she directs a research lab focused on visual cognition. Dr. Castelhano has made significant contributions to the field. She has receiving numerous research grants and awards for her work on visual attention and scene perception.

Integrative vision: uncertainty and the prioritization of visual processing

Prior knowledge and the broader scene context play a vital role in steering attention and informing visual search strategies by forming predictions about where objects are likely to appear. Yet, the impact of uncertainty—whether related to pre-existing knowledge or the immediate context—modulates how these predictions are used. Through a series of studies, we examine how different levels of uncertainty affect decision-making processes and the integration of contextual information. Our findings reveal the adaptive nature of attentional guidance, with individuals continuously adjusting their strategies based on the reliability of available information. Additionally, a novel computational model, which employs automated knowledge extraction, supports these insights. Collectively, these studies shed light on the dynamic interplay between uncertainty, context, and attentional control, emphasizing the flexible application of high-level knowledge in visual processing.

Wednesday, June 18, 1:00 - 1:50 pm

Kalanit Grill-Spector

Stanford University

Kalanit Grill-Spector is the Susan S. and William H. Hindle Endowed Professor in Psychology and the Wu Tsai Neurosciences Institute. Her research examines how the interplay between brain function, structure, and computations enable visual perception and how the anatomical and functional properties of the brain change from infancy to childhood to adulthood, improving visual abilities. She received her PhD from the Weizmann Institute of Science and was a postdoctoral fellow in Brain and Cognitive Sciences at MIT. At Stanford University, she directs the Visual and Perception Neuroscience Lab and is on the Center of Neurobiological Imaging board. Additionally, she has directed the graduate studies (2017-2021) and chaired (2021-2024) the Psychology Department, and served as an Editor for Journal of Vision and Neuropsychologia. She has received several awards including the Human Sciences Frontier Fellowship, Sloan Fellowship, Klingenstein Fellowship, Wu Tsai Big Idea, and is PI in multiple NSF & NIH awards.

The future of human vision: a cognitive computational neuroanatomical approach to study the human visual system

fMRI and computational modeling have transformed our understanding of the human brain. In the visual system, modeling population receptive fields (pRF) led to discoveries of multiple maps of pRF eccentricity, polar angle, and size and revealed both maps and clustered representations of visual categories. However, it is unknown how functional representations are scaffolded by brain structure, what is the nature of temporal computations, and what kind of constraints generate functional maps. Here, I will describe how innovations in imaging technologies such as quantitative and diffusion MRI, as well as computational modeling, referred together as cognitive computational neuroanatomy, have significantly advanced understanding of the human ventral visual stream that is involved in visual categorization. First, I will describe empirical data revealing the interplay between cytoarchitecture, white matter connections, and category representations. Findings suggest that eccentricity and cytoarchitecture are basic organizing principles. Second, I will describe a new empirical and computational framework to estimate the spatiotemporal population receptive field (st-pRF) of each voxel in visual degrees and milliseconds, revealing increasing spatial and temporal integration windows across visual streams. Finally, I will describe a new topographic deep neural network (TDANN) that enables testing which constraints predict both cortical responses and spatial organization. We find that a single unified principle – self supervised training together with a spatial loss that encourages units on the simulated cortical sheet to have correlated responses – predicts both functional responses and maps in the visual system– from V1 to high-level regions.

Thursday, June 19, 9:00 - 9:50 am

Josh McDermott

MIT

Josh McDermott is a professor in the Department of Brain and Cognitive Sciences at MIT, where he heads the Laboratory for Computational Audition. His research addresses human and machine audition using tools from experimental psychology, engineering, and neuroscience. Current interests include the construction of working models of human perception using machine learning, the study of ecological acoustics and its consequences for hearing, the design of improved prosthetic devices, and music perception.

SPEAKERS AND ABSTRACTS

New models of human hearing via machine learning

Decades of experimental and theoretical work have led to models of the ear that are widely used throughout perceptual science. Comparably accurate models of the rest of the auditory system could be similarly transformative. This talk will describe my lab's efforts to leverage contemporary machine learning to build neural network models of our auditory abilities and their instantiation in the brain. Such models have enabled a qualitative step forward in our ability to account for real-world auditory behavior and illuminate function within auditory cortex. They also open the door to new approaches for designing auditory prosthetics and understanding their effect on behavioral abilities.

Thursday, June 19, 9:50 - 10:40 am

Ueli Rutishauser

Cedars Sinai Hospital

Ueli Rutishauser, PhD is Board of Governors Professor in Neurosciences and Director of the Center of Neural Science and Medicine at Cedars-Sinai Medical Center and Faculty Associate in Biology and Biological Engineering at the California Institute of Technology. Dr. Rutishauser obtained a BS in computer science, a PhD in Computation & Neural Systems (Caltech) and postdoctoral fellowships at Caltech and the Max Planck Institute for Brain Research. Awards include the Troland Award by the National Academy of Sciences, the NSF CAREER award, and the Next Generation Leader Award by the Allen Institute. His laboratory studies the neural mechanisms of memory and decision making using computational and experiment methods. A key focus of his is to advance the technique of human single-neuron recordings. Recent work has focused on memory strength signals in the hippocampus, role of medial frontal cortex in cognitive flexibility and performance monitoring, confidence judgments, and mechanisms of working memory.

Probing human memory and decision making at the single-neuron level

The decisions we make, the memories we form, and the skills we learn define each of us as individual beings. While much has been learned about how circuits of neurons implement simple individual tasks, little is known about how such circuits give rise to human cognition. What defines when an episodic memory begins and ends? How do we bring back to mind the face of a person from memory? Why is maintaining memories in working memory effortful? We are probing these questions by recording from individual neurons in human subjects undergoing neurosurgical procedures, with a focus on the hippocampus, amygdala, and medial frontal cortex. I will discuss recent progress on how cognitive boundaries structure episodic memory, the neural substrate of working memory, and how disentangled abstract representations enable rapid learning and cognitive flexibility. I will also discuss new information geometric tools to quantifying the structure of population codes that have enabled these discoveries. Our findings reveal single-cell correlates of key aspects of human cognition and suggest specific interventions for new treatments for memory disorders.

Thursday, June 19, 1:40 - 2:30 pm

Andrew Pruszynski

Western University

Dr. Andrew Pruszynski is an Associate Professor and Canada Research Chair in Sensorimotor Neuroscience in the Department of Physiology and Pharmacology at The University of Western Ontario. He is a human and monkey systems neuroscientist whose work aims to understand how inputs from the skin and muscles contribute to the neural control of reaching, grasping, and object manipulation.

SPEAKERS AND ABSTRACTS

Planning while moving

Real-world actions often require executing a series of movements that cannot be fully planned in advance. Instead, the brain must simultaneously plan future movements while executing the current one. How the brain implements such online planning remains largely unknown. To investigate this, we have recently developed a sequential reaching task that manipulates how many future reaches a participant can plan while controlling the execution of the ongoing reach. In this talk, I will first show that humans and macaque monkeys plan at least two reaches into the future and that these planning processes interact with one another. I will then provide an initial account of how the macaque brain implements these processes, highlighting how populations of neurons in the motor and premotor cortex encode multiple upcoming movements while ensuring this information is separate from execution-related activity.

Thursday, June 19, 2:30 - 3:20 pm

Daniel Wolpert

Columbia University

Daniel Wolpert read medicine at Cambridge before completing an Oxford Physiology DPhil and a postdoctoral fellowship at MIT. He joined the faculty at the Institute of Neurology, UCL in 1995 and moved to Cambridge University in 2005 where he was Professor of Engineering and a Royal Society Research Professor. In 2018 he joined the Zuckerman Mind Brain Behavior Institute at Columbia University as Professor of Neuroscience. He was elected a Fellow of the Academy of Medical Sciences (2004), Fellow of the Royal Society (2012) and has been awarded the Royal Society Francis Crick Prize Lecture (2005), the Minerva Foundation Golden Brain Award (2010) and the Royal Society Ferrier medal (2020). His research interests are computational and experimental approaches to human movement (www.wolpertlab.com)

SPEAKERS AND ABSTRACTS

Computational principles underlying the learning of sensorimotor repertoires

Context is widely regarded as a major determinant of learning and memory across numerous domains, including classical and instrumental conditioning, episodic memory, economic decision-making, and motor learning. However, studies across these domains remain disconnected due to the lack of a unifying framework formalizing the concept of context and its role in learning. I will present a principled theory of motor learning based on the key insight that memory creation, updating, and expression are all controlled by a single computation – contextual inference. Unlike dominant theories of single-context learning, our repertoire-learning model accounts for key features of motor learning that had no unified explanation and predicts novel phenomena, which we confirm experimentally. Although this model was developed for motor learning the principles underlying the model are domain general. Our results suggest that contextual inference is a key principle underlying how a diverse set of experiences is reflected in behavior.

Thursday, June 19, 3:50 - 4:40 pm

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POSTER SESSION 1 June 17, 12:40 - 2:40 pm

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LAB TOUR OPTIONS

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Erez Freud Lab	Sherman 1014
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James Elder Lab	Lassonde 0002
Doug Crawford Lab	Lassonde 0003M

Life Science Building Labs and Demos:

Niko Troje Lab

Sign up for a tour at the registration desk

POSTER ABSTRACTS

Ahmed Nadeem

Laurence R. Harris

York University

Distance-Dependent Distortions in Haptic Spatial Updating Following Lateral Translation

When moving around one must continuously update one's internal spatial representations to interact effectively with one's environment. Although most literature has focused on visual spatial updating, haptic perception—derived from tactile, proprioceptive, and kinaesthetic signals—and haptic spatial updating remain underexplored. A well-known finding in the haptic literature is that haptic localization accuracy decreases as the distance from the observer increases. Concurrently, translations in a visual context—whether lateral, forward, or backward—are frequently undercompensated, leading to systematic misestimations of object displacement relative to self-motion during updating. These findings motivated us to investigate whether the increasing error in haptic localization with distance is further exacerbated by undercompensating for translations during updating. Participants haptically explored the locations of manipulanda positioned at preselected locations. After encoding their positions, participants either took a step leftward, rightward, forward, backward, or remained stationary for five seconds before replacing the object at its original position. Positions of observers and targets were recorded by an Optitrack system. Under stationary conditions, participants repositioned objects with high overall accuracy; however, the precision of their placements diminished as the distance from the observer increased. In contrast, following a lateral translation, objects were repositioned at locations further from their original positions. Moreover, accuracy diminished as both the translation distance and the distance from the participant increased. These results suggest that haptic spatial updating may overcompensate for observer translations, leading to a systematic mislocalization in which remembered haptic positions are perceived as being farther away than they truly are.

Poster Session: 1

Poster Board: 1

Ali Rezaei

Corson N. Areshenkoff, Daniel J. Gale, Anouk J. De Brouwer, Joseph Y. Nashed, J. Randall Flanagan, Jason P. Gallivan

Queen’s University

Human Cortical-subcortical Manifold Structure During the Transfer of Motor Learning

An often-desired feature of motor learning is that it generalizes to untrained scenarios. Yet, how this is supported by brain activity remains poorly understood. Here we show, using human functional MRI and a sensorimotor adaptation task involving the transfer of learning from the trained to untrained hand, that the transfer phase of adaptation re-instantiates the same cortical manifold structure as observed during initial adaptation. Notably, we find that these manifold changes, rather than occurring at the level of sensorimotor regions, predominantly occur across distributed areas of higher-order transmodal cortex, specifically in regions of the default mode network (DMN). We found that these learning-related manifold changes relate to the structural properties of transmodal cortex (its myelin content and neurotransmitter receptor density), and that intersubject differences in DMN manifold structure relate to both adaptation- and transfer-phase task performance. Together, these findings suggest that the transfer of learning across the hands is supported by the re-expression of the same activity patterns in the DMN as those that support initial learning. Collectively, these results offer a unique characterization of the whole-brain macroscale changes associated with sensorimotor learning and generalization, and establish a key role for higher-order brain areas, such as the DMN, in the transfer of learning to untrained scenarios.
Keywords: Motor learning, default mode network, brain connectivity, generalization, manifold, motor control, reaching

Poster Session: 1

Poster Board: 2

Alice Elizabeth Atkin

Daniel Scott, Aaron Granley, Anthony Singhal

York University

Cognitive and Sensorimotor Task Performance Predicts On-road Driving Risk in Commercial Truck, Bus, and Light Vehicle Drivers

Safe driving requires numerous cognitive and sensorimotor skills. Unsafe driving can be identified using an on-road evaluation, but this can be risky, time-consuming, and expensive. Poor performance on cognitive and sensorimotor tasks has previously been shown to predict on-road driving performance in privately licensed drivers, but commercially-licensed drivers have not yet been studied despite commercial driving generally being more demanding, with larger and heavier vehicles that increase the risk from unsafe driving. For this study, we recruited 3 types of commercial drivers (truck, heavy and light vehicle drivers) and presented them with the tablet based, Vitals cognitive screening tool. The Vitals tool uses a series of 4 tasks to measure reaction time, decision-making judgment, working memory, and sensorimotor control. Following the Vitals, participants completed a standardized on-road driving evaluation using their vehicle. Performance on the Vitals tool was shown to predict on-road performance across all vehicle types, with participants becoming more likely to fail their on-road evaluation as their performance on the Vitals decreased. On an individual task level, on-road evaluation failure was associated with lower success on the judgment and working memory tasks, and less time on-target in the sensorimotor control task. This study demonstrates that cognitive and sensorimotor task performance is a good predictor of risk in commercially-licensed drivers, regardless of vehicle type. Use of the Vitals tasks as a screening tool prior to an on-road evaluation may benefit both drivers and evaluators.

Poster Session: 1

Poster Board: 3

Alyssa Lynn

Siyavash Izadi, Dr. Michael Barnett-Cowan

University of Waterloo

Investigating the Contributions of the Right Temporoparietal Junction in Cybersickness and Sensory Reweighting During Virtual Reality Exposure

Virtual reality (VR) can induce cybersickness, characterized by symptoms such as headache, nausea, dizziness, and/or disorientation. Cybersickness may arise when sensory information from the visual, vestibular, and proprioceptive systems conflicts. Individual differences in susceptibility to cybersickness may stem from users' ability to adjust the contributions of each sensory system, a process known as sensory reweighting. Sensory reweighting enables users to prioritize more reliable sensory inputs, improving perception when confronted with unreliable or incongruent signals. This study examines the role of the right temporoparietal junction (rTPJ) in sensory reweighting and its impact on cybersickness. Previous research has shown that anodal transcranial direct current stimulation (tDCS) applied to the rTPJ during VR can reduce cybersickness. We hypothesize that the rTPJ plays a role in sensory reweighting and that tDCS targeting this region can modulate sensory reweighting, potentially reducing or increasing cybersickness through anodal or cathodal stimulation, respectively. Sensory modality reliance is assessed using the Oriented CHaracter Recognition Task (OCHART), which measures the extent to which individuals rely on bodily, visual, and gravitational cues when perceiving upright.
Preliminary results indicate that anodal stimulation was associated with a greater emphasis on gravitational cues relative to sham stimulation, while also showing a larger reduction in the reliance on bodily cues compared to sham stimulation. No significant differences were found in the weight changes for visual, bodily, or gravitational cues between sham and cathodal conditions.

Our findings enhance our understanding of how the brain supports perceptual adaptations when faced with sensory conflict in VR. Further data collection is necessary, however, to clarify the relationship between sensory reweighting and cybersickness.

Poster Session: 1

Poster Board: 4

Aman Anand

Farhana Zulkernine

Queen’s University

Situational Hallucination in Vision-Language Models: A Challenge for Situation-Aware Activity Monitoring

Understanding situational context is essential for AI systems deployed in assistive and safety-critical environments, such as hospitals and elderly care facilities. For example, differentiating between a caregiver assisting a patient and a potential medical emergency requires not just object recognition but also an awareness of the relationships between actions, actors, and environmental cues. Despite recent advances in Vision Large Language Models (VLLMs), we find that state-of-the-art models like LLava 1.5 (7B and 13B) exhibit situational hallucination, a failure to correctly interpret context shifts, often conflating visually similar but semantically distinct scenarios.

In this study, we systematically evaluate VLLMs across various contextual reasoning tasks, including actor role changes, viewpoint variations, and action transitions. Using a curated set of images depicting subtle yet meaningful situational differences, we observe that VLLMs fail to distinguish between different situations or context. For example, a chief holding a knife in the kitchen versus a man hiding a knife indicating a potential danger.

Our results show that VLLMs frequently misattribute intent, fail to recognize critical shifts in action, and struggle with multi-step event reasoning, leading to responses that are misleading or contextually incorrect.

This limitation has serious implications for assistive AI systems, particularly in hospital activity monitoring, where an AI misidentifying a routine checkup as an emergency or vice versa, can result in false alarms or overlooked critical events. The inability to maintain situational continuity and track contextual dependencies suggests that current VLLMs lack the robust multimodal reasoning necessary for real-world deployment in assistive applications. In future research, we plan to integrate cognitive-inspired situation awareness in the model to autogenerate prompt for VLLMs to reason beyond static visual cues, enabling safer and more reliable AI assistance in human-centered environments.

Poster Session: 1

Poster Board: 5

Anaa Zafer

Sara Djambazovska*; Hamidreza Ramezanpour; Gabriel Kreiman; Kohitij Kar

York University

Decoding Contextual Effects in Vision: A Cross-Species Behavioral Approach

The significance of context in visual perception is undeniable. Our understanding of the natural world is shaped not just by the foveated visual objects but also by the surrounding scene and prior experiences. While the influence of context on vision has been demonstrated psychophysically, the underlying mechanisms integrating objects and surrounding information during scene comprehension are not fully understood. Studies have extensively examined "low-level" contextual effects, such as extra-classical receptive fields and surround suppression, yet gaps remain in comprehending how context affects "higher-level" visual recognition tasks. To elucidate these neural processes, a detailed examination of the neural networks involved is essential. Rhesus macaques, with their visual processing circuits akin to humans, present an ideal model for this purpose. In our study, we assessed the behavior of 90 human participants via Amazon Mechanical Turk in a binary match to sample object discrimination task, using images with varied contexts (full, incongruent, no context, etc.). The results revealed a significant alteration in human performance due to contextual changes, exhibiting a consistent behavioral pattern across context categories (trial-split reliability of ~0.8). This finding was crucial for comparison with macaques. After training monkeys (n=2) to achieve ≥80% accuracy in object categorization with full-context images, we exposed them to the same contextually manipulated images. The behavioral variance shared between humans and monkeys was significant (~31%), and not attributable to low-level image factors such as object size or contrast. Interestingly, naive macaque inferior temporal (IT) neural responses did not fully account for the observed human-monkey shared variance (13% of image-level explained shared variance), suggesting that the effects are likely driven more by learning processes and feedback mechanisms than by innate IT response statistics. This research paves the way for future investigations into the neural mechanisms of contextual modulation in primate vision.

Poster Session: 1

Poster Board: 6

Arefeh Farahmandi

Parisa Abedi Khoozani, Gunnar Blohm

Queen’s University

Multisensory Integration Across Reference Frames with Feed-forward Networks

The integration of multiple sensory inputs is crucial for human perception and action in uncertain environments. Previous studies have shown multisensory integration in humans aligns with Bayesian optimal inference, although the neural mechanisms involved are still debated (Ernst et al, 2002; Kording et al. ,2006). Several population coding models have been proposed to implement probabilistic inference, including a recent suggestion that explicit divisive normalization can explain the empirical principles of multisensory integration (Ohshiro et al. 2011). However, whether and how divisive operations are implemented in the brain is not well understood. Indeed, existing models suffer from the curse of dimensionality and thus fail to scale to real-world problems. We introduce a multilayer feedforward network to approximate Bayesian inference in multisensory visual-proprioceptive integration across different reference frames. This model accounts for empirical principles of multisensory integration observed in Ventral Intraparietal (VIP) neurons such as inverse effectiveness, cross-modal enhancement, and suppression without requiring a neatly organized connectivity structure among neurons, unlike explicit divisive normalization models (Deneve et al. 2001).

Neurobiological studies show that responses of neurons in multisensory regions are either enhanced or suppressed with respect to their unimodal responses (Meredith et al. 1983). We measured response enhancement indices to quantify these neuronal behaviors. The results showed similar variability in the multisensory layer to that reported in VIP neurons (Avillac et al. 2007). Inverse effectiveness, a reported phenomenon in multisensory brain areas, states multisensory enhancement is greater for weak inputs than stronger inputs. Our model produced inverse effectiveness where multisensory enhancement only occurs when both sensory inputs are weak, and as the reliability of the sensory inputs increases, the bimodal response becomes suppressed. Overall, our findings show simple feedforward networks can approximate optimal inference across different reference frames and explicit divisive normalization is not necessary for the brain to achieve multisensory integration.

Poster Session: 1

Poster Board: 7

Arleen Aksay

Laurie M. Wilcox

York University

Observer Experience with 3D Displays Modulates the Effects of Cue Conflicts on Depth Estimates

When asked to estimate depth magnitude in naturalistic tree stimuli, observers lacking experience with virtual reality (VR) exhibit little scaling of depth with binocular disparity. In contrast, experienced observers show the expected relationship between disparity and perceived depth. Here, we asked whether novice observers' results reflect a general inability to generate metric depth estimates or sensitivity to cue conflicts that may degrade distance estimation in VR. We rendered 'branch' and 'thicket' stimuli in VR and 3D-printed exact physical replicas. In the branch condition, two branches were presented on either side of a central reference branch. The thicket condition consisted of clusters of overlapping branches. For both, the total disparity ranged from 0.33 to 2.10 degrees. Separate groups of novice observers estimated the 3D volume of 'branches' (N=28) or 'thickets' (N=28) using a virtual ruler. Both conditions were tested in VR. Our VR results replicated previous outcomes: novice observers showed limited depth scaling irrespective of complexity. Very different results were obtained using physical stimuli, for which estimates scaled well with disparity. These results support our hypothesis that novice observers' poor depth scaling is related to cue conflicts in VR (e.g., the vergence-accommodation conflict - VAC), which may distort perceived distance. Importantly, experienced observers show reasonable depth scaling for virtual stimuli, suggesting they can ignore such conflicts. In a third experiment, we replicated this study using a stereoscope with minimal VAC. In this case, depth estimates for a separate group of novice observers (N=25) did scale with disparity and, in the branch condition, were similar to the performance of experienced observers. The results suggest that novice users of 3D displays are highly susceptible to the effects of VAC. These findings highlight the need to consider experience for psychophysical studies and for understanding user experience in VR applications.

Poster Session: 1

Poster Board: 8

Ashkan Karimi

Xianze Meng, Karolina A. Bearss, Sarah Robichaud, Rachel J. Bar, Joseph FX DeSouza

York University

Neuroplastic Effects of Dance Training in Parkinson's Disease: Functional and Structural Adaptations in Speech-Related Brain Regions

Background: Parkinson's disease (PD) is a neurodegenerative disorder characterized by progressive motor and non-motor impairments, including speech deficits. Dance-based interventions have shown promise in improving motor function, cognitive engagement, and neuroplasticity, yet the neural mechanisms underlying these effects remain unclear. Objective: This study used multi-modal neuroimaging to investigate the impact of an 8-month dance training program on functional brain activity, cortical structure, and white matter integrity in individuals with PD.

Methods: Ten individuals with PD participated in dance training and underwent functional MRI (fMRI) and cortical thickness analysis (T1-weighted MRI) at four-time points. Four participants underwent diffusion-weighted imaging (DWI) at the last two time points. fMRI assessed BOLD signal changes in the Motor Cortex (Inferior Frontal Gyrus) during a dance-imagery task. Cortical thickness was measured in Broca's Area (Brodmann Area 44) and the Left Supplementary Frontal Language (SFL) Area. White matter integrity between these regions was evaluated using Fractional Anisotropy (FA), Axial Diffusivity (AD), Radial Diffusivity (RD), and Mean Diffusivity (MD).

Results: Functional Activity: BOLD signal reductions in the Motor Cortex from September to January ($p = 0.021$), with no further changes in May. Cortical Thickness: No significant differences in Broca's Area or the SFL Area ($p > 0.05$). White Matter Integrity: FA significantly increased from January to May ($p = 0.025$), with a marginal AD increase ($p = 0.056$), while RD and MD remained unchanged.

Conclusion: Dance training may have led to functional and structural neuroplasticity in people living with PD, enhancing motor-related activity and white matter connectivity between motor and language networks. While cortical thickness changes were not observed, findings suggest possible training-induced neuroplasticity. Dance may serve as a promising intervention for improving neural efficiency and motor-linguistic integration in PD, warranting further investigation in larger, more controlled studies.

Poster Session: 1

Poster Board: 9

Athena He

Moaz Shoura, Zaynab Azeem, Marco Sama, Jonathan Cant, Adrian Nestor

University of Toronto Scarborough

Multi-race Ensemble Perception: an EEG Investigation

Recent work has advanced our understanding of ensemble face perception and its neural mechanisms; however, the processing of multi-race face ensembles remains largely unexplored. This gap is particularly significant given the theoretical parallels between ensemble perception and the other-race effect, both of which involve a tendency toward perceptual averaging. Furthermore, understanding multi-race ensemble perception has practical relevance in diverse social settings.

Using electroencephalography (EEG), we examined neural responses in East Asian and White adults viewing: (i) single-race ensembles (i.e., groups of East Asian or White female faces), (ii) multi-race ensembles (with equal numbers of East Asian and White faces), and (iii) outlier ensembles (containing a single face of a different race from the majority). Neural decoding, using temporally cumulative classification, was conducted on EEG signals between 50–650 ms post-stimulus onset.

Results showed that other-race (OR) ensembles (i.e., distinct groups of single-race ensembles viewed by participants of the other race) could be reliably decoded despite the well-documented OR effect, which impairs recognition of other-race faces. Additionally, multi-race ensemble perception was primarily influenced by OR faces, as revealed by lower decoding accuracy compared to single-race OR ensembles. In contrast, perception of outlier ensembles was driven by the majority race, regardless of the participant’s race, suggesting that outliers tend to be overlooked. These findings provide insights into the neural mechanisms underlying ensemble face perception, other-race face recognition, and their interaction.

Poster Session: 1

Poster Board: 10

Avery Hannah Chua

Anna Kosovicheva

University of Toronto Mississauga

How Well Can We Track Our Own Eye Movements? A Novel Tracking Paradigm Provides Insights on Gaze Awareness

When asked where they have previously looked, people rarely report their visual behaviour correctly. However, most tasks probe explicit awareness (e.g., recognition), and it remains unclear whether poor awareness extends to implicit measures. To investigate this question, we designed a novel tracking paradigm. First, participants (n = 24 each) completed a classic visual search task while their eye movements were recorded. Next, participants completed a tracking task in which they were instructed to follow a moving red dot on the screen. In Experiment 1, the dot replayed either their own previously recorded gaze position or that of another participant, while in Experiment 2, it replayed either unaltered temporal sequences of their own eye movements or temporally reversed ones. During the tracking task, the dot was visible 50% of the time, randomly disappearing for brief segments of time, and participants were instructed to move their eyes to where they believed the dot would appear next. Furthermore, replayed eye movements were either superimposed on the same stimulus array displayed during the search task, or on a plain grey background. Tracking accuracy was measured by cross-correlating the previously recorded gaze position with the tracked positions. Our results in Experiment 1 showed that participants were not significantly more accurate in tracking their own eye movements versus others ($p = .88$), regardless of whether the eye movements were superimposed on the same stimulus array or not ($p = .48$). However, in Experiment 2, participants were significantly more accurate in tracking temporally unaltered eye movements versus their reversed counterparts ($p < .001$), and the presence of the same stimulus array facilitated better tracking accuracy ($p = .008$). Overall, our results suggest that though awareness of one's eye movements are generally poor, extreme manipulations, like temporally reversing one's eye movements, can influence tracking performance.

Poster Session: 1

Poster Board: 11

Aysha N. Kinakool

Aysha N. Kinakool, Stefania S. Moro, Remy Cohan, Sara A. Rafique & Jennifer K.E. Steeves

York University

Changes in Visual Cortex Resting-state Functional Connectivity but Not Neurotransmitter Concentrations in a Single Case Study of Charles Bonnet Syndrome

Charles Bonnet Syndrome (CBS) is characterized by visual hallucinations secondary to vision loss in the absence of cognitive impairment. Evidence suggests that the neural mechanisms of CBS may arise from hyperexcitability within an impaired visual system. The underlying aetiologies that cause vision loss may impact the neural correlates of CBS. Previous research has shown that CBS in an individual secondary to retinitis pigmentosa may be associated with altered resting-state functional connectivity (rsFC) between visual areas and nodes in the default mode and salience networks (Martial et al., 2019). We employed resting-state functional magnetic resonance imaging (rsfMRI) in a patient (AP) with CBS, and a history of age-related macular degeneration and ocular tuberculosis. We additionally employed magnetic resonance spectroscopy (MRS) to examine visual cortex glutamate and gamma-aminobutyric acid (GABA) concentrations. Compared to six age-matched healthy controls, patient AP showed: (1) increased negative connectivity between visual occipital network and nodes in the default mode network (precuneus and posterior cingulate); (2) increased positive connectivity between the precuneus, posterior cingulate cortex, and left intraparietal sulcus of the dorsal attention network; and (3) increased negative connectivity between right cuneal cortex and the temporo-occipital inferior temporal gyrus, and between the left lingual gyrus and the left posterior parahippocampal gyrus. In addition, patient AP showed no difference in visual cortex glutamate and GABA concentrations. Overall, the results suggest a disruption in the antagonistic relationship between task-negative (default mode) and task-positive (dorsal attention) networks of visual processing; and altered connectivity between early visual areas and functionally specialized regions for visual perception processing.

Poster Session: 1

Poster Board: 12

Benjamin Corrigan

S. P. Errington, A. Sajad, J. D. Schall

York University

Response Conflict Neurons: Re-evaluation in Medial Frontal Cortex of Non-human Primates

A major theory of cognitive control is based on the quantity “conflict”, which is the co-activation of incompatible response processes. In humans performing tasks that create response competition, neural evidence supporting the theory was identified with activation in medial frontal cortex, particularly ACC, observed with fMRI and single unit recordings in humans and inferred from event-related EEG. In non-human primates performing a saccade countermanding task, neurons identified with response conflict have been described in SEF but not in ACC. We re-examined the incidence of neurons signaling response conflict in supplementary eye field (SEF) and the dorsal and ventral banks of cingulate cortex (d/vCC) with more reliable sampling offered by 32-channel linear electrode arrays spanning cortical layers in two male Macaca mulatta performing saccade countermanding. We analyzed single neuron modulation of 2410 isolated units (813 DMFC, 976 dMCC, 621 vMCC) sampled in 164 penetrations at 32 grid locations spanning 26-34 mm anterior to the interaural line. Neurons modulating specifically when response conflict was maximal were found in cingulate cortex—more commonly in dCC than in vCC. Such neurons were more common in SEF. These findings confirm the presence of a response conflict signal in medial frontal cortex of monkeys although in a small fraction of neurons. Further research is investigating other measurement criteria and population-level descriptions to determine whether the weak response conflict signal in cingulate cortex is sufficient or negligible.

Poster Session: 1

Poster Board: 13

Bianca R. Baltaretu

Petros Georgiadis, Melissa Le-Hoa Võ, & Katja Fiehler

Justus Liebig University

Scene Semantic Effects on Spatial Coding in Naturalistic (Virtual) Environments

Interacting with objects in our environment involves object perception and object location coding. This can be achieved by using an egocentric (self-centred) and/or allocentric (object-centred) reference frame. For memory-guided actions, allocentric coding for more naturalistic scenarios has been shown to be subject to the influence of low- to high-level factors (e.g., task relevance). The semantic relationship between local objects (small, moveable) has also been shown to strengthen allocentric coding (i.e., stronger effects for local objects of the same object category). Currently, the role of the next level of the scene grammar hierarchy, i.e., anchor objects (large, stationary, predictive), in allocentric coding is largely unexplored. Here, we investigated the effect of anchor 1) identity and 2) presence on allocentric coding of local objects within two scene types (kitchen, bathroom). In a virtual environment, three local objects were presented on a shelf in one of three conditions: 1) scene-congruent anchors present, 2) cuboids present, or 3) only the shelf present. After a brief mask and delay, the scene was presented again without the local objects and one of the anchors/cuboids shifted (leftward or rightward) or not shifted. Then, participants had to grab the presented local object target with the controller and place it in its remembered location on the empty shelf. Our findings showed that placement behaviour was neither affected by anchor identity changes, nor by anchor presence. These findings suggest that any large(r), stable anchor object that is present benefits allocentric coding of local objects in memory-guided placement tasks.

Poster Session: 1

Poster Board: 14

Bjoern Joerges

Laurence R. Harris

York University

A Vestibular Contribution to Time-to-Contact Estimation?

Estimation of time-to-contact is commonly thought to be solved based on visual cues alone. In this project, we investigated whether the vestibular system contributes to this perceptual skill. To this end, we immersed 10 participants in a virtual reality office environment in which they were presented with a soccer ball travelling on a parabolic trajectory either according to Earth gravity (1g) or to inverted Earth gravity (-1g). The object disappeared at a randomized time after the peak and participants were asked to press a mouse button when the ball returned to its original height. Participants completed this task both standing upright and lying supine. While surprisingly there were no differences in estimated time-to-contact between 1g and -1g, we found a robust overestimation of time-to-contact between standing upright and lying supine in all 10 participants. A control experiment confirmed that this was not due to a general decrease in reaction times while lying supine versus when upright for our stimulus. Overall, this surprising result challenges common wisdom that time-to-contact estimation is solely guided by retinal cues; other sensory input such as vestibular cues may play a more important role than previously thought. Further research, e.g., using galvanic vestibular stimulation, is, however, needed to conclusive determine whether or not the vestibular system is involved.

Poster Session: 3

Poster Board: 1

Brando Sheldrick

Veronica Nacher-Carda, Jennifer Lin, Hongying Wang, Saihong Sun, Xiaogang Yan, J. Douglas Crawford

York University

Posterior Intraparietal Sulcus Activity During a Head Unrestrained, Memory Guided Reach Task

The purpose of the current study is to investigate how local field potential (LFP) activity along the mid-posterior intraparietal sulcus (IPs) is modulated by visual landmarks before and during reaches to remembered visual targets. We recorded both action potentials and LFPs using 32-channel neural probes in one female Rhesus monkey. A landmark (four identical dots positioned at the vertices of a virtual square) was displayed at one of fifteen locations within reach on a touch screen. A visual target then appears, either within or outside of the landmark square, followed by a visual mask. After the mask disappeared, the landmark reappeared either at the same location (stable landmark condition) or shifted by 8 degrees in one of eight directions (landmark shift condition). Gaze and head position were allowed to move freely, and the animal was rewarded for reaching within 4.7 cm of the target. In the 'no-landmark' control trials, the procedure was the same, but the landmark is not presented. In parallel array recordings from posterior ventrolateral prefrontal cortex, LFP activity displayed a decrease in delta band power during the memory-delay phase and an increase in both delta and theta power during the planning and execution of the reaching movement (Lin et al., CAN-ACN 2025). Preliminary analysis of the current IPS LFP dataset suggests a decrease in beta band power that is time-locked to the reaching movement. Additionally, there appears to be an increase in delta and theta band power before reward in the landmark task conditions compared to no-landmark controls.

Poster Session: 1

Poster Board: 15

Braxton Hartman

Dale Stevens, Naail Khan

York University

Atypical Relations Between Default, Dorsal Attention and Frontoparietal Control Networks in Autism Spectrum Disorder

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by difficulties in social interaction and communication, and by restricted and repetitive behaviours. We used resting-state functional connectivity fMRI to investigate the functional organization of three intrinsic brain networks which subserve domains of behaviour known to be impacted in ASD; the antagonistic “default” and “dorsal attention” networks—which subserve internally and externally directed cognition, respectively—and the “frontoparietal control” network which flexibly couples with either the default or dorsal attention network in order to dynamically direct the locus of attention.

Participants were individuals with ASD (n = 25) and typically developing (TD) individuals (n = 25). Using agglomerative clustering, we characterized the hierarchical organization of the three networks in each group separately. Despite the increasing utilization of such hierarchical analyses to characterize the relations between intrinsic brain networks, there is presently no well-established method for quantitatively comparing this organization between groups. Using a novel method of analysis, we demonstrated that there is a statistically significant difference in the intrinsic organization of these networks between individuals with ASD and TD individuals—the hierarchical similarity of participants within each group is greater than between groups.

Our findings revealed that ASD participants exhibited a fragmented frontoparietal control network, with its nodes abnormally clustering with either the default or dorsal attention network, rather than forming an independent network. Additionally, the typical anticorrelation between the default and dorsal attention networks was significantly reduced in ASD. This intrinsic network architecture may reflect a decrement in neural capacity to flexibly modulate between internal and external attention in response to task demands. These results suggest that ASD is associated with atypical hierarchical organization of large-scale intrinsic brain networks, potentially contributing to cognitive and behavioral symptoms.

Poster Session: 1

Poster Board: 16

Brittney Hartle

Robert S. Allison, Laurie M. Wilcox

York University

Convexity Biases in Stereoscopic Judgements of Ground Terrain

Safely traversing across irregular terrain requires identification of complex variation in upcoming surfaces. We previously showed that stereopsis plays a significant role when discriminating terrain irregularities. However, observers were often biased towards perceiving convex surfaces, even when stereopsis indicated a concave depression. It was surprising that strong, yet ambiguous shading could activate a convexity bias and override stereopsis. The aim of the current study was to 1) determine whether the bias was generalizable to other viewing environments, and if so, 2) better understand its origin. We first replicated our previous study using a virtual reality headset. We then investigated whether the distribution of stereoscopic cues impacted the bias by varying the availability of binocular disparities either by 1) only showing one half of the surface or 2) presenting the full surface to one eye and half of the surface to the other (half-occlusion). All stimuli consisted of virtual grass terrain with a central mound or dip. We measured discrimination thresholds for the direction of terrain features (convex vs. concave). As in our previous study; under strong shading, half of observers exhibited a convexity bias. Observers that had elevated (but normal) stereoacuity thresholds were more likely to exhibit biases for convexity than observers more sensitive to stereoscopic depth. Judgements of half-occluded surfaces showed that eliminating the binocular disparity signal from one surface half did not impact the convexity bias. The bias was only present when the shading cue was strong. Thus, our results demonstrate that low illumination in the shaded region did not reduce the reliability of stereoscopic cues. Instead, the bias was attributable to the presence of strong shading. Despite all observers possessing normal stereoacuity, 53% relied on an ambiguous shading cue to interpret the ground relief. In impoverished environments, this could lead to potentially hazardous misjudgments during locomotion.

Poster Session: 1

Poster Board: 17

Brooke Lim

Anna Kosovicheva

University of Toronto Mississauga

A Comparison of Methods for Measuring Interocular Delays

Many everyday tasks rely on binocular vision, which is impaired in individuals with amblyopia. Impairments in visual-spatial processing normally characterize amblyopia, but previous work has shown deficits in temporal processing as well, including processing delays in the amblyopic eye. Many techniques have been developed to measure interocular timing delays behaviourally by showing different images to the two eyes and recording participant responses. However, agreement between these measures has not been previously investigated. We compared four different assessment measures in normally-sighted observers: depth-based judgments (using the Pulfrich effect), interocular flicker integration, reaction time to monocular targets, and interocular temporal order judgments. Stimuli were presented using a high-speed projector with passive polarized filters (240 Hz per eye), enabling precise temporal control for dichoptic presentation. We also included a measure of sensory eye dominance to determine how eye dominance is related to each of the timing-based measurements. Pairwise comparisons of temporal delays measured across methods showed that the best-correlated pair of measures was between interocular flicker integration and temporal order judgements ($r = 0.50$). For each measure, we additionally calculated the average correlation between it and the remaining three measures. The Pulfrich effect was the best-correlated measure for examining timing delays between the eyes (Fisher $Z = 0.24$). In contrast, the measure that was least correlated with the other three measures was reaction time (Fisher $Z = 0.09$). Eye dominance was not correlated with the four temporal delay measures (Fisher $Z = -0.01$). Together, these results suggest that methods that rely on binocular integration are more reliable than monocular measurements. This highlights the importance of selecting appropriate tools for measuring interocular delays, and that suggests that combining specific methods may better characterize temporal delays seen in visual impairments.

Poster Session: 1

Poster Board: 18

Camille Proszanski

Erez Freud, Laurie M. Wilcox

York University

The Role of Stereopsis in Face Processing across the Visual Field

Stereoscopic realistic faces capture the volumetric 3D information available in the real world. However, most face perception studies have used 2D stimuli, which may be why the effects of visual hemifield specialization (an upper visual field advantage) are often small and have variable outcomes. Here, we evaluate the impact of naturalistic 3D face stimuli (relative to 2D), and their location in the visual field, on face detection and recognition. Stereopairs of photorealistic front facing face stimuli were presented using a mirror stereoscope in 3D and 2D. In all experiments, the target was present in 50% of the trials, and proportion correct was used to compute sensitivity (d'). In Experiment 1 (N=28), we used a novel visual search paradigm with stimuli presented in either the upper or lower visual field. The distractor faces were tilted 15 deg to the left (or right), and observers indicated if the target face (tilted in the opposite direction) was present. This low-level task showed no effect of modality (2D vs. 3D) and a weak effect of location. In subsequent experiments, we used the same stimuli but in high-level recognition-based tasks. We varied task difficulty and tested both upright and inverted faces (Experiment 2, N=22; Experiment 3, N=26). We found no effect of 3D viewing or location in either of the experiments, nor was there an interaction. The presence of a strong face inversion effect confirmed that observers were processing the faces holistically. Our results suggest that visual field asymmetries may only occur for tasks that rely on low-level properties. Further, the lack of effect of stereopsis implies that 2D images can be reasonable proxies for 3D faces. In ongoing studies, we are evaluating if these finding extend to faces that have greater relative disparity information.

Poster Session: 1

Poster Board: 19

Christopher L. Striemer

Branden T. Otte, Sean P. Dukelow, Stephen H. Scott

MacEwan University

Spatial Working Memory Impairment Predicts the Severity of Spatial Neglect Symptoms Over Time

Damage to the right temporal-parietal cortex often leads to spatial neglect – a disorder in which patients are unable to attend to people or objects on their contralesional (i.e., left) side. Previous research suggests that patients with spatial neglect may have impairments in spatial working memory (SWM). This has led some to suggest that a SWM deficit is a core component of the neglect syndrome that may exacerbate the severity of neglect symptoms. To further examine this hypothesis, 28 right hemisphere stroke patients (n=5 with spatial neglect) completed the Behavioural Inattention Test (BIT) – a standardized assessment for spatial neglect – as well as Spatial Span, Trails-A, and Paired-Associates Learning tasks using the Kinarm exoskeleton at baseline (median=31 days), and at ~2 months (n=21; median 65 days), and ~3 months (n=8; median=97 days) post-stroke. Our results demonstrate that, at each time point, patients with spatial neglect performed more poorly than patients without neglect on the Spatial Span task that measures SWM, as well as Trails-A, which measures visual search and visuomotor processing speed. In addition, at baseline, poorer performance on Spatial Span and Trails-A tasks were significantly correlated with the severity of spatial neglect symptoms (as measured by the BIT) across the entire patient group (n=28). More importantly, performance on the Spatial Span and Trails-A tasks at baseline were significant predictors of neglect symptom severity across the entire patient group at both the 2-month and 3-month follow-ups. Overall, these results provide further evidence that spatial neglect is accompanied by deficits in SWM and demonstrate, for the first time, that SWM deficits are associated with the severity of neglect symptoms over time.

Poster Session: 1

Poster Board: 20

Coleman Eagle Olenick

Heather Jordan, Nathan Rosen, Mazyar Fallah

University of Guelph

Memory Matching Modulates Inhibitory Control

Delayed match-to-sample (DMS) and delayed non-match-to-sample (DNMS) tasks both require participants to maintain a stimulus "on-line" in memory across a delay, before deciding which item to respond to. When making a saccade to the familiar target in the presence of a distractor, as in a DMS paradigm, one of two outcomes is observed. If the saccadic response is executed shortly after the appearance of the target/distractor, the saccade curves towards the distractor as a result of unresolved target-distractor competition. In contrast, if sufficient time elapses to resolve target-distractor competition, the saccade curves away reflecting inhibition of the non-target item (Guiricich et al , 2023). To better understand inhibitory control, we contrasted trials in which participants made saccades to the familiar match with those to the novel non-match stimulus, investigating the magnitude of the curvature away. With the general bias to novel stimuli, we predicted that more inhibition of the novel non-sample stimulus would be required when saccading to the familiar match than in the reverse case. Thus, we expected to observe greater curvature in DMS compared to DNMS trials. Participants executed saccadic responses to randomly interleaved DMS and DNMS trials. A coloured circle at fixation during the delay period informed the participant whether the target of their saccadic response should be made to the match or non-match item.

Consistent with previous studies using manual responses, more errors were made on DMS than DNMS trials. Saccadic RTs were faster for DMS than DNMS trials, but only for correct responses. Contrary to our hypothesis, significantly larger saccade curvatures were observed in the DNMS than the DMS. Also surprising given the response latency differences, the period in which curvature deviations were observed were the same across both tasks. We discuss these results in light of the drift diffusion model of perceptual decision-making.

Poster Session: 1

Poster Board: 21

Daanish Mulla

Mario Costantino, Erez Freud, Jonathan Michaels

York University

ATHENA: Automatically Tracking Hands Expertly with No Annotations

The human hand allows for dexterous manipulation unparalleled by any other living organism. As a result, humans can perform a rich repertoire of tasks, ranging from activities involving delicate finger control to forceful grasps. Conventionally, hand movements are recorded through expensive marker-based optoelectronic cameras that are prone to occlusion or time-consuming manual annotations of video recordings. The limitations of these systems have compelled researchers to predominantly study hand behaviours during simple movements within constrained in-lab settings that fail to capture the rich breadth of hand capabilities. To understand neural control of the hand, we need to study naturalistic hand behaviours that reflect how individuals learn complex skills in real-world settings. The purpose of our work was to develop and share an open-source Python-based toolbox for performing three-dimensional markerless tracking of the hands. Our toolbox uses Google's MediaPipe Solutions to automatically identify 2D locations of 42 key points bimanually across the hands and 33 key points across the entire body. The 2D key point locations from each camera view are triangulated to 3D. The 3D locations are refined using a multi-step procedure that improves the identification of left and right hands, iteratively smoothes the data, and enforces biomechanical constraints. The toolbox supports parallel processing of cameras, runs offline at approximately 0.25x real time for an 8 camera setup, and requires minimal dependencies. To validate the toolbox, we are currently comparing accuracy against an optoelectronic marker-based system during controlled unimanual reach-and-grasp movements and bimanual hand-object manipulation. In doing so, ATHENA will allow users to quantify hand kinematics during gross free-hand movements and fine precision tasks involving object interactions with both hands while exhibiting comparable tracking performance as marker-based technologies. Overall, we aim to share an easy-to-use, accurate solution for 3D hand tracking to facilitate studies for investigating naturalistic hand behaviours.

Poster Session: 1

Poster Board: 22

Danial Kordmodanlou

Danial Kordmodanlou, Nikolaus F Troje

York University

Perceptual Compensation for Illusory Parallactic Motion

Under real-world conditions, stereopsis and motion parallax provide complementary depth information, rarely leading to perceptual conflict. However, modern display technologies can uncouple these cues, creating illusory effects. For instance, when using shutter glasses with a stereo screen, observers moving laterally perceive illusory parallactic motion.

We investigate the perceptual mechanisms underlying this illusion by setting up a controlled VR experiment. Observers view an indoor scene through a framed display and compare two intervals in a 2IFC (two-interval forced-choice) task. In one interval, the scene is presented in stereo-only mode, where depth is conveyed via binocular disparity but lacks parallactic motion. In the other, the scene is shown monocularly with adjustable parallax gain. Participants judge which display appears to have more motion.

Preliminary results suggest:

In the monocular condition, motion parallax with a positive gain appears to induce less motion than an equal amount of negative gain.

In the binocular condition, the illusory parallax is perceptually comparable to real motion parallax at a specific positive or negative gain.

We interpret these findings as evidence that the brain predicts motion parallax based on stereoscopic depth and perceptually discounts expected parallactic motion. This transformation allows the egocentric retinal motion to be interpreted as a stable allocentric 3D environment. By quantifying the discounted parallax factor, our study sheds light on depth estimation mechanisms, spatial perception, and virtual display technologies, offering implications for VR design, telepresence systems, and vision science research.

Poster Session: 1

Poster Board: 23

Darrin Wijeyaratnam

Erin K. Cressman

University of Ottawa

Choice During Movement Preparation Leads to Greater Explicit Adaptation

The ability to make choices is fundamental to daily life, influencing one's motivation, sense of autonomy, and even ability to learn new motor skills. In the current experiment we examined the impact of providing participants with choice over their reaching target on visuomotor adaptation. In general, participants trained to reach with cursor feedback on a screen that (1) accurately represented their hand motion (aligned cursor), or (2) was rotated 40° clockwise relative to their hand motion (rotated cursor). A Choice group (CHO; n = 54) selected their reach target prior to moving, while a Yoked group (YOK; n = 54) followed the target sequence selected by the CHO group. After reaching with rotated cursor feedback, explicit (conscious strategy) and implicit (unconscious) adaptation were assessed using the process dissociation procedure. As expected, the CHO group reported a greater sense of autonomy compared to the YOK group, as established via a subscale of the intrinsic motivation inventory (CHO = 20.6 ± 0.3; YOK = 13.7 ± 0.5, $p < 0.001$). Both groups adapted their reaches to a similar extent during training (CHO = 35.1° ± 0.4°; YOK = 34.8° ± 0.4°, $p = 0.237$). Moreover, repeatedly choosing the same target sequence did not influence the extent of visuomotor adaptation ($p = 0.371$). However, the CHO group demonstrated greater explicit adaptation compared to the YOK group (CHO = 17.5° ± 1.6°; YOK = 10.6° ± 6.7°, $p < 0.001$). Implicit adaptation was comparable between groups (CHO = 16.1° ± 0.9°; YOK = 16.8° ± 1.1°, $p = 0.666$). These findings suggest that providing participants with the opportunity to make choices enhanced explicit adaptation, likely through increased task engagement.

Poster Session: 1

Poster Board: 24

Domenic Au

Robert S. Allison, Laurie M. Wilcox

York University

Forced Choice Methods for Assessing Visual Fidelity

Recent increases in display pixel count, frame rate and bit depth have challenged the ability of bandwidth limited links to transmit display data. Modern compressed display links aim to reduce bandwidth while presenting content that is visually indistinguishable from the original uncompressed versions. Subjective image quality assessment is essential and multiple methods have been proposed. Of these, the ISO/IEC 29170-2 flicker paradigm is a rigorous method used to define visually lossless performance. However, it is possible that the enhanced sensitivity to artifacts in the presence of flicker does not predict visibility under natural viewing conditions. Here, we test this prediction using high-dynamic range stereoscopic 3D images and video using two popular test protocols (flicker and non-flicker). As hypothesized, sensitivity to artifacts was greater when using the flicker paradigm, but no differences were observed between the non-flicker paradigms. Results were modeled using the Pyramid of Visibility, which predicted artifact detection driven by moderately low spatial frequencies. Overall, our results confirm the flicker paradigm is a conservative estimate of visually lossless behavior; it is highly unlikely to miss artifacts that would be visible under normal viewing. Conversely, artifacts identified by the flicker protocol may not be problematic in practice.

Poster Session: 1

Poster Board: 25

Elizaveta Yakubovskaya

Hamidreza Ramezanpour, Kohitij Kar

York University

Motion Adaptation Alters Object Position Estimates and Representations in Macaque IT Cortex, But Not in Artificial Neural Networks

Recent studies have demonstrated that the macaque inferior temporal (IT) cortex, a key area in the ventral visual pathway, supports not only object identification but also object position estimation—a function previously attributed to dorsal-stream mechanisms. In parallel, artificial neural networks (ANNs) optimized for object recognition replicate this positional decoding capability. Such findings invite an intriguing question: If these ventral-stream-aligned ANNs can recapitulate positional coding, can they also exhibit systematic positional biases induced by adaptation to motion, analogous to the well-known human aftereffects? We tested this by simulating adaptation in ANNs through the exponential decay of model features (Vinken et al. 2020). Using "brain-mapped" ANN architectures—feedforward convolutional networks (AlexNet, VGG), networks with skip connections (ResNet), and transformer-based models (ViT)—pre-trained on ImageNet, we analyzed responses from their most "IT cortex-like" layers to naturalistic test images. While these ANNs robustly decoded object positions under static conditions, none exhibited motion-adaptation-induced positional shifts. In contrast, when we presented motion-adapting rightward or leftward moving grating stimuli (3000 ms) to two passively fixating macaques and recorded large-scale IT responses to succeeding test images (40 images containing 1 of 8 objects, with varying latent parameters embedded in naturalistic backgrounds), the resulting position decodes from IT population activity showed directionally specific biases matching human perceptual aftereffects. These results suggest that the neural mechanisms in IT supporting adaptive shifts in perceived object position are not fully captured by current ANN models. Therefore, we hypothesized that additional history-dependent, nonlinear transformations might explain these dynamic adaptation effects. Testing a state-of-the-art dynamic video recognition model (SlowFast with ResNet-50 backbone) showed that even this more temporally sophisticated model failed to reproduce adaptation-induced positional aftereffects. Our results reveal a key gap: while current ANNs can decode position, they lack the temporal processing needed to replicate the adaptive positional biases in the macaque ventral stream.

Poster Session: 1

Poster Board: 26

Elysa Eliopulos

Bernard Marius ‘t Hart, Denise Y. P Henriques

York University

Reevaluating Strategy Development as a Single-Step Process in Visuomotor Adaptation

In response to a changing environment, humans can adapt their movement with contributions from both implicit, or unconscious and explicit strategies. Explicit visuomotor adaptation is thought to develop gradually in a series of small incremental steps. However, in some of our data we observed large, sudden changes in strategy comparable to Aha!-learning. Here, we investigate the timecourse of explicit learning in motor adaptation following the introduction of 5 perturbation sizes. To do so, we asked participants to report where they planned to move their hand throughout a motor adaptation task. This project will aim to test if 1) strategies develop in one or two discrete steps, and 2) the likelihood and magnitude of participants’ aiming strategy will increase as the rotation size gets bigger. Having a better understanding of cognitive strategy development in motor tasks may guide future work on motor learning, and applications for support in skills training and rehabilitation.

Poster Session: 1

Poster Board: 27

Emily Fewster

Bat-Sheva Hadad, Erez Freud

York University

Naturalistic Visuomotor Behaviours Reveal Reduced Handedness Lateralization in autism

Autistic individuals often exhibit differences in perceptual and visuomotor functioning. One account for these alterations suggests that autism involves reduced specialization of cortical systems. In the current study, we investigate how handedness, one of the most robust markers of cerebral lateralization, is modulated in autistic individuals. While previous studies already demonstrated more cases of left-handedness and reduced right-handed specialization in autism, those studies primarily relied on self-reports and questionnaires. Here, we employed a naturalistic task to explore this topic. Autistic and non-autistic right-handed participants (27 in each group) recreated five LEGO© models using blocks placed on a standardized tabletop. This design allowed us to capture dynamic, real-world visuomotor behaviours and explore how autistic individuals use their right and left hands to investigate and act on their reaching space. Our results revealed key group differences. First and most importantly, autistic participants displayed a lower proportion of right-hand grasps, suggesting reduced lateralization. Second, we observed differences in the use of 3D space, with autistic participants showing a stronger preference for blocks closer to their hands, suggesting larger safety margins in visuomotor interactions with the surrounding 3D environment. Analysis of the movement trajectories revealed that autistic participants had more idiosyncratic movement sequences and completed the task slower than non-autistic participants, indicating differences in motor efficiency. These findings demonstrate reduced specialization of hand use in autism, which may contribute to challenges and differences in visuomotor control.

Poster Session: 1

Poster Board: 28

Emily M. Heffernan

Benjamin Wolfe, Anna Kosovicheva

University of Toronto – Mississauga

The Impact of Font on Typo Detection: A Novel Visual Search Paradigm

In visual search tasks, we scan our environment to identify a target (e.g., looking for your car in a parking lot). A better understanding of the factors that lead to success and failure in visual search requires a task that mimics our lived experiences but permits a high degree of experimental control. Here, we developed a novel typo detection paradigm to uncover how attentional processes interact with visual properties of stimuli in a word-based visual search task. Participants (N=9) scanned pseudo-paragraphs comprised of random 5-, 6-, and 7-letter words to find typos (i.e., incorrectly spelled words), which were present on 50% of trials. Five types of typos were included: transpositions (two letters swapped), insertions (a letter added to a word), deletions (a letter removed from a word), repetitions (a letter repeated), and substitutions (a letter replaced with another letter). In addition, half of the trials were presented in an “easy-to-read” font (Arial) and half were presented in a “hard-to-read” font (a version of Roboto Flex with narrow width and a high stroke contrast). Font had a main effect on reaction time: participants responded more slowly when the stimuli were presented in the hard-to-read font. Font had no overall impact on accuracy. However, participants were worst at identifying transposition errors, and for these trials, font did have a significant effect, such that performance was lower for the hard- versus easy-to-read font. These findings also highlight substantial individual differences in performance and sensitivity to font manipulation. Taken together, these results indicate that the appearance of text does impact visual search for typos, but only for specific types of errors. This paradigm can elucidate how constraints in peripheral vision (e.g., crowding) impact visual search performance for text-based stimuli.

Poster Session: 1

Poster Board: 29

Emma Peters

Erin K. Cressman

University of Ottawa

Mental Fatigue Does Not Impede Visuomotor Adaptation Driven by Implicit Processes

Mental fatigue leads to declines in cognitive and motor performance. We have previously shown that mental fatigue impairs motor learning in a visuomotor adaptation task, engaging both explicit (i.e., cognitive strategy) and implicit (i.e., unconscious) processes (Apreutesei and Cressman, 2024). Specifically, mental fatigue led to decreased visuomotor adaptation early in training, and increased mental fatigue was positively correlated with impaired explicit engagement. The current research looked to extend this work and establish the impact of mental fatigue on implicit visuomotor adaptation, when contributions from explicit processes were negligible. Participants trained to reach with distorted cursor feedback that was rotated 20° clockwise relative to hand motion in a virtual environment. These rotated training trials were completed following a mentally fatiguing load dual back task (TLDB) lasting 32 minutes (Mental Fatigue (MF) group) or watching a documentary for the same duration (Control (CTL) group). Self-reported mental fatigue increased significantly for the MF group after completing the TLDB task, while the CTL group did not exhibit a similar increase in mental fatigue following the documentary. The extent of visuomotor adaptation was similar for MF and CTL participants across all rotated reach training trials and this adaptation was shown to arise implicitly, as explicit contributions were confirmed to be absent. Furthermore, no correlation was found between mental fatigue levels following the TLDB task and average implicit adaptation achieved across training blocks. These results suggest that mental fatigue does not interfere with visuomotor adaptation when it is driven implicitly. Additionally, the results support our proposal that mental fatigue interferes with engagement of cognitive strategies, while leaving implicit processes in visuomotor adaptation unaffected.

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Poster Session: 1

Poster Board: 30

Erica J. Li

Erica Li, Aidan Knights, Sarah Armstrong, Dhwani Bhavsar, Cameron Clarke, Markus Mendes, Bianca Padilla, Maxwell Schaub, David Shore

McMaster University

Investigating the Influence of Psychedelic Use on Visual Mental Imagery

We investigate the linkage between classical psychedelics (e.g., psilocybin, LSD, DMT) and mental imagery. Psychedelics are known to induce alterations of visual perception and can create hallucinations; mental imagery classifies the ability to generate sensory-like experiences without external input. To assess the face validity of this relation, we evaluate mental imagery ability in those who have and have not taken a psychedelic in the past year. Our measures of interest include subjective report of vividness (i.e., clarity, brightness, or intensity), and objective accuracy at colour matching (i.e., between a perceived colour and an imagined one). We will also evaluate the presence of Hallucinogen Persisting Perception Disorder (HPPD) and its relation with vividness or accuracy of mental imagery. Participants complete the Vividness of Visual Imagery Questionnaire (VVIQ), record a history of psychedelic use, polysubstance use, and any presence of HPPD symptoms. Participants then complete a mental imagery task, where they view a colored square, visualize it, and then identify its color on a fine-grained color wheel requiring precise selection. Group differences in task performance and self-reported imagery scores will be analyzed using independent samples t-tests or non-parametric equivalents, if assumptions of normality are violated. Potential covariates, such as polysubstance use, will be explored. This study is currently undergoing data collection. Findings may provide insights into the influence of psychedelics on perception and imagery, with implications for understanding HPPD and the broader role of mental imagery in cognition.

Poster Session: 1

Poster Board: 31

Ezgi Fide

Shayna Rosenbaum, Kohitij Kar

York University

Neural Predictivity of Artificial Neural Networks of the Primate Ventral Stream is Significantly Affected by Behavioral Task States

Specific artificial neural networks (ANNs) are currently the best approximation of primate ventral stream responses. However, it is relatively unknown how the neural predictivity of these models depends on the behavioural task state of the animals. To investigate this, we recorded neural activity across the inferior temporal (IT) cortex of two macaque monkeys (288 sites in each monkey) during a passive fixation task and a battery of active binary object discrimination tasks involving 10 objects (132 images per object). We used several high-performing ANNs (VGG-16, VGG-19, AlexNet, and ResNet-18) to predict the neural responses in the 70-170 ms time window of the IT cortex, which has been shown to best explain human behavioural patterns (Majaj et al., 2015). Given the extensive object recognition-based task training of these networks, we initially expected that they would better predict neurons when recorded during the task conditions. Interestingly, our results, however, revealed the opposite. We observed significantly higher neural predictivity of ANNs for passive compared to active task states. Based on previous findings (Kar et al., 2019), we hypothesized that late-phase (150-210 ms) IT responses, which are likely more affected by recurrent computations, might exclusively account for the differences observed in IT predictivity. Indeed, further analysis confirmed that task dependent differences are primarily driven by activity in the late (150-210 ms) time window compared to earlier (80-130 ms) ones, with the late-phase responses showing a more pronounced difference between task states. These findings demonstrate that the neural predictivity of ANNs in explaining ventral stream responses is task-dependent, highlighting the importance of considering behavioural task states when using these models to study brain responses. Moreover, our results provide insights into the role of recurrent computations in shaping ventral stream activity during object recognition tasks, particularly in the late phase of neural responses.

Poster Session: 2

Poster Board: 1

Farida Mohamad

Farhana Zulkernine

Queen's University

Non-Contact Blood Glucose Estimation Using PPG and rPPG Techniques

With the growing demand for accessible and non-invasive health monitoring, our work presents a comprehensive pipeline that leverages facial video input for blood glucose (BG) estimation. The system processes the input through distinct branches dedicated to blood volume pulse (BVP) signal noise reduction and BG prediction. We present a backend system for non-contact BG monitoring using both contact-based photoplethysmography (PPG) and remote-photoplethysmography (rPPG) techniques. The system employs deep learning models to extract a denoised BVP signal from facial videos using rPPG techniques and other traditional PPG measurements. A significant challenge is the lack of datasets containing face videos, PPG data, and ground truth BG measured with a medical device. Therefore, our approach integrates a machine-learning-based denoising method to enhance the rPPG signal and facilitates the use of various BG prediction models, such as the Decision Tree, Linear Regression, Random Forest, LSTM, ResNet, and Support Vector Regression. We employed multiple datasets for training and evaluating different components of our pipeline, including the Univ. Bourgogne Franche-Comté Remote-PhotoPlethysmoGraphy (UBFC-rPPG) dataset, Pulse Rate Detection Dataset–PURE, TokyoTech Remote-PPG, the Vision for Vitals (V4V) dataset, and PPG dataset red channel. The performance of the different models was assessed using Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE). Among the tested models, the random forest regressor achieved the lowest MAE (10.68) and RMSE (12.81), demonstrating superior predictive performance. In contrast, ResNet model produced the highest errors (MAE of 36.25 and RMSE of 47.91), indicating that it performed worse than the other approaches. We are also working on collecting our own data for model improvement and validation. Future work will focus on refining the predictive models and exploring novel models, data preprocessing, and denoising techniques with our own data to further improve the accuracy of both contact-based and contactless BG measurement.

Poster Session: 2

Poster Board: 2

Fatema Nakhuda

Georg S.O. Zoidl, Christiane Zoidl, Armin Bahl, Georg R. Zoidl

York University

Pannexin1 Channels Modulate Visual Habituation and Neural Network Dynamics in Larval Zebrafish

Pannexin1 (Panx1) is an integral ion and metabolite membrane channel in the central nervous system that regulates synaptic plasticity. Despite its well-documented role in ATP release and neurotransmission, downstream signalling pathways that contribute to learning and memory remain largely unexplored. Using 6-day-old zebrafish larvae, we have previously shown that Panx1a, a homolog of Panx1, is critical for visual habituation, with knockouts (Panx1a-/-) showing persistent startle responses compared to wild-type larvae. We used post-hoc fosab labelling to identify brain activity hotspots that require Panx1a for habituation. Our results show higher baseline transcription and reduced activity-induced transcription in localized brain regions in the knockouts, suggesting the involvement of Panx1a in excitation-inhibition (E/I) balance. We demonstrate this further by pharmacologically modulating receptor signalling pathways. NMDA receptor antagonism partially rescued habituation deficits, and GABA receptor blockade disrupted habituation in both genotypes. Additionally, local field potential recordings and spike analyses in the dorsolateral pallium (hippocampus analog) and optic tectum (sensory center) indicate altered oscillatory activity across frequency bands in Panx1a-/- larvae post-habituation, suggesting disrupted network dynamics. The molecular, pharmacological, and electrophysiological evidence implies that loss of Panx1a shifts the excitation-inhibition balance during learning and memory processes.

Poster Session: 2

Poster Board: 3

Fermin H. Retnavarathan

Fermin Retnavarathan , Tara Nichols, Lynn Turkstra, Riley Morgan, Dasnoor Saini, Andrew Silva, Xiaoxin Chen, Ben Thompson, Xiaoqing Gao, Haotian Lin, Agnes Wong, Daphne Maurer, Ewa Niechwiej-Szwedo, David Shore

McMaster University

Evaluating the Test–Retest Reliability of a Newly Developed Battery of Binocular Vision Tests

Patients with amblyopia typically fail all clinical tests of binocular vision. Binocular dysfunction prevents patients from using binocular depth cues such as disparity to perceive depth. Without depth perception, patients face difficulties in everyday activities such as walking up a flight of stairs, reading, and driving. Remarkably, in a recent study by Maehara et al. (2019), several amblyopia patients who failed clinical tests of binocularity demonstrated the Pulfrich illusion. When a light attenuating filter is placed over one of the eyes and an individual is viewing an object move laterally across their field of view, the object will appear to take an elliptical path (Pulfrich, 1922). The reduced luminance in the one eye causes a signal processing delay in that eye. This delay in processing between the two eyes is interpreted in the brain as depth giving rise to the Pulfrich illusion.

The observation of an intact Pulfrich illusion in this population suggests current clinical tests may not accurately assess the full range of binocular abilities in these patients. To explore this hidden binocularity further, our multi-institutional team has developed a battery of eight binocular vision tests to obtain more precise measures of binocularity. Before we correlate performance on these tests with other measures, we must ensure the tests correlate with themselves. The present study evaluated the test–retest reliability of the battery by having control participants complete four tasks in the battery one week apart. These include the tasks Letter Dominance, Pulfrich, Plaid Motion, and Motion Parallax. Correlational data analyses revealed three out of four of the tests provide reliable measures of binocularity.

Poster Session: 2

Poster Board: 4

Fira (Alimu) Gulifeire

Michael Barnett-Cowan

University of Waterloo

Understanding Cybersickness in Virtual Reality: The Role of Sensory Reweighting, Age, and Quantified Movement

Cybersickness (CS) in Virtual Reality (VR) is a form of motion sickness that can manifest as dizziness, nausea, discomfort, or a combination of these symptoms, potentially limiting VR's widespread adoption. While research has documented age-related differences in CS susceptibility, the underlying mechanisms remain unclear. This study examines the relationship between CS, sensory reweighting ability, age, and movement patterns, building on recent work by Chung and Barnett-Cowan (2023) on sensory reweighting in VR and Dilanchian et al. (2021) on age-related differences in VR interactions.

We hypothesize that:

H1: Individuals with greater sensory reweighting ability—specifically, the ability to downweight visual and bodily cues relative to gravity—will experience fewer CS symptoms.

H2: Older adults, due to age-related changes in movement patterns and balance control, will exhibit greater sensory mismatch and more pronounced CS symptoms. Furthermore, movement sway and Center of Mass (CoM) velocity displacement are expected to correlate positively with CS severity across age groups.

Participants in our study of varying ages undergo VR exposure while movement data are recorded using a Qualisys markerless motion capture system. Sensory reweighting ability is assessed by measuring perceptual upright before and after VR exposure. Kinematic data are analyzed using Theia 3D and Visual 3D software to explore relationships between movement patterns, CS severity, and sensory reweighting ability.

To date, data have been collected from 25 younger adults (M = 23.8 years, SD = 2.71; 18 female, 7 male), and data collection has recently begun for four older adults.

This study aims to advance our understanding of age-related differences in CS susceptibility and their underlying mechanisms. Findings may inform the development of age-inclusive VR design strategies, improving usability across applications such as healthcare, rehabilitation, and training.

Poster Session: 2

Poster Board: 5

Gabriela Oancea

Sara Thompson, Luc Tremblay

University of Toronto

Manual Asymmetries in the Visual Control of Goal-directed Aiming Movements: Insights From the Non-dominant Hand

Even if humans perform movements with both hands (e.g., grab an object with the non-dominant hand to manipulate it with the dominant hand), much research on the visual control of actions has focused on the dominant hand. Critically for the current study, the dominant hand relies more on preplanning (Bagesteiro & Sainburg, 2002), whereas the non-dominant hand relies more on online feedback (Lavrysen et al., 2008). Thus, we explored manual asymmetries in reaches performed with or without a target perturbation and limited visual information. Right-handed participants (n=15) performed trials with each hand to a target (30 cm) that could "jump" 3 cm closer (27 cm) on ⅓ of trials, limiting the need for a secondary limb acceleration (see Elliott et al., 2010). To avoid terminal feedback and focus on limb-target regulation (Tremblay et al., 2017), vision after movement onset was limited to a 20ms window presented before peak velocity. With the 30 cm target, participants spent longer time after peak velocity (TAPV) ($p = .029$) using their left ($M = 274.48$ ms, $SD = 48.62$) compared to their right hand ($M = 253.58$ms, $SD = 42.13$), corroborating evidence that left-hand movements are less preplanned. On jump trials (27 cm), movement endpoints significantly shifted toward the new target position with both hands (right-hand correction-amplitude = 9.3 mm, left-hand correction-amplitude = 7.5 mm). Critically, TAPV was greater ($p = .044$) when using the left ($M = 247$ ms, $SD = 39$) compared to the right hand ($M = 235$ ms, $SD = 40$), challenging the idea that the left hand is better suited to use online feedback. This work supports the idea of distinct control strategies between hands and has applications for rehabilitation/sports contexts by tailoring training to each arm.

Poster Session: 2

Poster Board: 6

Gaelle Nsamba Luabeya

Ada Le, Lina Musa, Amirhossein Ghaderi, Simona Monaco, Erez Freud &
J. Douglas Crawford

York University

Integration of Functional Connectivity for Multimodal Cues during a Reach-to-Grasp Task

Real-world behavior requires the integration of multiple cues for coordinated action, for example object location cues to aim a reach combined with object-orientation cues to form a correct grasp. To understand how the brain might integrate these different sensory and motor components, we employed a cue-separation event-related fMRI task in which twelve participants were visually cued to the object shape (square) and Location (L: left or right to center), and verbally instructed how to manually Orient the grip (O: horizontal or vertical), with each cue followed by a delay in randomized temporal order (OL vs. LO). We then employed standard univariate analysis and graph theory analysis (GTA) of 200 cortical nodes to understand how the cortex integrates these action cues over time. As expected, the univariate analysis revealed order-dependent, sensory-specific activation: during the first delay early Visual Cortex was activated for the visual instruction and Superior Temporal Gyrus for the auditory orientation instruction, followed by the opposite patterns during Delay 2. Widespread sensorimotor activation occurred during the action period, independent of cue order. GTA revealed two significant network modules (clusters of nodes with similar time BOLD series): one spanning occipital-parietal cortex (with important hubs in V1, SPOC and pIPS), and one spanning auditory / somatomotor cortex (with important hubs in M1, PMd and ACC). These results show how different instructions are integrated into the reach plan, i.e., bottom-up visual cues through 'dorsal stream' parietal reach areas and top-down auditory task instructions through the frontal cortical reach network.
Supported by the Canadian Institutes of Health Research (CIHR), the National Science and Engineering Research Council (NSERC) and the Vision: Science to Applications (VISTA) program.

Poster Session: 2

Poster Board: 7

Georg S. Zoidl

Nickie Safarian, Christiane Zoidl, Steven Connor, Georg R. Zoidl

York University

The Role of Panx1a in Neurodevelopment: Pathway-Specific Interventions for Metabolic Crisis

Pannexin-1 (Panx1) is a major ATP release channel implicated in neurodevelopmental and neurodegenerative disorders. Ablation of Panx1a function in gene-edited zebrafish selectively affected dopaminergic signaling, suggesting this gene's function in neuronal networks that use dopamine. By inducing a metabolic crisis in dopaminergic neurons with 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP), we identified a molecular mechanism in which Panx1a ablation changed AMPK-mTORC1 signaling pathways, cell death, and altered neuronal network connectivity. Accordingly, rescue effects of modulation of the mTORC1 pathway and NLRP3 inflammasome on behavioral performance and neural connectivity following MPTP treatment were tested in Panx1a+/+ and Panx1a-/- zebrafish larvae. Targeting the NLRP3 inflammasome with INF39 alleviated both genotypes' motor and neural connectivity deficits caused by MPTP as assessed by automated scoring of motor behaviors and in vivo dual electrode LFP recordings, respectively. While mTORC1 pathway genes were enriched in Panx1a-/- larvae, metformin - a mTORC1 suppressor - enhanced neuronal connectivity but failed to improve behavioral outcomes, likely due to short treatment duration. These findings support roles of Panx1a in energy metabolism and inflammation. Specifically, targeting the NLRP3 inflammasome offers a promising avenue for mitigating the effects of metabolic stress early in life. Funded by NRSC DG RGPIN-2019-06378 (GRZ).

Poster Session: 2

Poster Board: 8

George Mather

Patrick Cavanagh, Glendon College, CVR, York University

University of Sussex

Computational Modelling Reveals ON/OFF asymmetry in the Snakes Motion Illusion

In the Snakes motion illusion, known in the literature as the Fraser-Wilcox or peripheral-drift illusion, a stationary pattern containing a spatially asymmetrical sawtooth-like luminance profile can appear to drift for a few seconds when it first appears, and then whenever the viewer blinks or makes saccadic eye movements. Recent evidence (Mather & Cavanagh, 2025, JOV, 25,13) indicates that the illusion is associated with retinal luminance changes caused by the reflexive pupil movements that accompany onsets, blinks and saccades: Pupil dilation time is strongly correlated with perceived movement duration. We tested whether the standard computational model of human motion sensing – the Adelson-Bergen energy sensor – can account for this effect and another motion illusion caused by the flashed onset of a stepped luminance profile (Mather, 1984, Vis. Res. 24,1399-1405). Results showed that the standard energy model can explain the earlier edge flash illusion but cannot explain the peripheral-drift illusion. However, after a simple modification to the energy model it can successfully account for peripheral drift. When the energy sensor's output is split into ON and OFF portions and the ON output is attenuated relative to the OFF output, as suggested by evidence for ON/OFF asymmetries in the visual system, the sensor signals motion in the predicted direction and over the predicted time course of the peripheral drift illusion.

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Poster Session: 2

Poster Board: 9

Harshitha Koppisetty

Robert Allison, Laurie Wilcox

York University

Audiovisual Signals Shape Our Perception of Materials in Virtual Reality

The sound and appearance of interacting objects determine how we perceive their material properties.

Extending our preliminary results reported at IMRF 2024, we investigated how observers resolve discrepancies between a material's sound and its appearance in realistic virtual environments. Specifically, we evaluate how audio identity, visual identity, active engagement, and audio quality interact to determine the material classification.

Participants (N =42) experienced simulations of an object being struck by a metal rod in a virtual reality headset. All combinations of impact sounds and visual textures for four materials were paired for the target object, creating sixteen conditions. To examine the effect of agency, half the trials involved an agent striking the target (agent-interaction), while in the other half, participants struck it themselves (self-interaction). They then classified the target object as one of the four materials. In a second experiment, for a smaller set of conditions, three groups of 18 participants were tested with sounds produced by metal, plastic, and glass rods, combined with varying levels of white noise.

The first experiment showed that participants primarily classified the material based on auditory properties, agency had no effect on perception, and in four of the sixteen conditions, potential audiovisual illusions were observed. The second experiment showed that the material of the rod and added white noise influenced material classification. Glass rod-generated sounds led to more consistent responses as compared to sounds generated by other rods.

Our findings suggest that for impact events the auditory signal is the strongest determinant of material classification in the presence of conflicting appearance. While agency had no effect, additional factors, such as the material of the sound-generating rod and sound quality, did influence perception. These results highlight the importance of sound in VR and how audio-visual cues interact in complex ways to impact material perception.

Poster Session: 2

Poster Board: 10

Harvey Donnelly

Tahsin Reza, Matthias Niemeier

University of Toronto

Simulating Motor Control in Realistic and Unrealistic Worlds: Spontaneous Emergence of Integrated Task Representations in Reinforcement Learning Networks

Motor control is nonlinear due to the constraints of our physical world, which often necessitate computing task-relevant features together. Previous research has shown integrated representations of task features in human brain activity, but it remains unclear whether this integration arises from real-world affordances or computational necessities like limited computational resources. Since we experience only one physical world, testing an unrealistic world empirically is impossible. To address this, we used computer simulations to examine task feature integration in motor control. We trained a reinforcement learning model on a 3D reaching task involving 5x5 targets with varying elevations and azimuths at a constant distance. We analyzed representations in the model's action network using Representational Dissimilarity Matrices (RDMs) and compared activation patterns to three predictors: azimuth, elevation, and an integrated predictor requiring both azimuth and elevation to be identical for similarity. A multiple regression analysis showed that azimuth and elevation predictors explained activity across all three network layers. The integrated predictor became relevant in Layers 2, suggesting integration required additional processing. Comparing a network trained under real-world physics to one trained in an unrealistic environment where torque dependencies between joints are reduced, we found a significantly stronger influence of the integrated predictor in the intermediate layer of the real-world network. These findings provide the first direct evidence that real-world physics shape integrated representations of task features in motor control computations. It suggests that the physical structure of our environment fundamentally influences how motor control systems, both biological and artificial, compute and integrate task-relevant information.

Poster Session: 2

Poster Board: 11

Helio Perroni Filho

Mohammad Akhavan, Jayant Varma, Sarah Kamoun, James Elder

York University

Robot Wheelchair Convoys for Assistive Human Transportation

AirChair is a semi-autonomous human transportation system composed of multiple wheelchairs operating as a convoy. The first wheelchair follows an on-foot human guide, the second wheelchair follows the first, and so on. Each wheelchair independently tracks its target with the help of an RGBD camera, and performs motion planning to follow along while steering clear of obstacles. The guide manages the convoy through a mobile control interface, allowing them to intervene as needed to ensure passenger safety. The effectiveness of combining automation technologies with an engaged operator is demonstrated by experiments in uncontrolled, real-world environments, which also suggest directions for further development.

Poster Session: 2

Poster Board: 12

Hoora Mohseni

Hoora mohseni, Ali Rezaei, Maryam Ansari, Seetha lakshmi Rajeev, Randy Flanagan, Jeff Wammes, & Jasson Gallivan

Queen's University

Cortical-subcortical Manifold Dynamics During Learning

The rapid acquisition of motor skills is a fundamental aspect of human behaviour, yet the dynamic neural processes that underpin learning remain incompletely understood. Traditional functional MRI (fMRI) approaches, which commonly average activity across numerous trials or estimate covariance patterns across long time windows, inherently limit our ability to resolve the fleeting, moment-to-moment fluctuations in brain activity likely critical for adaptive learning. To address this limitation, we investigated changes in the geometry of human whole-brain dynamics at the single imaging-volume resolution across two-days of visuomotor adaptation. Using fMRI data continuously acquired across the two testing sessions, we projected single-volume fMRI timeseries data into a low-dimensional manifold space reflecting the dominant dimensions of functional connectivity observed across cortex, subcortex and cerebellum during pre-learning (Baseline) trials. This established a reference neural space from which we could directly observe and quantify deviations in whole-brain dynamics as learning unfolded. Our analysis revealed that, during the earliest phases of initial learning, the path length of subjects' neural trajectories within this manifold significantly decreased, suggesting an initial neural stabilization in neural dynamics. This 'contraction' of the trajectories during early learning was followed by a gradual rebound back towards baseline-levels during late learning. Notably, on the second day of testing, we observed a strikingly similar pattern of neural changes, strongly suggesting that these path length dynamics reflect an intrinsic temporal structure associated with learning rather than a spurious effect. Importantly, we further found that these changes in path length throughout learning directly mirrored subjects' visuomotor errors across both days of testing, tightly linking these dynamic neural changes to behavioral performance. Collectively, these results provide a unique time-resolved perspective on the changes in brain activity associated with learning, enhancing our understanding of how the brain acquires new sensory-to-motor mappings.

Poster Session: 2

Poster Board: 13

Iroshini Gunasekera

Romina Abadi, Faruq Afolabi, Xue Teng, Robert S. Allison, Laurie M. Wilcox

York University

Perceiving 3D Size: The Role of Depth Cues and Object Interaction

Studies of size perception have often focused on the effect of distance and have used simple 2D stimuli. However, factors affecting the perceived size of volumetric 3D shapes have received less attention. Here, we evaluate the contribution of monocular and binocular depth information to size perception during passive viewing and active interaction with the stimuli. Using virtual reality (VR), we presented a virtual shape-posting toy. Targets were 3D shapes (triangle, pentagon, square, and quatrefoil), and on each trial, one target appeared alongside a box with identically shaped slots. Participants indicated if the target was larger or smaller than the corresponding slot in a 2AFC task. Shape size varied according to the method of constants; the psychometric data were fit with cumulative normal distributions to compute JNDs and PSEs. We assessed the effects of stereopsis and object motion in two experiments. In Experiment 1 (N=28), the shapes were viewed monocularly or binocularly and were stationary or could be picked up and rotated. In Experiment 2 (N=26), we evaluated the effect of two types of motion (passive oscillation vs active movement) and monocular vs. binocular viewing. In Experiment 2, positional data for both head movements and object trajectories were collected. We found that observers discriminated size accurately across all test conditions; PSEs showed no consistent bias. Binocular judgments were more precise (smaller JNDs) than monocular judgments. Surprisingly, in the monocular conditions, discrimination performance worsened when participants interacted with the object. Analysis of target positions during trials showed that observers did not adopt different strategies depending on the depth cues available (e.g. they did not bring monocularly viewed objects closer). Our results underscore the importance of binocular depth information in the perception of 3D object size, even when motion or active interaction could theoretically improve size judgments.

Poster Session: 2

Poster Board: 14

Isimeme Okonofua

Peter Jes Kohler, Jeffrey Schall, and Michelle Schall

York University

Individual Differences in Visual Evoked EEG Explained by Variation in Cortical Folding

EEG signals index human behaviour, perception, and cognition, justifying their use as scientific and diagnostic tools. The activity of cortical pyramidal cells produces current dipoles that create voltages that can be measured as EEG signals. Dipoles more perpendicular to the scalp produce stronger signals than those oriented otherwise. An EEG signal therefore depends on the 3D orientation of the region from which it originates, as well as the underlying neural activity, making data difficult to interpret because each cortex has a different folding pattern. We aim to understand the relative contribution of variability in cortical folding to the generation of EEG signals. We will employ EEG and MRI data from a study where participants viewed visual texture stimuli in a steady-state design where low-level activity associated with image updates, and activity elicited by symmetries in the textures can be isolated in distinct frequency components of the response. Although all participants viewed the same stimuli, we observed marked differences in their EEG signals. We are investigating the contribution of V1 and V2 cortical folding variation on the pattern of the image update response, under the assumption that low-level activity originates primarily from those areas. We will use an inverse solution method to image the cortical origin of the image update response. Then, we will conduct dipole simulations in cortical regions differing in location and orientation to simulate the even harmonic signal, revealing information about the physical properties of the neural generators of this signal. We expect to find major contributions of regions of visual cortex that are more perpendicular to the scalp. Our findings will contribute to the understanding of the origin of EEG signals, enhancing their usability in science and healthcare.

Poster Session: 2

Poster Board: 15

Jacob Godard

Erin Cressman

University of Ottawa

The Effects of Reward and Punishment on Retention of Visuomotor Adaptation

Performance related feedback impacts motor learning. Specifically, Galea et al. (2015) established that the extent of initial visuomotor adaptation is increased if one is punished for poor performance accuracy, while immediate retention of learned movements is enhanced if one is rewarded for accurate performance. In the current research we tested this proposal, investigating the impact of punishment and reward feedback conditions on initial motor learning and retention over a 24-hour period. Participants trained to reach to targets in a virtual reality environment where hand position information was distorted. In particular, a cursor representing a participant's hand position was rotated 40˚ clockwise relative to actual hand motion. Within this adaptation phase half of the participants lost points for errors in reaching accuracy (Punishment Group), while the other half of participants earned points based on their reaching accuracy (Reward Group). This phase was followed by a washout phase, an immediate retention phase (i.e., a readaptation phase), and a second retention phase 24-hours later. Using the Process Dissociation Procedure (PDP), we assessed the contributions of explicit (i.e., conscious strategy) and implicit (i.e., unconscious) processes within each phase. Participants also indicated their level of task enjoyment throughout the task. In contrast to Galea, preliminary results indicate that the extent of initial visuomotor adaptation was similar between groups. Explicit and implicit contributions also did not vary between groups. Retention, both immediately following the washout phase and again 24 hours later, was slightly higher for participants in the Reward Group. These findings suggest that feedback related to punishment and reward may independently impact retention of motor learning.

Funding. This research was supported by an NSERC Discovery Grant awarded to Erin Cressman.

Poster Session: 2

Poster Board: 16

Jaykishan Patel

Richard Murray, Javier Vazquez-Corral, Konstantinos Derpanis

York University

Comparing Deep Neural Network Architectures as Models of Human Lightness and Illusion Perception

Inferring surface reflectance from luminance images is challenging, as identical luminance patterns can result from different combinations of illumination, reflectance, and 3D shape. Classical models have struggled with this ambiguity, but convolutional neural networks and vision transformers show promise in estimating surface color under varying illumination. This study tests the effects of model size, architecture, and the transferability of features from pretraining on a different task for reflectance estimation, along with whether different models utilize similar features for illusion perception. Using ResNet34, VGG13, MobileNetV3, and dense prediction transformer as encoders in a UNet architecture, we trained decoders to estimate reflectance from luminance images in a custom Blender-generated dataset. Encoders with pre-trained ImageNet or depth prediction weights were trained for reflectance estimation. Frozen encoders were utilized to evaluate whether their features could transfer to reflectance estimation without fine-tuning. Both frozen and fine-tuned models performed well on reflectance estimation, with frozen models being slightly less accurate. Model responses were computed for several illusions, including the argyle, Koffka-Adelson, snake, simultaneous contrast, White's, and checkerboard assimilation. Model responses were consistent with illusions perceived by human observers. Furthermore, illusion-like responses were weaker in control conditions, except for the argyle and assimilation illusions. Low-parameter models performed as well as high-parameter models on illusion perception but were less accurate in reflectance estimation, challenging the hypothesis that illusions arise from efficient coding. Saliency analysis showed that for all models, similar regions were responsible for perceived illusions, often focusing on shadowed areas. Saliency maps showed high correlation for regions contributing to illusion perception in all models, with slightly lower agreement for frozen models. These results suggest lightness illusions arise from visual systems' using natural scene statistics to generate an accurate perceptual correlate to reflectance and highlight the potential of deep learning architectures for modeling human lightness and color perception.

Poster Session: 2

Poster Board: 17

Jean De Dieu Uwisengeyimana

Kohitij Kar

York University

Probing Motion-Form Interactions in the Macaque Inferior Temporal Cortex and Artificial Neural Networks for Complex Scene Understanding

Traditionally, the processing of object motion and form has been attributed to the dorsal and ventral visual pathways, respectively. However, recent studies challenge this strict dichotomy. For example, Hong et al. (2016) demonstrated that the ventral stream represents spatial information, while Ramezanpour et al. (2024) showed that object motion could be decoded from the inferior temporal (IT) cortex. These findings prompt further exploration of how the ventral pathway supports the integration of motion and form, particularly in naturalistic environments. In our study, we aimed to investigate this integration using neurophysiological recordings from rhesus macaques and several artificial neural networks (ANNs). We hypothesized that camouflaged scenes would create situations where object motion aids the detection of form-based attributes that are otherwise less perceptible in stationary scenes. To test this, we presented 132 camouflaged videos to two rhesus macaques, recording neural activity at 95 reliable IT sites using a neuron reliability threshold: 0.4. Videos were shown for 500 ms and included moving camouflaged objects and stationary frames. Our results show that motion enhanced the representation of form-related attributes in the IT cortex. For instance, decoding object size from neural responses yielded a marginally higher correlation with moving stimuli (Pearson $R = 0.63$) than stationary frames ($R = 0.57$). Similar trends were observed for object X- and Y-positions. Additionally, object speed was significantly predicted by IT population responses ($R = 0.26$, $p = 0.002$). We evaluated several image-based and video-based ANNs, finding that models like S3D, R2plus1D_18, and Swin3D outperformed others. Video-based models strongly aligned with primate behavior, highlighting their ability to model both temporal and spatial dynamics. Our findings are the first steps to probing dynamic scene perception in biological and artificial systems, offering insights for developing vision systems capable ofhandling complex, dynamic environments.

Poster Session: 2

Poster Board: 18

Jennifer Lin

Verónica Nácher, Hongying Wang, Saihong Sun, Xiaogang Yan, Julio C. Martinez-Trujillo, J. Douglas Crawford

York University

Ventrolateral Prefrontal Cortex LFPs Encode Visual Context-dependent Preparatory Activity During Memory-guided Reaches

The purpose of the current study is to understand what prefrontal local field potential (LFP) signals encode during a memory-guided reach task, with or without additional visual landmarks. We implanted a 128-channel Plexon Array over the posterior ventral prefrontal cortex (pVLPFC). Single unit activity, LFPs and behavioral (eye, head, hand) signals were recorded simultaneously in a female Rhesus monkey trained to perform a memory guided reaching task. The hand was initially placed at 1 of 3 varying locations of a waist level LED bar while gaze fixated centrally. A landmark was presented on a touch screen at 1 of 15 locations. A visual target then appeared transiently at a variable location within or outside this virtual square, followed by a visual mask. After the mask, the landmark either reappeared at the same location (stable landmark condition) or shifted by 8 degrees in one of 8 directions (landmark shift condition). The fixation light then extinguished, signaling a reach to the target. 'No-landmark' controls were the same, but without the landmark. Preliminary analysis of time-power plots revealed frequency band-specific decreases in power during the delay before reach and increases in power peaking near movement onset. Task-dependent modulations were observed in the time-frequency plots in the preparatory activity as visual complexity increased. In addition, the presence of a landmark produced a second power peak between acquisition and reward. This suggests that prefrontal LFP signals contains visual context-dependent information for reach planning and execution.

Supported by the Connected Minds Program, funded in part by the Canada First Research Excellence Fund.

Poster Session: 2

Poster Board: 19

Jes Parker

Kristopher G. Hensley & A. Caglar Tas

York University and University of Tennessee, Knoxville

Information Consulted for Visual Stability Decisions in Naturalistic Scenes

The current study investigated transsaccadic visual stability in naturalistic scene images to test whether the visual system relies on spatial location of the saccade target, as previously found with simple dot stimuli, or relational positions of the objects in the scene during visual stability decisions. The task included displacements of the saccade target, saccade source (Experiment 2 only), whole scene, background, or a landmark object that was located 2° above or below the saccade target object (Experiment 3 only). In the control condition, everything remained stationary. We also manipulated visual stability using the intrasaccadic target blanking paradigm, which has been demonstrated with simplistic stimuli to increase sensitivity to changes that occur during the saccade. Participants reported whether they detected any movement. The results across three experiments showed that saccade target object displacements were more easily detected than any other displacements in the scene, demonstrating the prioritization of the saccade target object in the establishment of visual stability. Further, disrupting visual stability improved displacement detection for the saccade target and saccade source objects, likely a result of selective attention received by both prior to the execution of a saccade. Further, disrupting stability also improved displacement detection for the landmark object, suggesting that the attention allocated to the saccade target spreads and benefits objects in close spatial proximity. However, blanking did not improve displacement detection for whole scene or background displacements, suggesting that objects that benefit from attention prior to saccade execution are then consulted in visual stability processes.

Poster Session: 4

Poster Board: 27

Jinkun Chen

Xuemin Yu, Marta Kryven

Dalhousie University

Can Multimodal LLMs See Human-Like Patterns?

To work with people in the real world, artificial agents need a model of how people perceive, express intentions, and pursue goals in interactive tasks. However, existing LLM Theory Of Mind benchmarks are limited to simple descriptive scenarios. We present two experiments evaluating multimodal LLMs' progress toward this goal.

Experiment 1 tests LLM's recognition of symmetry in abstract images. Humans have strong priors for symmetry, as it signals a likely natural origin and intentionality. We generated 100 symmetric and 100 asymmetric images and compared LLMs (meta-llama/Llama-3.2-11B-Vision-Instruct and OpenAI GPT-4o mini) confidence ("yes" token probabilities) in symmetry judgments.

We found that meta-llama consistently reports high confidence for symmetric ($\mu=0.96\pm0.04$) and asymmetric images ($\mu=0.94\pm0.03$) with a minimal discriminability (Mann-Whitney $U=83$, $p=0.007$, Cohen's $d=0.69$). In contrast GPT-4o gave moderate ratings to symmetric ($\mu=0.55\pm0.23$), and near-zero ratings to asymmetric images ($\mu=0.003\pm0.003$), showing a significant discriminability ($U=100$, $p<0.0001$, $d=3.40$).

Experiment 2 tests LLMs' ability to understand human goals in visual tasks. We used data from human participants who created 8×8 pixel patterns in two conditions. In the no-goal condition, people freely created a series of patterns. In the goal conditions, on each trial people reported their goal before creating a pattern. We corrupted the patterns by randomly flipping (10%, 30%, 50%, 70%, and 90%) of black pixels to white, and evaluated GPT-4o mini's ability to restore them.

In the no-goal condition, LLM image restoration relied on local extrapolation, decreasing in effectiveness as corruption increased, resembling early visual system processing. We also found that goal cues increased recall ($\mu=41.2\pm8.2\%$, $\mu=29.5\pm7.4\%$) and the ratio of correctly restored to corrupted pixels ($\mu=35.4\%$ vs. $\mu=20.1\%$), suggesting an emerging ability to 'translate' between object-level goals and numerical pixel patterns.

Poster Session: 2

Poster Board: 20

John Jong-Jin Kim

Laurence R. Harris

York University

Comparing the Method of Adjustment and Continuous Psychophysics for Assessing the Perceptual Size-distance Relationship

Recently, continuous psychophysics has gained popularity for swiftly and engagingly measuring visual sensitivity (Burge et al. TICS 2025). Here, we compared people's ability to estimate an object's size or position based on how far away it appeared to be in a 2D scene using the traditional method of adjustment (MoA) (c.f., Kim et al., Perception 2022) and a continuous psychophysics (CP) method. Participants adjusted the size and position of a target in a full-size 2D hallway scene projected onto a wall with a ground plane continuous with the experimental room, either adjusting its position based on its size (Size-to-Position task) or resizing it based on its position (Position-to-Size task) to make it match the size of a 3D reference box they held in their hands. In MoA, targets were displayed with the size or position equivalent to distances of 4-16m. For each trial, participants adjusted the target to be the correct position or size. In CP, target size or position was continuously changed during each block. A block started with a simulated target distance of 4-20m, and the target's size or position changed in a random walk every 0.5s by adding a value from a normal distribution with a StDev of 0.0125 within a range of ±0.05 for size or ±0.025 for position. Participants continuously adjusted the target to keep its position or size correct. The target size/position results were fitted with a linear model, revealing that the intercepts and slopes (indicating perceived eye-height and horizon respectively) differed between the tasks and test methods such that they were only accurate in the Size-to-Position task using MoA. These findings suggest that misperceiving eye-height and the location of the horizon may contribute to misperceiving distance when viewing an object in a 2D scene.

Poster Session: 2

Poster Board: 21

Jonathan Pitino

Gerome Manson, Ellery Ingersoll-McNeely

Queen's University

Exploring the Role of External Visual Feedback in Reaching Movements to Somatosensory Targets

Visual information about the environment helps us navigate obstacles, avoid collisions, and accurately reach targets. It is unknown however, if visual information about the structure of the environment also helps us perform movements to non-visual somatosensory targets, for example, clapping our hands. Previous work indicates that movements to somatosensory targets may rely on distinct control networks compared to movements to visual targets, and thus may rely less on external visual cues.

Neurologically healthy participants performed reaching movements toward unseen somatosensory targets on their non-reaching hand, and fixated on an illuminated LED (left/right/centre) distal to the targets. Movements were performed in a completely dark environment, with and without a 3x3 LED array of visual contextual elements illuminated between the reaching limb and target location, during movement planning. Movement trajectories were recorded using high-resolution motion capture, and eye positions were recorded using electro-oculography. To assess the impact of the visual contextual elements, movement endpoint error and gaze-dependent error were analyzed.

Analysis of movement endpoint error revealed significantly less undershooting to somatosensory targets, when visual contextual elements were present during movement planning ($p=0.03$). The appearance of contextual elements also resulted in significantly faster reaction and movement times. Together, these findings provide evidence that information about the visual environment is integrated into movement planning processes for non-visual targets. These results suggest that enriching the visual environment can also positively impact movements to non-visual somatosensory targets.

Understanding how the nervous system modulates it's use of visual and somatosensory input, depending on the context and goal, will expand our understanding of motor recovery for patients with somatosensory deficits. Results can also help improve adapted user interfaces, such as dynamic visual overlays in augmented/virtual reality, to improve motor performance. Future directions include studying reaching movements to visual targets, and electroencephalography to record visual evoked potentials.

Poster Session: 2

Poster Board: 22

Jordyn B. Heron

Stefania S. Moro, Jennifer K. E. Steeves

York University

Sex and Sexual Orientation Differences in Visual Cognition

Longstanding research has identified sex differences on several cognitive domains. Females outperform males on tests of face and emotion recognition, verbal fluency, and perceptual speed, while males outperform females on tests of mental rotation, route navigation, and target accuracy. In addition to sex, emerging research suggests that sexual orientation also plays a role in cognition, particularly on mental rotation tests: heterosexual males consistently outperform homosexual males, who tend to perform similarly to heterosexual females. However, it remains largely unclear how heterosexual and homosexual females differ in cognitive task performance, particularly on female-favouring tasks. Therefore, this study aims to quantify the roles of sex and sexual orientation in male- and female-favouring tasks using a balanced design that prioritizes equal representation of sex and sexual orientation across four groups of participants: heterosexual and homosexual males and females. Participants complete a test battery comprised of three visual cognitive tasks assessing mental rotation, identity (face/voice) recognition, and cognitive-motor integration. Sex is expected to moderate the relationship between sexual orientation and task performance, with homosexual males resembling heterosexual females on male- and female-favouring tasks, and homosexual females resembling heterosexual males only on male-favouring tasks. Preliminary data replicate established sex differences in these tasks, with males outperforming females in mental rotation and females outperforming males in identity recognition. Data collection is ongoing, particularly for homosexual participants. Findings from this study aim to advance our understanding of visual cognitive and visuomotor development, as well as the biological basis of sexual orientation.

Poster Session: 2

Poster Board: 23

Julie Lewczuk

Ashkan Karimi, Paleesa Kapoor, James Makokis, Dionne Gesink, Belinda Daniels, Tesh Dagne, Joseph F.X. DeSouza

York University

A ResNet18 Inspired Deep Neural Network for EEG-Based Classification of Major Psychiatric Disorders

Background: Deep learning has shown promise in neuroimaging for analyzing cognitive tasks and diagnosing neurological disorders. EEG-based studies have identified neural patterns linked to psychiatric disorders, highlighting its potential for automated diagnostics. However, accurate classification remains challenging due to the complexity of EEG signals.

Objective: This study presents a deep learning model integrating a ResNet18-based convolutional neural network (CNN) with a long short-term memory (LSTM) layer to classify six major psychiatric disorders and healthy controls using EEG power spectral density (PSD) and coherence features.

Methods: EEG data from 1792 subjects, including six psychiatric disorder groups and a healthy control group, were analyzed. Features included 114 PSD values from 19 EEG channels across six frequency bands and 1026 coherence values. Data were reshaped into six-layer matrices (224×224) to match the ResNet input format. The model was trained using the Stochastic Gradient Descent with Momentum optimizer, with an initial learning rate of 0.01, a mini-batch size of 256, and 101 epochs. Notably, all EEG data were from an Asian population, and no publicly available EEG dataset representative of Indigenous and African populations was available for analysis.

Results: The model achieved an overall accuracy of 80.67% with an average F1-score of 81.02. Performance varied across disorders, with high accuracy for obsessive-compulsive disorder (100% precision) and healthy controls (90.67% precision), while mood disorder had lower accuracy (58.55% precision). A pruning technique reduced complexity while maintaining strong performance.

Conclusion: This study demonstrates the feasibility of using a ResNet18-inspired deep neural network with LSTM for EEG-based psychiatric disorder classification. While high performance was observed for certain disorders, further feature selection and model tuning are needed for mood disorder classification. The lack of diverse representation in the training dataset limits generalizability, emphasizing the need for EEG datasets from more diverse populations.

Poster Session: 2

Poster Board: 24

Justin Zhou

Jonathan A. Michaels, Marieke Mur

Western University

Temporal Continuity Learning Promotes Object-centric Representations

Humans recognize objects across a wide range of identity-preserving transformations, such as changes in viewpoint, even when these produce substantial variations in retinal input. This robustness may rely on object-centric visual representations – where different views of the same object cluster in representational space while remaining distinct from views of other objects. Temporal continuity learning, which exploits smooth changes in object identity over time, has been proposed as a mechanism for developing such representations. Evidence from behavioural and neural studies suggests a role for temporal continuity learning in visual development, yet direct computational evidence remains scarce.

We test whether temporal continuity learning promotes object-centric representations using a self-supervised predictive learning model. Our approach consists of three stages: (1) Create stimuli depicting objects in motion with realistic dynamics, (2) Use self-supervised predictive learning to train a neural network model on these stimuli, and (3) Assess the trained model for object-centric representations. Evaluation focused on representational clustering and separability.

Stimuli were digitally rendered 4-second videos of slowly rotating objects. A convolutional autoencoder with a recurrent bottleneck layer was trained on these generated videos to predict future frames. For comparison, a purely feedforward control model was also created, which was trained on the same predictive learning task but unable to exploit temporal information due to its architectural limitations.

Both models showed significant object- and category-level clustering but the recurrent model exhibited greater representational separability than the feedforward control model. These findings are consistent with the hypothesis that temporal continuity contributes to the development of object-centric visual representations. By demonstrating that self-supervised predictive learning can leverage temporal statistics, this study offers insights into the mechanisms that visual systems, both biological and artificial, may use to achieve robust object recognition.

Poster Session: 2

Poster Board: 25

Karen Abraham

Lucas Michaud and Dr. Yves Lajoie, PhD

University of Ottawa

The Effects of Virtual Reality on Postural Control: Determining if Dual-Tasks Promote Automatic Behaviour During Postural Threat Situations?

Virtual reality (VR) provides an effective tool for simulating postural threat environments and assessing balance control mechanisms. This study investigated whether a dual task (DT) promotes more automatic postural behavior during a VR-induced postural threat situation. Twenty-three participants completed single-task and dual-task trials while standing on a force plate in VR. The dual-task condition involved a continuous cognitive task while exposed to a virtual board-edge simulation. Center of pressure (CoP) displacement was analyzed in anteroposterior (AP) and mediolateral (ML) directions using standard deviation, oscillation area, and signal regularity. While standing in a postural threat situation increased sway in the ML direction the area did not change between baseline and plank condition. Standing on the virtual plank also made the signal more irregular. Additionally, performing a dual task further increased CoP regularity and reduced CoP sway. These results suggest that dual-tasking promotes more automatic and efficient postural control mechanisms even in postural threat conditions, which can potentially serve as a training method to enhance balance stability in challenging environments in real-world settings. This aligns with theories of motor automaticity, where engaging in a secondary task reduces conscious focus on maintaining balance, leading to more efficient postural control mechanisms.

Poster Session: 2

Poster Board: 26

Kate Moses

Liam Morassut, Sadiya Abdulrabba, Dr. Gerome Manson

Queen's University

The Influence of Experience on Sensory Information Needed for Piano Learning

When learning a new skill, such as playing the piano, one must learn to combine and integrate numerous sources of sensory information, including visual, auditory, and tactile information. The contribution of different sources of sensory feedback to piano sequence learning has been extensively studied in expert pianists, with limited research targeting novice piano learning. Our study investigated the role of sensory feedback in piano sequence learning in individuals with (experienced) and without (novice) previous piano learning experience. Novice (N = 17) and experienced (N = 10) piano players performed piano sequences across three different sensory feedback conditions: audiovisual, auditory-only, and visual-only. On day one, participants performed a pre-test, an acquisition period, and an immediate retention test. During the pre-test, participants performed three sequences at 120 BPM and received audiovisual feedback from the piano. During the acquisition trials participants practiced each sequence at both 60 BPM and 120 BPM. Each sequence was randomly assigned to a sensory feedback condition (i.e., audiovisual, visual-only, or auditory-only). During the acquisition trials, participants were provided with feedback about their accuracy (i.e., correct, or incorrect) and asynchrony (i.e., time between stimulus and response). The immediate post-test assessed retention by having participants perform each sequence at 120 BPM with audiovisual feedback from the piano. Participants then performed a 24-hour delayed retention test which was the same as the pre-test. Analysis of the data revealed that both experienced and novice groups, significantly improved in both accuracy and asynchrony between the pre-test and post-test, and the pre-test and retention test regardless of the sensory condition in practice. When comparing between groups, experienced participants were significantly more accurate [$F(1.40, 34.08) = 4.52$, $p < 0.05$)] and synchronous [$F(1.17, 29.27) = 4.005$, $p < 0.05$] than novices.

Poster Session: 2

Poster Board: 27

Kayrel Edwards

Prof. Ozzy Mermut, Prof. Jennifer Steeves, Prof. William Pietro, Prof. Christopher Barrett

York University

Examining Potential Bias in Optical Technologies

Can we deliver a blueprint to develop ethical technologies towards erasing the racism in optical devices? Melanin pigment determines skin tone. The main objective of this project is to measure the response of optical technologies as a function of tissue melanin content, to determine the extent of device racial bias. To do this, we have developed AI algorithms and fabricated artificial tissue models across the melanin spectrum to assess how melanin concentration variations affect optical readings in various everyday tools and medical devices, such as apple watches, cerebral oximeters, and pulse oximeters. Power loss measurements of NIR light through artificial tissue models made of chitosan and melanin, show that more than 90 % of light is lost when transmitted through dark skin (Melanin concentration > 10 µg/mg; or Fitzpatrick Type V-VI) compared to fairer skin. By developing new methods for enhancing Near Infrared (NIR) light transmission through dark skin, we aim to help increase the sensitivity of optical technologies for darker skin tones.

Poster Session: 2

Poster Board: 28

Kayton Jaksic

Nora Pourhashemi, Taylor Cleworth

York University

The Effects of Movement Perception on Balance Responses and its Interaction With Dynamic Visual Cues

Background: Detecting changes in self-motion is essential to maintain balance [1]. While individuals can accurately perceive movement during dynamic balance [2], it is unknown how movement perception affects balance responses, and how this interacts with changes in visual information. Therefore, the purpose of this study is to examine the effects of perceiving movement on balance responses and the concurrent effects of dynamic visual stimuli. Methods: In experiment 1, young adults stood on a tilting platform during various conditions: eyes open/closed, static/dynamic stance, and tracking/non-tracking. Cortical activity (EEG), muscle activity (EMG), kinematics, and subjective measures were recorded and analyzed for each trial. In experiment 2, young adults stood on a translating platform and tracked trunk position while exposed to visual perturbations in the anterior and posterior directions. Balance responses were analyzed across three post-stimulus windows (0-1s, 1-2s, 2-3s). Perceived position to objective displacement ratios and cross correlations were used to quantify the relationship between perceived and postural responses. Results: In experiment 1, the secondary tracking task had minimal effects on postural movements during static and dynamic balance tasks. Movement amplitude and cortical activity remained constant while balance confidence decreased. In experiment 2, participants exhibited a strong postural response to the visual stimuli. The perceived position lagged behind the actual position in the first and third windows but led the actual position in the second window, where the perceived to trunk displacement ratio was the greatest. Conclusions: Perceiving movement affected subjective responses but did not affect objective postural responses. The visually evoked postural response and its interaction with the perception of self-motion may be altered 1-2s post-stimulus. Further work is needed to advance our understanding of perceived movement during upright stance when sensory cues are manipulated.

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Poster Session: 2

Poster Board: 29

Kinkini Monaragala

Eric Nemrodov, Shao Feng Liu, Ilya Nudnou, Dan Nemrodov, Adrian Nestor

University of Toronto Scarborough

Imagining Taylor Swift - Neural Mechanisms for Visual Imagery

Despite recent progress in unraveling the neural mechanisms for face perception, their counterparts, that subserve visual memory and imagery, are yet to be elucidated. To address this challenge, here, we used electroencephalography (EEG) in neurotypical adults (n=17) to assess neural responses elicited by face images, as participants viewed them or recalled their appearance in response to an auditory cue. Specifically, we appealed to pattern classification and multivariate feature selection techniques to decode facial identity using a set of images depicting front views of familiar (e.g., Taylor Swift) and unfamiliar White female faces.

Regarding the neural dynamics, we found, consistent with prior research, that perceptual information can be robustly decoded between approximately 150ms -1s after stimulus onset. In contrast, imagery information was extracted roughly between 500ms-3s after an auditory prompt. Second, regarding the spatial profile, we found that imagery and perceptual decoding of familiar faces relied on a common set of central and frontal channels. However, unfamiliar face decoding from perception recruited a complementary set of occipitotemporal and frontal channels. Further, representational similarity analysis revealed relatively good correspondence between perceptual and imagery decoding. Last, a combination of visual and semantic information, as captured by convolutional neural networks and transformer models, accounted for the similarity structure revealed by neural decoding.

Thus, the present findings shed light on the visual representations underlying face imagery, on their spatiotemporal dynamics and on their relation with perception. Moreover, methodologically, they demonstrate the ability of EEG decoding to reveal fine-grained information regarding visual memory and imagery for faces.

Poster Session: 2

Poster Board: 30

Kiran K. Bumra

Tooba Shahzad, Madison Reiter, Miracle Ozzoude, Diana Gorbet, Nicole Smeha, Sara Weinberg, Lauren E. Sergio

York University

Concussion Recovery and Skilled Performance in Working-aged Adults: Sex Differences in the Neural Correlates of Persistent Symptoms After Concussion

Background: When we interact with our surroundings, we often do so through indirect means - where specific rules govern how we perceive and respond to our environment, a process called cognitive-motor integration (CMI). After a concussion, the neural networks responsible for CMI frequently become damaged, making it difficult to perform complex movements. We previously identified connections between white matter integrity and visuomotor performance in working-age adults experiencing persistent post-concussion symptoms (PPCS). We aim to address gaps in literature and examine how sex, age, and changes in CMI processes affect visuomotor performance in those with PPCS. Methods: 24 working-aged adults (12 male, mean age: 41.8±10.38 and 12 female, mean age: 49.2±7.40) completed two visuomotor tasks, one with direct hand-to-target movement, and one indirect interaction requiring CMI where they moved their hand in a different plane and had visual feedback reversal between target and cursor motion. Participants completed questionnaires to assess their ongoing symptoms and dizziness severity. MRI scans were used to obtain and analyze thickness and headsize-adjusted volume of regions involved in CMI. Results: We observed that age, sex, and left cuneus region volume significantly predicted movement time in the CMI task; older age and larger cuneus volumes were associated with longer (worse) movement times, and males exhibited shorter movement times compared to females ($p < .005$). Similarly, sex and left superior frontal lobule volume significantly predicted full path length in the CMI task, with being male and having a smaller left superior frontal lobule volume was associated with shorter path lengths ($p < .05$). Lastly, CMI reaction time was predicted by the left precentral cortex thickness as a function of sex and age ($p < .05$). Conclusion: These data indicate that an individual's sex and age affect the neural control underlying skilled-performance deficits following concussion.

Poster Session: 2

Poster Board: 31

Kristen Lott

Nicholas Logan, Zahra Hosseini, Nikolaus F. Troje

York University

Social Gaze Across Communication Media

Video-mediated communication is prevalent for remote communication but does not achieve the same efficiency as face-to-face interaction. This is due to the offset between the location of the camera and the location of their users in front of their screens. This offset has two components: (1) the fixed disparity between the camera location and the centre of the screen, and (2) the dynamic component that varies with the location of the users in front of their screens. This offset disrupts the use of directional non-verbal cues, like eye-contact. Much research exists investigating the differences in efficiency between videoconferencing and face-to-face communication, yet little has been done to examine how social gaze is impacted by these media and which components of the offset are driving differences in gaze. Three experiments are reported that examine dyadic gaze during communication. Gaze and head orientation from both participants were recorded while playing Heads-Up. The type of communication media was manipulated across experiments to examine how gaze differs when communicating face-to-face, over Zoom, and over a screen-based communication system, called DEEP, that is able to independently manipulate both the fixed and dynamic component of the offset. Results revealed that eye-contact and direct gaze events were more frequent and of longer duration when communicating face-to-face relative to over Zoom (Experiment 1). When communicating over DEEP, resolving both components of the offset led to more frequent eye-contact events relative to just resolving the fixed offset or neither (Experiment 2). When directly comparing face-to-face to communication over Zoom and DEEP, eye-contact and direct gaze events were of similar duration between face-to-face and DEEP but shorter in Zoom (Experiment 3). These results highlight the impact videoconferencing has on gaze and suggests that resolving both components of the offset in Zoom is important for reestablishing normal patterns of gaze.

Poster Session: 2

Poster Board: 32

Kumar Vaibhav Jha

James Elder

York University

Long Term Multiple Object Tracking

Multiple Object Tracking (MOT) is a subfield of computer vision that focuses on associating object detections across video frames, allowing for identity assignment and motion tracking. Current state-of-the-art MOT systems are generally successful in generating accurate short-term tracks, which can be sufficient for certain applications (e.g., traffic counts). However, these systems generally fail to deliver the long-term tracks required for traffic routing analysis and for sports video applications.

Graph-based methods provide an intuitive approach to the long-term tracking problem by representing object detections as nodes in a graph and encoding association probabilities as edge weights. A classical graph-based formulation constructs a graph from video detections and solves a min-cost flow problem, theoretically ensuring optimal tracking results under certain assumptions (first-order Markov assumption, track independence assumption).

With the rise of deep learning, graph-based MOT solutions have evolved to incorporate Graph Neural Networks (GNNs) for solving the association problem. These deep-learning-based approaches achieve state-of-the-art performance and generally outperform classical methods. However, these solutions remain heuristic and lack the theoretical guarantees that accompany classical graph-based methods. Here we explore whether additional cues, such as velocity and more advanced appearance features, as well as more careful probabilistic modeling, can make classical methods competitive with more recent GNN approaches. Along with this, we also aim to examine the assumptions underlying the classical methods to see if they are a limiting factor in terms of performance.

Poster Session: 3

Poster Board: 2

Lina Musa

Musa, L., Luabeya, G.N., Sheldrick, B., Rezaei, A., Sun, S., Yan, X., Crawford, J. D.

York University

Investigating the Impact of TMS-Induced Perturbation of Egocentric and Allocentric Brain Hubs on Behavioral Performance

Introduction: Reach target locations can be encoded in egocentric (EGO) or allocentric (ALLO) reference frames. A preliminary functional connectivity analysis of task-based fMRI data (Chen et al., 2014) identified distinct brain hubs associated with these perspectives, with the EGO task linked to the superior extrastriate visual cortex (ExstrSup-2) and the ALLO task linked to the inferior extrastriate visual cortex (ExstrInf-2) (Schaefer et al., 2018). This follow-up study uses TMS perturbation to examine the causal role of these hubs and determine whether correlation-based functional hubs can exhibit behavioural differences, with a hypothesis of EGO influenced by dorsal stream TMS and ALLO both because allocentric representations need to be converted into egocentric representations for action (Chen et al. 2018).

Methods: Sixteen participants performed a pointing task under two conditions (EGO vs. ALLO) with similar sensory and motor demands (Musa et al., 2024). TMS was applied during the delay phase to perturb the EGO and ALLO hubs, and task performance was evaluated by measuring the accuracy and precision of pointing to a remembered target location. Accuracy was quantified by mean horizontal reaching error (deg), and precision was assessed by mean ellipse area (deg^2). Three TMS conditions were used: EGO hub, ALLO hub, and control (no stimulation), at triple-pulse, 1 Hz intensity, and 120% of the motor threshold.

Results: In the control condition, accuracy and precision were significantly better in the ALLO task (0.96° less error and $2.61°^2$ decrease in ellipse area). TMS to the superior hub reduced accuracy in both the EGO and ALLO tasks, while TMS to the inferior hub decreased accuracy only in the ALLO task. Precision decreased for both tasks upon inferior hub stimulation, with a greater effect in the ALLO task.

Conclusion: Landmark-based reaching involves specialized interactions between the dorsal and ventral streams.

Poster Session: 3

Poster Board: 3

Mani Setayesh

Kinkini Monaragala, Nina Lee, Lawrence Guo, Dan Nemrodov, Adrian Nestor, &
Matthias Niemeier

University of Toronto Scarborough

Derivatives of EEG Signals: Using Machine Learning to Uncover the Dynamics of Neural Representations

Machine learning has proven highly sensitive in analyzing electroencephalography (EEG) data. Using the voltages of all electrodes at a given time point as spatial features in classifiers allows for the decoding of detailed experimental information, outperforming univariate approaches to mapping the time course of neural representations. These representations exhibit even higher signal-to-noise ratios (SNRs) when classifiers use voltages from multiple consecutive time points as concatenated features. However, it is unclear why such spatio-temporal features are more informative. The improvement could stem from more reliable estimates of the EEG voltage maps or from the dynamic changes in the voltages. To test these possibilities, we re-analyzed data from previous EEG studies on grasping, training classifiers (support vector machines, SVMs) to decode visual and visuomotor features such as object shape, material, and grasp orientation. We provided classifiers with voltages from 3-7 consecutive time points (~6-14 msec, respectively). As a baseline, data points in each time window were concatenated to be then used to train the classifiers. Alternatively, to isolate the effect of changes over time, we fit polynomials of degrees 0, 1, or 2 to each time window and used their parameters—one at a time—as features to train the SVMs. We found that the constant term of the 0th-degree polynomials, as well as the intercepts of the 1st- and 2nd-degree polynomials, produced SNRs comparable to the baseline classifiers. The results show that a reliable estimate of the topography of the voltage maps is the dominant contributor to EEG classification. Interestingly, the slope parameter of the 1st-degree polynomial also contributed to classification performance, albeit to a lesser extent. By contrast, the slope and the quadratic term of the 2nd-degree polynomial yielded no significant classification. Our findings demonstrate that dynamic changes in voltage maps carry decodable information about experimental manipulations in EEG data.

Poster Session: 3

Poster Board: 4

Maria Koshkina

James H. Elder

York University

Towards Long-term Player Tracking

In team sports analytics, long-term player tracking remains a challenging task due to player appearance similarity, occlusion, and dynamic motion patterns. Accurately re-identifying players and reconnecting tracklets after extended absences from the field of view or prolonged occlusions is crucial for robust analysis. We introduce SportsSUSHI, a hierarchical graph-based approach that leverages domain-specific features, including jersey numbers, team IDs, and field coordinates, to enhance tracking accuracy. SportsSUSHI achieves high performance on the SoccerNet dataset and a newly proposed hockey tracking dataset. Our hockey dataset, recorded using a stationary camera capturing the entire playing surface, contains long sequences and annotations for team IDs and jersey numbers, making it well-suited for evaluating long-term tracking capabilities. The inclusion of domain-specific features in our approach significantly improves association accuracy, as demonstrated in our experiments.

Poster Session: 3

Poster Board: 5

Mario Costantino

Bat-Sheva Hadad, Maryam Vaziri-Pashkam

York University

Weak Action Predictions in Autism

Humans are adept at predicting the actions of others by interpreting subtle preparatory movements, a skill crucial for successful social interactions. This study investigated whether autistic individuals, who experience challenges in social interactions, exhibit reduced efficiency in predicting others' actions. Additionally, we examined whether autistic individuals demonstrate improved understanding of the actions of other autistic individuals, a hypothesis based on the concept of ingroup advantage in social cognition. To address these questions, we used a competitive-reaching task in which an "attacker" was directed by an auditory cue to move toward one of two possible targets, while a "blocker" attempted to anticipate the attacker's trajectory and reach the same target as quickly as possible. Using motion-tracking technology, we measured the blockers' finger reaction time (fRT), as the time interval between the attacker's movement initiation and the blocker's response, as well as the blockers' movement velocity. Results revealed that autistic blockers exhibited longer fRTs and slower movement velocities compared to non-autistic blockers, indicating deficits in both the decision-making process and movement execution components of action prediction. Notably, this impairment was consistent regardless of the attacker's identity, challenging the hypothesis that autistic individuals are better at predicting the actions of other autistic individuals. To ensure that these differences were specific to action prediction rather than general visuomotor impairments, we conducted a control experiment in which blockers responded to an auditory cue. In this experiment, no significant differences in reaction times were observed between autistic and non-autistic blockers, suggesting that the observed differences in the main task were not due to visuomotor processing differences but rather specific to action prediction deficits. Taken together, these findings provide novel evidence that autistic individuals struggle to efficiently integrate perceptual cues necessary for predicting others' actions, offering insights into the mechanisms underlying social interaction challenges in autism.

Poster Session: 3

Poster Board: 6

Marium Alvi

Marium H. Alvi, Ryley P. Nathaniel, Karmen Rai, Liya Ma

York University

Repeated Within-session Intra- and Extra-dimensional Learning in Marmosets

Cognitive flexibility is the brain's ability to suppress current strategies in favor of better alternatives when the context changes. Reductions in cognitive flexibility are a transdiagnostic deficit in several neuropsychiatric disorders. How the primate brain supports this process is not well understood.

We trained 4 marmosets on a touchscreen-based Wisconsin Card Sorting Task (WCST) involving 2 dimensions: 3 shapes (star, square, heart) and 3 colors (yellow, red, blue). Marmosets underwent shape training, choosing the correct black shape from pairs to obtain a reward, followed by training on the remaining shape pairings. Similarly, they were trained on colors presented as circular patches. Once learned, they progressed to the full marmoset WCST (mWCST), in which they identify and select the compound stimulus with the target feature ignoring the irrelevant dimension. When they choose 8 correctly in a 10-trial block, the target feature shifted either within dimensions (e.g. red to blue) or across dimensions (e.g. red to heart). All marmosets quickly learned to perform multiple intra- and extra dimensional switches within a daily session. Afterward, animals were introduced to 6 new features, 3 shapes and 3 colours. Marmosets applied their learned skills to make multiple switches within their first two sessions. Next, we will implement a feature reinforcement learning model to simulate rule switching behaviour during the mWCST, providing insights into how animals adapt to intra- and extra-dimensional shifts.

Poster Session: 3

Poster Board: 7

Maryam Ansari Esfeh

Maryam Ansari Esfeh, Ali Rezaei, Keanna Bamdad Rowchan, Hoora Mohseni, Seetha Lakshmi Rajeev, Randy Flanagan, Jeffrey Wammes, Jason Gallivan

Queen’s University

Functional Interactions Between the Action-Mode Network and Sensorimotor Cortex During Sensorimotor Adaptation

Adaptive behaviour relies on dynamic, systems-level interactions between distributed brain networks. While the critical contributions of sensorimotor cortex to learning are well-documented, a comprehensive understanding of how higher-order brain systems, particularly the action mode network (AMN), dynamically interact with these sensorimotor regions remains poorly understood. Building upon a recently established framework that posits the AMN as orchestrating goal-directed behavior through its interactions with motor systems (Dosenbach et al., 2025), we investigated the evolving functional organization of both somatomotor cortex and the AMN during visuomotor rotation learning across multiple timescales. Using fMRI, we continuously measured brain activity across two days of visuomotor adaptation, encompassing baseline, early and late learning, and washout phases. To characterize the dynamic changes in network interactions between the somatomotor cortex and the AMN, we projected covariance patterns across these regions onto a low-dimensional manifold space and examined reconfigurations of this neural space across distinct stages of learning. Our analysis revealed distinct shifts in the manifold representation of both AMN and somatomotor cortex regions across learning phases, demonstrating a dynamic reorganization of functional connectivity both within and between these critical networks. Specifically, we found that AMN areas exhibited prominent shifts along the manifold particularly during early learning and washout, whereas somatomotor cortex areas showed more gradual shifts, deviating from baseline connectivity across learning and returning during washout. To further characterize and validate the manifold-derived connectivity changes, we conducted complementary seed-based connectivity analyses. Collectively, these findings illuminate the dynamic interplay between sensorimotor and AMN networks during visuomotor adaptation, providing unique insights into the temporal orchestration of these systems. Our results also advance our understanding of how the AMN, a key network for action initiation and goal-directed behavior, guides and modulates sensorimotor regions to enable adaptive motor control.

Poster Session: 3

Poster Board: 8

Matteo Dunnhofer

Christian Micheloni, Kohitij Kar

York University and University of Udine

Dynamic Object Processing in Macaque IT Cortex: Temporal Dynamics and Model Limitations

The macaque inferior temporal (IT) cortex, the apex of the ventral visual stream, plays a crucial role in object recognition. While most studies have relied on static images to predict neural responses and build encoding models, how dynamic visual inputs are transformed into IT responses remains incompletely understood. Here, we presented 200 videos (500 ms each, 18 frames at 60 Hz) to two macaques while recording neural activity from 132 reliable sites in the IT cortex. Each video contained objects moving within a fixed background, enabling us to investigate the temporal dynamics of IT population responses. We addressed three key questions. First, we asked whether IT neurons exhibit reliable activity beyond the initial transient response (70–150 ms) in response to videos. Neural responses demonstrated significant reliability throughout the video duration (~0.62 Spearman-R split-half correlation), suggesting that dynamic stimuli engage sustained processing in the IT cortex. Second, we assessed whether these later responses could predict object identity using linear decoders. Decoding performance was significantly above chance (~58% classification accuracy ~500ms post video onset, chance-level=10%), indicating that IT activity carries discriminative information for object recognition beyond the initial response phase. Third, we evaluated how well feature activations from feedforward models (e.g., convolutional neural networks) could explain IT responses along its entire reliable dynamics. The early (70-170ms) responses were significantly better predicted (~51% explained variance) by any frame-based model activation compared to later response phases (470-570 ms, %EV ~19%), highlighting a critical limitation of feedforward architectures in accounting for dynamic neural processing. Our findings reveal that dynamic stimuli elicit sustained and informative responses in the IT cortex. The inability of standard feedforward models to explain later neural responses suggests the need for models incorporating recurrent or temporal mechanisms to explain IT representations better.

Poster Session: 3

Poster Board: 9

Matthew T. Jacobs

Kevin P. Cross, Stephen H. Scott

Queen's University

Convergence of Proprioceptive and Visual Feedback Across Parietal, Primary Motor & Premotor Dorsal Cortex

A key feature of the motor system is the ability to rapidly generate goal-directed motor corrections to counteract disturbances of the limb. Responses generated from rapid corrections to visual and proprioceptive perturbations recruit significantly overlapping neural populations in rostral M1[1]. The present study explores if this result was regionally specific or if it extends to other sensorimotor areas. Specifically, PMd receives anatomical projections from visually dominant parietal areas such as V6a, whereas caudal M1 preferentially receives anatomical projections from proprioceptively dominant parietal areas, such as PE. Consequently, we predicted a gradient in neural responses to sensory feedback with greater responses to visual versus proprioceptive responses in PMd, the reverse to be observed in caudal M1, and for PE to only respond to mechanical loads, aligning with past observations of receptive field response which display a bias towards proprioception.

A macaque was trained to perform reaching movements using the Kinarm Exoskeleton Lab. A cursor (circle) represented finger position in a virtual reality system aligned with the horizontal workspace. On random trials, the cursor was shifted (visual perturbation) or a mechanical load was applied to the limb (proprioceptive perturbation) requiring a motor correction to reach a goal target with the cursor. Individual micro-electrode recordings occurred in caudal bank of M1 (n = 40), rostral M1 (n = 85), PMd (n = 59) and PE (73).

As predicted, recordings in PE demonstrate sensitivity only to mechanical loads. Unexpectedly, there were no significant differences mediated by perturbation type across the three motor areas, though recordings in the bank of M1 trend towards a larger response to mechanical loads. These results suggest sensory integration occurs either at the level of motor cortices or upstream, potentially in parietal cortical regions.

1. Cross, K. P., Cook, D. J., & Scott, S. H. (2024). eNeuro.

Poster Session: 3

Poster Board: 10

Megan Goar

Michael Barnett-Cowan

University of Waterloo

Vestibulo-Motor Reweighting Dynamics and Perceptual Reweighting: Effects on Cybersickness

Virtual reality (VR) offers immersive experiences through electronic visual and auditory displays. While VR has applications in entertainment, training, and rehabilitation, its widespread adoption is limited by cybersickness, a condition characterized by symptoms such as nausea, headaches, and disorientation. Cybersickness is thought to arise from complex visual motion cues that conflict with vestibular and proprioceptive inputs. To resolve these conflicts, the central nervous system (CNS) may adjust sensory weighting by downweighting (decreasing reliance on) visual cues and upweighting vestibular cues. Electrical vestibular stimulation (EVS) can be used to measure changes in vestibulo-motor weights by calculating coherence and gain between EVS and centre of pressure (COP) responses. However, because EVS does not provide meaningful head orientation cues, it may further disrupt sensory integration. This study examines how the CNS responds to simultaneous disruptions in both visual and vestibular inputs and whether sensory reweighting influences both perceptual and balance outcomes. Participants played a nauseating VR game (Meta Roller Coasters) for 20 minutes while receiving continuous stochastic EVS (0–25 Hz, ±4.5 mA) to elicit balance responses in CoP. The OCHART task was used to assess the perceptual upright, and a vector sum model was applied to calculate relative sensory weights for upright perception. Preliminary data (N=3, projected N=20) suggest individual variability in sensory reweighting strategies, with some participants upweighting vestibular cues over time and others downweighting them. Those who upweighted vestibular cues were more likely to downweight visual cues for upright perception. These different reweighting strategies may influence both cybersickness severity and standing balance performance. This study will provide insight into how the CNS adapts to conflicting sensory cues and whether shared neural mechanisms regulate both perception and balance in VR-induced sensory conflicts.

Poster Session: 3

Poster Board: 11

Michael Feyerabend

Jarrod Dowdall, Juan Pimiento Caicedo, Michelle Jimenez-Sosa, Stefan Pommer, Julia Sunstrum, Jeniffer Rachel, Samuel Mestern, Felix Preuss, Andreas Neef, Jochen Staiger, Wataru Inoue, Julio Martinez-Trujillo

University of Western Ontario

Decoding Neuronal Diversity from Extracellular Recordings: A Novel Approach Integrating Neuropixels, Optogenetics and Intracellular Recordings

Single cell electrophysiological recordings are essential for understanding neuronal information encoding in behavioral contexts. Extracellular recordings (EC) have provided significant insights into cortical function but struggle to identify distinct cell types. Traditionally, neurons are classified as narrow or broad spiking based on action potential duration, often equating these types with inhibitory and excitatory neurons, respectively. However, this classification is problematic due to the existence of broad spiking interneurons and narrow spiking pyramidal neurons. Recent unsupervised clustering techniques for cell type classification in vivo have struggled to align identified clusters with a consensus cell type taxonomy.

In this project, we use the “Visual Coding – Neuropixels” dataset from the Allen Institute for Brain Science, which includes optogenetic labeling of the following subpopulations: vasoactive intestinal polypeptide (VIP), somatostatin (SST), and parvalbumin (PV) expressing neurons. Additionally, we obtained a sparse label for excitatory cells (EXC) based on cross-correlograms. We leverage characteristic feature profiles of these non-overlapping subpopulations for supervised classification of EC units with high accuracy in mouse V1. Our goal is to apply this procedure across species, informed by single-cell in-vitro characterizations in marmoset. Prediction outcomes were evaluated by comparing predicitons with functional connectivity.

Our results demonstrate that EC unit classification can be applied to species lacking transgenic tools, which is particularly useful for primate studies. We enhance our understanding of neuronal responses on the circuit level by offering a probabilistic readout during in vivo experiments. These techniques will be invaluable for systems neurophysiologists studying the cerebral cortex of behaving animals.

Poster Session: 3

Poster Board: 12

Michelle Hirsch

Andrée-Ann Cyr, Buddhika Bellana

York University

Evaluating the Feasibility of a Naturalistic Wikipedia-Based Information Foraging Task

Curiosity, the intrinsic drive to seek information, is critical to well-being in old age. While past research shows age-related declines in self-reported curiosity, objective measures suggest older adults indeed express curiosity; however, the information-seeking styles underlying its expression may differ. Decision-making and memory literature findings show that older adults tend to display a more exploitative style (reliance on prior knowledge), whereas younger adults display a more exploratory style (preference for novelty). While considerable work exists on curiosity, few paradigms have examined curiosity alongside its consequences on real-world information-seeking. To address this gap, we propose an information-foraging task where participants freely browse Wikipedia (Lydon-Staley et al., 2021). Exploitative and explorative information-seeking patterns can be operationalized through the semantic relatedness between visited pages (i.e., higher semantic relatedness in exploitative information-seeking). To assess the utility of this approach, we simulated data (i.e., Wikipedia URLs) for either information-seeking pattern (exploitative: $n = 72$; explorative: $n = 72$) using ChatGPT. Extracted texts per URL were then transformed into a numerical vector (via tf-idf), and semantic similarity between URLs was estimated using cosine similarity, alongside graph theoretic and trajectory-based metrics. Analysis of effect sizes (Cohen's d) indicated that all metrics had very large effects (> 0.8) and aligned with exploitative and explorative groups in the predicted directions, suggesting feasibility. As such, our work may be an effective paradigm for enhancing our understanding of the relationship between curiosity and aging in the context of real-world information-seeking – with potential downstream implications for curiosity-based interventions in old age.

Poster Session: 3

Poster Board: 13

Mohammad Akhavan

James Elder

York University

Detect and Disinfect Surface Contamination Using Fluorescence Imaging and UV-C Light

Ensuring surface hygiene is critical in different sectors such as healthcare and food industries, where biological contamination poses significant risks. This research focuses on using fluorescence imaging and UV-C light for real-time detection and disinfection of human-related contaminants, specifically respiratory residues such as saliva. These residues, often invisible to the human eye, emit fluorescence under UV-C excitation and can be detected using UV cameras. This approach has the potential to improve the efficiency of autonomous disinfection robots, reducing both operation time and energy consumption.

For contamination detection, this study compares the performance of supervised and unsupervised classification methods, both based on tri-variate normal models. The unsupervised approach leverages a Gaussian Mixture Model (GMM) for segmentation. Additionally, an optimal cue combination strategy is applied to UV image channels to enhance the contrast-to-noise ratio (CNR) across different surface types, including steel, plastic, and wood, aiding in the selection of optimal UV camera parameters.

This research endeavors to employ UVC light not only for the identification of surface contaminants but also for the subsequent disinfection of those surfaces. The disinfection process aims to eliminate viruses or bacteria on identified biological residues effectively. To assess the efficacy of the disinfection procedures, the proposed work involves measuring the amount of UVC dosage received by surfaces.

In conclusion, this research aims to assess the effectiveness of this approach for real-time detection and disinfection of human-related contaminants, with the goal of integrating it into a disinfection robot. The proposed framework has significant applications in hygiene-sensitive environments, such as hospitals, long-term care facilities for seniors, and food processing plants, where precise contamination detection and efficient disinfection are essential for maintaining safety standards.

Poster Session: 3

Poster Board: 14

Nafiz Sadman

Farhana Zulkernine

Queen's University

From Data Imbalance to Diagnostic Insight: Evaluating Vision-Lanugage Model for Rare Disease Classification

Artificial intelligence (AI) advancements are transforming the radiology domain, providing significant enhancements in diagnostic precision and patient management. Nonetheless, incorporating AI into routine clinical practice poses difficulties, especially when confronted with datasets that inadequately depict severe illnesses. Our work examines BiomedCLIP, a state-of-the-art vision-language model (VLM), on the IU-Xray dataset, which reflects the intricacies of real-world healthcare where rare diseases may be neglected. We assessed BiomedCLIP's ability to classify in three contexts: zero-shot inference, fine-tuning, and linear probing. In the zero-shot context, the model was unable to classify 80% of diseases, underscoring considerable limitations when directly applied to imbalanced clinical data. Fine-tuning exhibited enhancements of 60% of the labels which were distinct diagnostic categories. Linear probing improved accuracy for diseases with overlapping features, such as, 'Pnemonia' and 'Consolidation', by implementing a more customized classification layer.
To clarify the model's decision-making process, we utilized Grad-CAM visualizations, which can offer radiologists explicit insights into the areas of interest inside radiographs. This transparency enhances clinical validation and cultivates more trust in AI-driven diagnostics. Our research connects experimental AI with clinical applications by tackling imbalanced data issues and prioritizing interpretability. Ultimately, these findings facilitate the development of more dependable and interpretable diagnostic systems that can improve patient outcomes and aid clinical decision-making.

Poster Session: 3

Poster Board: 15

Nathaniel Goldstein

Laurie M. Wilcox, Erez Freud

York University

The Effect of Binocular Vision on Visuomotor Control

Binocular vision plays a crucial role in allowing us to experience the spatial layout and physical properties of objects in our visual environment. This depth information is vital for both perception and action-based behaviours, as research shows that adults make faster and more precise grasps when binocular depth cues are available. However, most studies on this topic involved tasks where participants reach for objects positioned at a fixed distance and move them closer towards them. In contrast, real-world movements occur in various directions and at different distances relative to the observer. Here we evaluate the contribution of binocular depth information (e.g., disparity, vergence) to a range of grasp characteristics for bidirectional movements (i.e., towards vs. away from the body). In a within-subjects design, participants grasped 3D discs of varying sizes (3.5 - 5.5 cm diameter) at two distances (18 and 36 cm from observer). Participants performed the task under binocular and monocular viewing conditions, with the non-dominant eye covered. On each trial, participants grasped an object and placed it on a peg positioned closer or further away from their body as quickly and accurately as possible. Our results indicate that the availability of binocular depth information modulates both components of the task (grasping the object and repositioning it at the new location). Specifically, under binocular viewing the maximum grip aperture (MGA) was smaller, the time to grasp the objects was shorter, and the time spent repositioning the object within a few centimetres to its final location was smaller. These effects were consistent for both movement directions. We observed minimal interactions between depth, distance, and size, suggesting independent effects of these variables on visuomotor behaviour. Taken together, these results provide further insights into the contribution of 3D depth cues to multi-dimensional visually guided movements.

Poster Session: 3

Poster Board: 16

Nicholas Logan

Nikolaus F Troje

York University

Learning Systematic Improvements to ARKit's Face Tracking Accuracy

Apple's TrueDepth camera and API ARKit provide valuable tools for tracking facial motion, pose, and gaze. This framework can monitor facial behaviour and eye movements, both offline and in real-time. Here, we showcase a tool that makes this functionality readily available to researchers in behavioural science and experimental psychology.

Our tool is implemented as an app that can be downloaded from Apple's App Store and used either to record data into CSV format or to stream data over LAN for other real-time applications. We present examples of the tool being used in both settings.

To account for systematic biases in ARKit's tracking and ultimately improve capture quality, we collected a large dataset. Through our data collection process, we discovered and documented the limits of the system by providing accuracy and precision data for head pose and eye gaze, contrasted with ground truth data collected using OptiTrack with Motive 3 for motion capture and Pupil Labs' Neon eye tracking glasses.

New generation iPhones not only provide the sensors and API needed for face tracking, but additionally enough computational power to leverage deep learning models for light supplementary training and real-time inferencing. We use this to adjust the data collected through ARKit by providing users with an option to perform a short personal calibration session. Then, a pre-trained deep neural network, after briefly training further on the short calibration session, can more accurately represent the user's face in 3D space.

This work aims to bring better quality face and eye tracking into the hands of more researchers at an affordable price point. It also acts as a preliminary step towards our future work, approaching real-time novel view synthesis. Furthermore, the dataset we generated in our development will undoubtedly also prove useful for future work from researchers in similar areas.

Poster Session: 3

Poster Board: 17

Nima Vahdat

James Elder

York University

Graph Convolutional Neural Networks for Contour Detection and Grouping

Contour detection and grouping are fundamental tasks in computer vision, playing a crucial role in object recognition and scene understanding. Traditional approaches often struggle with capturing global and configural shape information, as they rely primarily on local cues. In this work, we model contour grouping as a graph-based problem and leverage Graph Convolutional Networks (GCNs) to explore the impact of message passing on learning global shape structures.

We represent the problem as an undirected graph \(G = (V, E) \), where each node \(v_i \in V \) corresponds to an endpoint of a line segment, and edges \(e_{ij} \in E \) define relationships between these endpoints. The graph includes two types of edges: \textit{real edges}, which connect endpoints of the same line segment, and \textit{virtual edges}, which link endpoints of different segments based on geometric and perceptual grouping cues. The objective is to classify each edge \(e_{ij} \) with a binary label \(y_{ij} \in \{0,1\} \), indicating whether the connection contributes to a meaningful contour.

To evaluate our approach, we construct a \textit{synthetic dataset}, allowing controlled experimentation on contour grouping performance. By incorporating GCNs, we investigate how message passing enhances the representation of structural relationships among line segments, leading to improved contour grouping. We hypothesize that GCNs facilitate learning higher-order dependencies, enabling better identification of continuous boundaries. Experimental results on our synthetic dataset demonstrate the effectiveness of our approach in capturing global shape properties and improving contour completion. Our findings contribute to advancing graph-based perceptual organization and enhancing shape-based reasoning in deep learning models.

Poster Session: 3

Poster Board: 18

Nina Lee

Lin Lawrence Guo, Adrian Nestor, Matthias Niemeier

University of Toronto

Action Intentions Reactivate Representations of Task-relevant Cognitive Cues of Weight

Recent research shows that the intention to act on an object alters its neural representation in ways as afforded by underlying sensorimotor processes. For example, the intention to grasp and pick up an object results in representations of the object's weight. But these representations become grasp-specific only immediately before object lift if weight information is relayed through a common object material. This feature triggers earlier representations regardless of intention probably because material-weight contingencies are overlearned. By contrast, recently learned weight cues should be recalled deliberately during grasp planning resulting in early grasp-specific representations. Here, we examined how action intentions affect the representation of newly acquired colour-weight contingencies. We recorded electroencephalography while human participants grasped or reached for objects that varied in shape ("pillows" vs. "flowers") and density as indicated by their colour (red vs. blue). Multivariate analyses revealed a grasp-specific reactivation of colour during planning that was mirrored in beta band. This suggests that task-relevancy influences the representation of colour such that previously encoded colour-weight contingencies may be reactivated as required for grasping, mediated top-down via working memory. Grasp-specific representations of shape and colour were also present in theta band, perhaps reflecting attentional activity. These results provide new insights into the interplay between cognition and motor planning processes.

Poster Session: 3

Poster Board: 19

Nizwa Javed

James Elder, Helio Perroni Filho

York University

Snapbot: A Social Robot with Long-Range Attentive Sensing

Social robots are becoming increasingly prevalent in environments such as shopping malls, museums, and public events. These robots not only navigate among humans but also engage with them in meaningful ways, fulfilling tasks that require autonomy and social intelligence. In this work, we present SnapBot, a social robot that is equipped with 360-degree field of view and a novel attentive sensing platform that is capable of long range face recognition over distances up to ~35m.

This platform is comprised of two stages. The pre-attentive stage consists of, an array of four wide field-of-view (FOV) RGBD cameras collectively providing a low-resolution 360° FOV around the robot. A deep object detector is used to detect humans within this panoramic FOV. Depth returns and camera geometry are then used to determine the 3D location of each detected individual relative to the robot while person tracking and re-identification modules maintain a history of the relative ground plane trajectories of these individuals.

The attentive stage consists of a high-resolution, narrow FOV camera aligned with a mirror-based gaze deflection system that can fixate any azimuth within the panoramic pre-attentive FOV. Individuals in the far field detected pre-attentively are sequentially fixated by the attentive stage. We demonstrate that due to constraints on the viewing geometry a single axis of rotation is sufficient to acquire high-resolution facial imagery of all visible individuals in both near and far fields, whether standing or sitting, child or adult, supporting facial identity recognition. This social attention system can potentially provide a substrate for more advanced socially intelligent behavior.

Poster Session: 4

Poster Board: 20

Nora Pourhashemi

Taylor W. Cleworth

York University

The Role of Modified Optic Flow Gain During Static and Dynamic Balance Control

BACKGROUND: Vision provides critical feedback to maintain upright stance. Optic flow gain, which is the amount of visual motion relative to head movement, can be manipulated using virtual reality (VR) [1]. Amplifying optic flow-related visual feedback tightens postural control [1], whereas reducing it increases postural sway amplitude [2]. The purpose of this study was to determine the minimum optic flow-related visual feedback required to maintain stability comparable to baseline (gain of 1) during static and dynamic stance.

METHODS: In experiment 1, 36 young adults stood on a force plate under firm and foam conditions for 60 seconds. In experiment 2, 26 young adults stood on a force plate mounted on a platform that translated in the anteroposterior (AP) direction (± 5cm, <1Hz) for 60 seconds. For both experiments, participants wore a VR head-mounted display that modified optic flow gain ranging from 0 to 1. Centre of pressure (COP) displacements were calculated and analyzed using amplitude (root mean square; RMS) and frequency (mean power frequency; MPF), sample entropy (SE), and detrended fluctuation analysis (DFA)-derived scaling exponent (α). RESULTS: In experiment 1, AP COP RMS, MPF, and SE increased, while DFA-α decreased on foam compared to firm surfaces. A gain of 1 resulted in the lowest DFA-α on foam surfaces. In experiment 2, AP COP RMS decreased when optic flow gain was less than 0.5x, while DFA-α decreased as optic flow gain increased.

CONCLUSIONS: Optic flow gain influences postural control under more challenging and dynamic conditions (foam and support surface translations). During challenging conditions, DFA-α decreased as optic flow gain increased. Overall, half the amount of optic flow-related visual feedback was sufficient to sustain baseline characteristics of sway.

ACKNOWLEDGEMENTS: VISTA, NSERC, CFI. REFERENCES: [1] Lavalle & Cleworth (2023) Neurosci Lett; [2] Phu et al. (2023) Exp Gerontol.

Poster Session: 3

Poster Board: 21

Obaida Al-Naib

Gerome Manson

Queen's University

Enhancing Recognition Memory Through Motor and Visual Feedback: Comparing Active, Dynamic, and Static Learning Conditions

Previous research suggests that active writing, where individuals generate writing movements, enhances recognition memory more effectively than static viewing. However, the specific contributions of dynamic and static visual input versus active motor engagement remain unclear. The aim of this study was to investigate the role of visual feedback and motor engagement in recognition memory by comparing three learning conditions: active writing, dynamic viewing, and static viewing.

In this experiment, neurologically healthy participants with no prior knowledge of Arabic were recruited. Participants encoded a list of Arabic words under three conditions: (1) static viewing, where participants viewed a static image of the word; (2) dynamic viewing, where participants watched an animation of the word being written out; and (3) active writing, where participants actively wrote the word after observing a dynamic animation. Following the acquisition phase, participants completed a recognition test where they identified previously presented words among distractor words they had not seen before. Recognition accuracy, reaction time, and confidence ratings (from 0-100%) were recorded.
Statistical analyses revealed that recognition memory was significantly more accurate after active encoding (84%) compared to static viewing (68%; $p = 0.034$). Although accuracy was higher in dynamic encoding (80%) than static viewing, the difference was not significant ($p = 0.068$). There was also no difference in recognition accuracy between active and dynamic encoding. Confidence ratings did not differ between conditions. These findings suggest that motor involvement and dynamic visual input play a key role in enhancing memory consolidation.

This research highlights the importance of both active motor engagement and dynamic sensory feedback in the recognition memory. The findings have potential applications in educational strategies and rehabilitation programs, particularly for individuals with learning disabilities or cognitive impairments.

Poster Session: 3

Poster Board: 22

Paria Mehrani

Dr. John K. Tsotsos

York University

On the Role of Attention in Vision Transformer Models

Vision transformers (ViTs) have become a dominant architecture in many AI models tackling vision problems, outperforming convolutional neural networks (CNNs) in vision tasks such as image classification and segmentation. What sets these models apart from CNNs is the introduction of attention modules that were motivated by reference to the effects of attention in humans. Some studies reported that ViTs are more human-like than CNNs, closing the gap in machine and human vision. While most studies assessed human-like performance in ViTs in an end-to-end manner, such as by comparing object recognition errors, direct probing of the attention modules to disentangle their role in this improvement is often neglected. If attention modules in ViTs make them more human-like, do they also have the same known effects as visual attention in humans? To answer this question, we probed attention modules in ViTs and studied their effects on figure border ownership assignment, namely, facilitatory attentional modulation and the inhibition of distractor influence. As feedforward architectures, attention in ViTs is bottom-up. Therefore, we inspected the effect of bottom-up attention by comparing pre- and post-attention responses to a single shape in the image. In this case, one expects attention on the single salient shape, leading to an increase in the modulation index. Instead, we observed a reduction. To simulate selective attention in ViTs, we infused a top-down signal that restricted the computation of attention scores to either preferred or non-preferred stimuli. Unlike in humans, where attending to a non-preferred stimulus suppresses neural responses, ViTs exhibited an enhancement, nearly matching the response to the preferred stimulus. Together, our results highlight substantial gaps between attention in ViTs and humans, suggesting that despite human-like object recognition errors, vision transformers lack attentional mechanisms with effects similar to those observed in humans.

Poster Session: 1

Poster Board: 32

Petros Georgiadis

Erez Freud, Peter Kohler, Douglas Crawford

York University

Decoding Brain Activity: EEG-Based Neural Representations of Reaching and Placement Movements

Successful interactions with our environment rely on coordinated movements, such as grasping and placing objects, yet most research has focused on object acquisition, overlooking the relocation phase. While both actions share common features—such as hand localization, orientation, and sensitivity to task complexity—they differ in sensory reliance and movement intention. Grasping is typically guided by visual input and concludes with haptic feedback at contact, whereas placement often depends on an internal representation of the target location. To investigate the neural mechanisms underlying these processes, EEG data were recorded from four right-handed young adults (mean age: 22, SD: ± 2.4) performing a sequential grasp-and-place task with pseudo-randomized object orientation and placement location. We expected differential engagement of parietal and frontal areas during planning and execution. Source localization analyses in the time and frequency domains revealed distinct neural activity patterns between the two tasks. During movement preparation, our preliminary results suggest that grasping and placement differed in (1) frontal activation of the contralateral hemisphere, (2) occipital activity related to target encoding, and (3) motor engagement in the ipsilateral hemisphere. During execution, (1) the trend of frontal activity differences persisted, and (2) motor regions exhibited greater desynchronization during placement, possibly indicating increased demands for online control. To further investigate how these regions interact dynamically, we will apply graph theory analysis to uncover task-specific network configurations over time. These findings will enhance our understanding of movement control in the human brain and support dynamic movement classification for assistive devices. This research is supported by funding from NSERC and the Connected Minds.

Poster Session: 3

Poster Board: 23

Pranavan Thirunavukkarasu

S. P. Errington, A. Sajad, B Corrigan, J. D. Schall

York University

Laminar Architecture of Error Responses in Medial Frontal Cortex

Hubel and Wiesel's seminal work in cat primary visual cortex established the concept of columnar organization, forming the foundation of the canonical cortical microcircuit. However, cortical cytoarchitecture is not uniform—the presence of a clearly defined granular layer 4 varies across regions, and laminar profiles identified in sensory cortices do not consistently apply to agranular frontal areas responsible for cognitive functions such as error monitoring. This challenges the notion of a universal canonical microcircuit. We address this gap by using laminar probes to record spikes from individual neurons and local field potentials (LFPs) across layers in the medial frontal cortex (MFC), including the supplementary eye field and the dorsal and ventral banks of anterior cingulate cortex of four macaque monkeys performing a stop-signal task. Although interconnected, these regions are functionally, cytoarchitecturally, and anatomically distinct. Combining converging evidence from 1) single-unit data characterized by spike waveform shape, spike timing patterns, and cross-correlations between distant and neighboring neurons and 2) LFP measured as current source density and spectrolaminar profile, we localized the laminar origins of error-related signals with high confidence. Our findings refine the canonical framework in MFC and present a biologically plausible microcircuitry model that monitors and refines behavior.

Poster Session: 3

Poster Board: 24

Raphael Q. Gastrock

Andrew King, Denise Y. P. Henriques

York University

Precision and Performance in Skill Acquisition: Improved Speed, Accuracy, and Path Efficiency Following Training in a 2-D Racing Task

People have the tremendous ability of acquiring and mastering many motor skills. Skill acquisition studies show that learning is accompanied by offline gains, or improved performance upon re-experiencing the task, performance generalization to other contexts, and speed and accuracy improvements. However, these tasks usually imposed constraints on movement type and speed. Here, we developed a task where participants learned to improve accuracy, while not constraining movement times. Participants (N = 45) controlled the movement of a car through a racing track using a stylus on a digitizing tablet, and moved through the track as fast and as accurately as possible, across training in two consecutive days. In day 1, participants performed well in the task, showing immediate high levels of accuracy. Lap times and path lengths, however, showed more continuous improvements throughout the first training day. In day 2, participants re-experienced the same track as in day 1. Lap times were faster compared to the initial trials of day 1, and quickly attained comparable performance levels as the final trials of day 1. Moreover, accuracy and path length measures showed evidence for offline gains. We then flipped the track orientation by 180°, which slowed down lap times and decreased accuracy, but participants quickly regained similar performance levels as in the trained orientation. Finally, participants performed a block where they had to move through the trained track orientation in reverse. Although accuracy improved within this block, lap times and path lengths did not end with the same levels of performance as in the previous training blocks, suggesting interference in learning. Our results show how skill acquisition in a continuous movement task can occur quickly and show substantial retention and generalization patterns.

Poster Session: 3

Poster Board: 25

Rayan Farahvash

Junsoo J. Pak, Justin Howe, Robert L. Whitwell

University of Western Ontario

Dual Adaptation and Grasping: The Effects of Repetition and Awareness

One approach to studying motor learning in goal-directed action is to apply an adaptation protocol while participants reach for visual targets. On ‘adaptation’ trials, the trajectory of the limb is manipulated, forcing participants to update their motor plan to stay ‘on-target’. In one task variant, trials are split into two directionally-opposed manipulations of limb position. Reduced after-effects in such ‘dual’ adaptation variants are thought to result from competing activity in overlapping neural circuits. Interference is observed when the manipulations are predictably alternated across trials, but not when the manipulations are pseudo-randomized and participants are made aware of the upcoming condition. We tested whether these patterns would generalize to a grasp adaptation protocol in which grasp aperture adapts to the real (i.e., haptic) size of a target that is smaller or larger than its virtual size. Past work demonstrates strong after-effects when smaller (or larger) haptic size is administered in a ‘blocked’ trial order. Here, participants grasped virtual targets whose haptic sizes were either 1-cm smaller or 1-cm larger and were administered in an alternating or pseudo-randomized trial order. Furthermore, participants were made aware or kept unaware of an association between virtual target colour and location and its haptic size. Compensation and after-effects for the larger haptic size was strongest in the aware groups, intermediate in the randomized unaware group, and null in the ‘alternating’ unaware group. All groups failed to compensate for the smaller haptic size, indicating failure to ‘dual’ adapt. In a second adaptation sequence, the test for aftereffect involved swapping the locations of the coloured targets to determine whether learning was location- or colour-based. The results indicated the aftereffect was largely based on target location. Our findings suggest that explicit awareness can play a strong role in facilitating adaptation of grasp aperture to haptic size.

Poster Session: 3

Poster Board: 26

Remy Cohan

Stefania S. Moro & Jennifer K. E. Steeves

York University

Quantifying Phosphene Size Using MRI-guided Transcranial Magnetic Stimulation to Primary Visual Cortex

Visual phosphenes are perceived flashes of light in the absence of retinal input and can be evoked by transcranial magnetic stimulation (TMS) to primary visual cortex (V1). Previous dose-response studies using direct electrical stimulation (DES) of the visual cortex have shown that higher intensities produce larger phosphenes, suggesting increased stimulation intensity affects a larger cortical area. Unlike DES, in TMS intervening tissues such as scalp, skull, and cerebrospinal fluid can attenuate induced electric fields. Prior studies have examined stimulation intensity, but few have investigated how individual differences in phosphene size relate to biophysical factors. The current study examines TMS-induced phosphene size and its relation to phosphene thresholds, scalp-to-cortex distance, and modelled electric field strength measured using MRI-guided stereotaxic neuronavigation and our computer-based phosphene reporting tool. V1 stimulation evoked phosphenes in quadrants of the visual field corresponding to retinotopic region. Perceived phosphene size was negatively correlated with phosphene thresholds, indicating that higher phosphene thresholds led to smaller perceived phosphenes. Age and scalp-to-cortex distance were not correlated with phosphene size, consistent with the notion that scalp-to-cortex distance does not account for different intervening tissue types and corresponding properties. Phosphene size, however, was negatively correlated with electric field strength, indicating that intervening tissue properties may attenuate TMS intensity. These findings suggest that variability in phosphene perception may reflect biophysical factors, such as intervening tissue properties and highlight the importance of accounting for biophysical factors and electric field modelling to better understand variability in TMS-evoked phosphene perception. In addition, using a standardised method such as a phosphene mapping tool to quantify individual differences in TMS response is valuable to facilitate standardization of methods for non-invasive brain stimulation to advance TMS research and optimize its application in clinical settings.

Poster Session: 3

Poster Board: 27

Ricky Chow

Jennifer A. Bugos, Shimin Mo, R. Shayna Rosenbaum, Claude Alain

York University

Music Training Mitigates Age-related Changes in Mismatch Negativity and Precision in Auditory Memory

Musical training is associated with enhanced auditory perception and domain-general cognitive abilities. Research has demonstrated cognitive advantages from musical engagement, (e.g., inhibitory control) present throughout the lifespan, but whether this applies to perception in older age is unclear. We investigated if and how music training enhances precision in perception in 26 older amateur and professional musicians (62–85 years, 13 females) and 25 older non-musicians (61–82 years, 16 females). Participants were administered a novel paradigm of auditory mnemonic discrimination while electroencephalography was recorded. The mismatch negativity (MMN), an event-related potential of change detection, was measured using a passive auditory oddball paradigm with standard and deviant pure-tone sequences differing in pitch contour. After exposure, all participants completed an incidental memory test for targets amongst similar lure sequences (matched for frequency but differing in contour) and dissimilar foil sequences (differing in frequency and contour). Compared to non-musicians, musicians showed enhanced MMN amplitudes and better memory discriminability for targets compared to lures and foils. Findings suggest better precision in perception and auditory memory performance in older adult musicians as compared to non-musicians. Given age-related declines in both perception and memory, findings suggest contributions of musical engagement to cognitive reserve in support of healthy neurocognitive aging. Future research is necessary to examine the causal mechanisms of perceptual and cognitive benefits associated with music training.

Poster Session: 3

Poster Board: 28

Rivka van Klei

Pranavan Thirunavukkarasu, Steven Errington, Amirsaman Sajad, Jeff Schall

York University

Representation of Time in the Supplementary Eye Field of Macaques

Areas in the medial frontal cortex (MFC) play a crucial role in adjusting behaviour by monitoring the outcomes of past actions to achieve intended goals. The Supplementary Eye Field (SEF), a region within the MFC, exerts proactive, indirect control over gaze by anticipating and preventing interference before an event occurs (Stuphorn et al., 2010; Stuphorn & Schall, 2006). However, the precise neural mechanisms remain unclear. To address this, we recorded neural data from the SEF in four monkeys. Here, we describe the neural spiking patterns of neurons in the SEF in a stop-signal task that are related to the passage of time and the probability that an event will occur. Monkeys gained reward for generating a saccade to a target and inhibiting it when a stop-signal appeared. The onset of a fixation point indicated the start of a trial, whereafter a variable delay the target would appear. This design enabled the identification of signals related to the passage of time and the probability that an event will occur. ~35% of SEF neurons show a ramping increase or decrease in their activity before the onset of the next event. These ramping signals vary based on the length of the passed time, suggesting representation of time in the SEF. These findings offer insight into how SEF contributes to proactive control, and, ultimately, help to understand the cortical circuitry responsible for response inhibition and cognitive control, which is essential for improved diagnoses and development of targeted therapies with fewer side-effects.

Poster Session: 4

Poster Board: 1

Riya Shanbhag

Georg S. O. Zoidl, Fatema Nakhuda, Heike Naumann, Christiane Zoidl, Armin Bahl, Georg R. Zoidl

York University

The Role of Pannexin-2 in Vision and Adaptive Behavior: Insights from a Zebrafish Model

Pannexin-2 (Panx2) is a unique ion channel localized to ER-mitochondria contact sites. These specialized intracellular domains are abundant in neurons and glia and essential for calcium homeostasis, inflammation, and apoptosis. How intracellular contacts contribute to neuronal function remains unclear. To investigate Panx2's role in neuronal communication, we generated a Panx2 knockout zebrafish model (Panx2Δ11) using TALEN technology. HCR-FISH demonstrated panx2 mRNA expression in visual centers, like the optic tectum and thalamus. Panx2 protein expression was observed in the retina and optic tract arborization fields, in 6 days post-fertilization TL larvae (Panx2+/+). RNA-seq profiling of Panx2Δ11 larvae revealed downregulation of genes involved in visual and sensory perception and lens development. Consistent with these molecular findings, behavioral assays demonstrated that Panx2 loss impairs visual information processing. Panx2 mRNA is also expressed in other brain regions, including the ventral and dorsal habenula. The adaptive behaviour of Panx2Δ11 larvae, assessed by visual habituation, a form of non-associative learning, demonstrated a decreased response 24 hours post-training. This result suggests a role for Panx2 in memory consolidation and adaptive responses, potentially modulated by the habenula. Given Panx2's localization at ER-mitochondria junctions, organelles critical for neuronal bioenergetics, these findings suggest a potential novel link between Panx2, cellular metabolism, and memory consolidation processes.

Poster Session: 4

Poster Board: 2

Romesa Khan

Hongsheng Zhong, Shuvam Das, Jack Cai, Matthias Niemeier

University of Toronto

Predictive Coding Explains Asymmetric Connectivity in the Brain: A Neural Network Study

Seminal frameworks of predictive coding (PC) propose a hierarchy of generative modules, each attempting to infer the neural representation of the module one level below; the predictions are carried by top-down feedback projections, while the predictive error is propagated by reciprocal forward pathways. Such symmetric feedback connections support visual processing of noisy stimuli in computational models. However, studies have yielded evidence of asymmetric cortical feedback connections. Long-range descending pathways have been shown to cascade over multiple cortical areas, and an advantage of long-latency over short-latency visuomotor feedback has been observed. Furthermore, experiments studying visuospatial attention in primates indicate a potential benefit of medium-range predictive feedback, extending from area V4 to area V1in signal processing under noise. We investigated the contribution of neural feedback during sensorimotor function, in particular visual processing during grasp planning, by utilizing convolutional neural network models that had been augmented with predictive feedback and were trained to compute grasp positions for real-world objects. After establishing an ameliorative effect of symmetric feedback on grasp detection performance when evaluated on noisy stimuli, we characterized the performance effects of asymmetric feedback, similar to that observed in the cortex. Specifically, we tested model variants extended with short (S)-, medium (M)- and long (L)-range feedback connections (i) originating at the same source layer or (ii) terminating at the same target layer. We found that the performance-enhancing effect of PC under adverse conditions was optimal for M asymmetric feedback. Moreover, this effect was most prominent when M feedback originated at a level of representational abstraction that was proximal to the input layer, in contrast to more distal layers. To conclude, our simulations show that introducing biologically realistic asymmetric predictive feedback improves model robustness to noisy visual stimuli in a neural network model optimized for grasp detection.

Poster Session: 3

Poster Board: 29

Royze Simon

Judith Bek, Katayoun Ghanai, Karolina Bearss, Rebecca Barnstaple, Rachel Bar, Joseph DeSouza

York University

Neural Effects of Multisensory Dance Training in Parkinson's Disease: Evidence from a Longitudinal Neuroimaging Single Case Study

Dance is associated with beneficial outcomes in motor and non-motor domains in Parkinson's disease (PD) and regular participation may help delay symptom progression in mild PD. However, little is known about the neurobiological mechanisms of dance interventions for PD. The present case study explored potential neuroplastic changes in a 69-year-old male with mild PD participating in regular dance classes over 29 weeks. Functional MRI was performed at four timepoints (pre-training, 11 weeks, 18 weeks, 29 weeks), where the individual imagined a dance choreography while listening to the corresponding music. Neural activity was compared between dance-imagery and fixation blocks at each timepoint. Analysis of functionally defined regions revealed significant blood-oxygen-level-dependent (BOLD) signal activation in the supplementary motor area, right and left superior temporal gyri and left and right insula, with modulation of these regions observed over the training period except for the left insula. The results suggest the potential for dance to induce neuroplastic changes in people with PD in regions associated with motor planning and learning, auditory processing, rhythm, emotion, and multisensory integration. The findings are consistent with dance being a multimodal therapeutic activity that could provide long-term benefits for people with PD.

Poster Session: 3

Poster Board: 29

Ryley P Nathaniel

Yiping Zhang, Liya Ma

York University

Medial Frontal Neuronal Activities During Repeated Rule Switches in Rats

To study the neural mechanisms underlying cognitive flexibility, we developed a novel rule-switching task, in which rats learned to switch between blocks of trials under either Stay or Shift rules. Under the Stay rule, the correct side—left or right, remained the same for every trial in the block. Under the Shift rule, rats must alternate their choices from trial to trial to win a reward. In each trial, prior to the response period, rats nose-fixated in the central port for a 1-second delay period. Rats learned the Shift rule within three (3) days. We then conduct single-unit recordings from the medial frontal cortex (MFC) while they learned to switch from the Shift to the Stay rule, which they learned on the first or second day of training. Over 16 days, they progressed through Training Stages from Beginner to Expert on rule switching. To identify the factors that contributed to performance, we evaluated a total of 16 multilinear regression (MLR) models using Akaike Information Criterion. Response accuracy was best predicted by the model with Training Stage, Rule, Trial Position after a switch, and Rule-Side interaction as factors. Reaction time was best predicted by the model with Training Stage as the sole factor. Expert animals committed much less perseverative errors and relatively more regressive errors. We then applied linear regression models to the activities of MFC neurons. The most influential factor was Side of choice, best explaining the activities of 35% of neurons. The second-biggest factor was Rule, which optimally explained the activity of 29% of neurons. Additionally, neuronal activity during the delay period can be used to predict whether the animal was about to make an error. Our novel task is well suited for the analysis of the single-neuron, population and network-level mechanisms that support this training-related improvement in cognitive flexibility.

Poster Session: 4

Poster Board: 3

Sabine Muzellec

Kohitij Kar

Brown University and University of Toulouse

Beyond One-Way Mapping: Linking Model-Brain Asymmetry to Behavioral Predictions in Visual Object Recognition

Advancements in artificial neural networks (ANNs) have yielded object recognition models that closely mimic the primate ventral visual pathway. Traditional evaluation metrics focus mainly on how well ANN units predict neural activity, often overlooking the bidirectional nature of this relationship. In this study, we investigate the symmetry of predictive relationships between ANN components and inferior temporal (IT) neurons and explore its implications for aligning computational models with primate behavior. We conducted large-scale neural recordings from 288 sites across the IT cortex in two macaques engaged in 45 binary object discrimination tasks using 1,320 naturalistic images. Human behavioral data were collected from 80 participants, achieving an image-level reliability of 0.89. Our analysis revealed significant asymmetries in the bidirectional predictive relationships between ANN units and neural responses. By employing linear regression and centered kernel alignment (CKA), we tagged two classes of ANN units: “best” units (top 10th percentile explained variance, EV) demonstrated significantly higher CKA values compared to all units ($p<0.0001$) while “worst” units (bottom 10th percentile EV) showed significantly lower CKA values. This asymmetry was consistent across multiple architectures, including Vision Transformer (ViT), ResNet50v2, Inception-v3, and AlexNet. Crucially, we found that the “best” ANN units more accurately predicted both human and macaque object discrimination performance compared to the “worst” units ($p<0.05$, permutation test). This relationship also remained consistent across different object categories. Interestingly, monkey IT neurons identified as “best” units as predicted by other monkey ITs also demonstrated a similar enhanced prediction of human behavior, suggesting potential shared neural mechanisms across species. Taken together, our findings underscore that developing human-like object recognition in ANNs requires optimizing neural prediction accuracy and jointly ensuring representational symmetry with biological systems.

Poster Session: 4

Poster Board: 4

Sarvenaz Heirani Moghaddam

Erin Cressman & Gerome Manson

University of Ottawa

Assessing Explicit Processes in a Small Mirror Reversal Compared to a Small Visuomotor Rotation

We have shown that implicit processes do not contribute to learning a small (20°) mirror reversal distortion. However, it remains unclear whether explicit processes, such as awareness of changes in one's reaching movements and pre-planned aiming strategies, contribute to learning this distortion. This experiment identified the explicit processes involved in learning a small mirror reversal and compared these to the processes engaged when adapting reaches to a small visuomotor cursor rotation of 20°. Participants in the MR group (N=19) reached for left and right targets positioned 10° to the left and right of the body midline while receiving mirror reversed cursor feedback. Reaching toward the left target caused the visual cursor to shift 10° to the right of the body midline, creating a 20° MR. Additional groups of participants reached with cursor feedback that was rotated either 20° clockwise (VR CW group, N=10) or counterclockwise (VR CCW group, N=10) relative to their hand movements. Participants then reached with no-cursor feedback to establish awareness of changes in reaches. To assess pre-planned aiming strategies, participants were asked to position a line indicating where their hand needed to go to direct the cursor to the target. Analysis of angular errors at peak velocity during the late MR trials revealed that 13 out of 19 participants in the MR group learned to reach accurately by aiming toward the right side of the midline when the left target was displayed. All participants in the VR CW and VR CCW groups adapted their reaches to the rotated cursor feedback. Participants in the MR group further demonstrated awareness of changes in their reaches and the use of pre-planned aiming strategies, whereas the VR groups did not. Findings suggest that explicit processes contribute to learning a small MR, highlighting fundamental differences between MR and VR distortions.

Poster Session: 4

Poster Board: 5

Seyed M. Hosseini

James Elder

York University

Explainable Monocular Metric Depth Estimation

Monocular depth estimation (MDE) faces challenges in maintaining metric accuracy in zero-shot scenarios. Drawing from Gibson's Ground Theory, we propose a novel method that uses the ground plane as a fundamental reference frame for depth estimation. Our approach simplifies MDE by integrating semantic segmentation with ground plane modeling and geometric principles.

We first identify ground regions using semantic segmentation. We then estimate the ground plane geometry by determining camera orientation relative to the ground and applying projective geometry to calculate accurate ground depths. This ground depth information is systematically propagated throughout the scene using two key strategies: (1) direct depth assignment for objects adjacent to the ground and (2) depth propagation along 3D Manhattan line segments. Finally, we apply Laplacian depth completion to generate a dense, metric depth map.

Our contributions include: ground plane modeling that reduces scale ambiguity, innovative depth propagation strategies that maintain metric accuracy across the entire scene, and semantic integration that enhances interpretability and generalization. Our method demonstrates capabilities in zero-shot scenarios, offering a more explainable and robust solution for monocular depth estimation that aligns with human perceptual strategies.

Poster Session: 4

Poster Board: 6

Shao-Yang Tsai

Shao-Yang Tsai, Nicole D. Anderson, Andrew Frank, Jocelyn Keillor, Andrew Law, Jed Meltzer, Allison B. Sekuler, Eugenie Roudaia

Baycrest

Task-Dependent Modulation of Spontaneous Blinking in Older Adults with Normal Cognition and Mild Cognitive Impairment

Spontaneous eye blink rate (EBR) is influenced by scene context and task demands and is considered an index of dopamine function. Growing evidence links EBR to cognitive abilities in older adults, with potential alterations in mild cognitive impairment (MCI). In this study, we examine blink behavior in older adults (60–85 years) with normal cognition and MCI during active and passive visual tasks.

Participants completed a neuropsychological test battery followed by two electroencephalography (EEG) sessions within two weeks. Electrooculography (EOG) signals were used to record eye blinks across four conditions: (1) a contour integration task (CIT), where participants report the global orientation of a contour embedded in clutter; (2) a simple reaction time task (SRT); (3) passive viewing of radial dot motion (DOT); and (4) fixation on a blank screen (REST), which was interleaved between the other tasks. Blink rate and inter-blink-interval distributions were extracted to assess task effects, group differences, and test-retest reliability.

Preliminary data from 15 MCI and 37 control participants indicate that blink behavior is affected by task conditions and shows high individual variability. Blink rate was generally lower in DOT compared to other conditions. Tasks requiring button presses (CIT, SRT) showed a greater proportion of long-interval blinks (3–6 s) compared to other tasks, while short-interval blinks (<1.5 s) were more frequent in the REST condition. These results suggest that inter-blink intervals reflect task engagement.

EBR indices will be examined in relation to task performance and cognitive function, with test-retest reliability reported. Longitudinal follow-ups at six and eighteen months will assess whether blink behavior can help predict cognitive decline or progression from MCI to dementia.

Poster Session: 4

Poster Board: 7

Shaya Samet

Jasman Kahlon, James H Elder, Nick Baker, Erez Freud & Peter J Kohler

York University

The Contribution of Configural Shape to Object Recognition is Processed by a Late-Onset Mechanism Likely Localized in Right Temporal Cortex

Object shape perception, an essential aspect of visual processing, depends on both local shape features, such as line curvature and edge angles, and configural shape information, which arises from the spatial relationships of these features. Recent work has dissociated these contributions using specialized stimuli and behavioral methods. We used high-density EEG to investigate cortical mechanisms of local and configural shape perception. Object silhouettes were presented during passive viewing in an SSVEP paradigm, isolating differential brain responses between conditions. Stimuli included natural animal silhouettes (upright or inverted), synthetic curvature-matched controls, named CMC (Elder et al., 2018), and stimuli with disrupted configural shape, named Frankensteins (Baker & Elder, 2022). In Study 1 (n = 32), we compared pairs of CMC classes and upright/inverted animals to assess effects of local curvature and global configural constraints. Results revealed occipital and temporal cortical activity emerging 170–280 ms post-stimulus, influenced by both curvature and configural shape. Matching local curvature statistics affected brain processing, but responses to natural shapes remained distinct from CMCs. Differential responses to natural shapes versus CMCs were subject to an inversion effect, reflecting semantic and holistic processing. Inverted animals, however, retained measurable differences from CMCs, suggesting residual configural properties. In Study 2 (n = 30), we employed Frankenstein and intact stimuli, pairing Frankenstein and intact shapes for shapes where Frankensteining had strong or weak behavioral effects in a categorization task. Responses to Frankenstein stimuli were smaller overall, peaking later (~350 ms) in the right temporal cortex. Right-lateralized activity differentiated intact shapes from Frankensteins, with inversion removing these effects. These neural responses were only found for stimulus sets that produced behavioral effects on object recognition, underscoring their role in configural shape processing.

Poster Session: 4

Poster Board: 8

Simar Moussaoui

Adam Frost; Matthias Niemeier

University of Toronto Scarborough

Working Memory in Action: Investigating Challenges of Transsaccadic Memory in ADHD

Every waking second, we make three saccadic eye movements to move our retinal images. Thus, to attain a coherent image of the world we need to remember visuo-spatial information across saccades using transsaccadic working memory (tWM). tWM needs to rely on intact oculomotor and memory functions that are known to be affected in ADHD, presumably contributing to cognitive challenges (e.g., capacity dependent cognitive challenges in reading comprehension in ADHD that are alleviated when reading requires no saccades). However, there is no systematic research on tWM in ADHD. Thus, we explored tWM in neurotypical and ADHD individuals using a behavioural paradigm to investigate spatial differences in tWM. Participants completed a fixational working memory task and a tWM task using left and rightward saccades, and low and high memory loads. We captured measures of precision and accuracy of performance that, when submitted to a principal component analysis, produced two components. One component captured systematic error and the other unsystematic error. An inter-hemispheric remapping deficit was significantly apparent for the component that reflected systematic error, particularly through measures of centripetal bias (responses closer to the central fixation point) and horizontal compression (responses more compressed relative to actual target location). Both components demonstrated poorer performance after making saccades relative to no saccades and after high relative to low memory loads. However, controls demonstrated an amplified load effect for the saccade conditions relative to the fixation condition requiring no eye movements. Crucially, performance in ADHD was worse after right- than leftward saccades. Future work will investigate the relationship between tWM deficits in ADHD after rightward saccades and difficulties with reading where rightward saccades are more common. Our results highlight the dynamic nature of transsaccadic working memory.

Poster Session: 4

Poster Board: 10

Siyavash Izadi Sokhtabandani

Alyssa Lynn

University of Waterloo

Using Noisy Electrical Vestibular Stimulation to Assess Sensory Reweighting in Virtual Reality

Cybersickness remains a prevalent issue for virtual reality (VR) applications, largely stemming from mismatched sensory cues in the visual and vestibular systems. Individual susceptibility varies, highlighting the need to understand how short-term neural plasticity underpins multisensory reweighting during VR exposure. Building on earlier findings that high-intensity VR can downweight visual cues, this study explores the sensory reweighting of bodily, gravitational, and visual information after a noisy Electrical Vestibular Stimulation (EVS), which may mask vestibular inputs. Participants complete the Oriented CHAracter Recognition Task (OCHART), which measures the perceptual upright (PU), before and after VR sessions with and without EVS. We hypothesize that EVS-induced masking of vestibular signals will further reduce reliance on vestibular information, thereby diminishing cybersickness. Preliminary results (n=14) reveal that PU is affected by bodily, gravitational, and visual orientation information, consistent with prior literature. Additionally, our preliminary non-EVS data, which showed less visual and bodily influence following high-intensity VR, suggest that EVS may enhance these adaptive shifts in cue weighting. Ongoing work employs a vector sum model to quantify the contributions of each cue to orientation perception. Identifying individual differences in sensory reweighting will inform personalized strategies to alleviate cybersickness and improve user comfort. These findings also hold relevance for designing more immersive and accessible VR systems, ultimately enhancing the overall user experience.

Poster Session: 3

Poster Board: 31

Sofia Varon

Carol Coricelli, Eva Deligiannis, Karsten Babin, Kevin Stubbs, Laurie M. Wilcox, Jody C. Culham

University of Western Ontario

The Addition of Stereopsis to Natural Scenes Enhances Human Brain Activation in Scene-selective Regions

Information about 3D layout is crucial for many tasks in real-world scenes, including reachable spaces, where binocular disparity may be particularly effective for estimating the distances of objects to guide adept reaching and grasping actions. While extensive neuroimaging research has investigated 3D vision using simple stimuli (e.g., stereograms) and scene processing using static 2D photographs, little is known about how neural scene processing utilizes realistic 3D information. We used 3-Tesla functional magnetic resonance imaging to investigate how scene processing is affected by the addition of binocular disparity and motion parallax in 24 participants with normal binocular vision. We rendered five virtual scenes of reachable spaces (e.g., desk, kitchen table) such that retinal size, simulated distance, physical size, and binocular disparities were all consistent with real-world geometry. These scenes were presented under five viewing conditions: 2D Static (same static image presented to each eye); 3D Static (binocularly disparate images presented to each eye); 2D Translation (video of the scene shifting without relative movement between objects); 2D Parallax (video of the scene with relative movement between objects consistent with motion parallax); 3D Parallax (video of the scene with both parallax and binocular disparity). As expected, we found differences between 3D and 2D stimuli in known disparity-selective visual regions (including V3A, V3B, IPS0, V6). More interestingly, compared to 2D images, 3D images showed enhanced activation in the right parahippocampal place area (for static images) and the left occipital place area (for both static and parallax stimuli). Compared to 2D Translation, 2D Parallax led only to a modest increase in activation in MT+. Taken together, results suggest that information provided by binocular vision about the distances of objects from oneself and each other may play a more important role in scene processing than previously appreciated.

Poster Session: 4

Poster Board: 11

Soroush Ziaee

Kohitij Kar

York University

Linking Inferior Temporal Cortex Activity to Object Recognition Behavior Under Variable Task Demands

The inferior temporal (IT) cortex is a critical brain area that supports object recognition, with prior studies linking IT responses (70–170 ms post-stimulus) to behavior. However, it remains unclear whether the exact linkage between IT and behavior can explain object recognition performances in primates when the delay between stimulus presentation and the decision-making is increased. To investigate this, we designed a delayed match-to-sample task presenting Test images to macaques for 100 ms, followed by a delay of 100, 400, 800, or 1200 ms. After the delay, the animals had to choose between a target and distractor object, indicating the object they had seen. We also simultaneously recorded large-scale IT activity to probe the underlying neural mechanisms. First, we observed that as the delay increased, recognition accuracy declined. Interestingly, the image-level accuracy patterns changed significantly (as measured by correlation across delays). Are these shifts in behavior driven by changes in the IT responses? To address that, we generated the standard IT population activity-based linear decoders integrating responses from 70-170 ms post-image onset (similar to Majaj et al. 2015). Surprisingly, IT-based decodes remained stable across all delay conditions, suggesting that object representations in IT during the image presentation do not change across delays. Therefore, additional neural mechanisms in the IT cortex during the delay period or other brain areas (e.g., ventrolateral prefrontal cortices) must be needed to account for the observed behavioral differences. We modeled the task using a ResNet-50 architecture followed by a recurrent neural network, which successfully reproduced the observed behavioral decline, indicating the need for recurrent processing beyond IT. Ongoing work will use these model-based predictions to test the delay activity at IT and vlPFC. These findings refine our understanding of how the ventral stream and associated brain areas support object recognition across different behavioral demands.

Poster Session: 4

Poster Board: 12

Sydney Doré

Jenna Black, Aarlenne Z Khan, Gunnar Blohm

Queen's University

Saccade-Pursuit Coordination With Simulated Central Vision Loss

In fully-sighted individuals, pursuit and saccadic eye movements work together to foveate moving objects, with pursuit maintaining target fixation and catch-up saccades occurring when targets move off the fovea during pursuit. While mechanisms of saccade-pursuit interactions are well understood in healthy individuals, less is understood in cases of central vision loss, such as with age-related macular degeneration (AMD). Some AMD patients develop preferred retinal loci (PRL), replacing the fovea as the oculomotor reference during fixation. To examine plasticity in saccade-pursuit mechanisms and rehabilitation feasibility, we simulated central vision loss in healthy young adults and investigated whether and how participants adapted to using a PRL as their new oculomotor reference over 5 days of visual tracking tasks.

20 fully-sighted participants performed a pursuit task, involving a moving target that jumped randomly (designed to evoke catch-up saccades) while viewing with a gaze contingent artificial central scotoma. The scotoma, shaped like a bitten cookie, was designed to encourage participants to use a specific PRL (highest acuity peripheral location). They also completed a saccade task to examine the development of the PRL as an oculomotor reference. For both tasks, most participants displayed saccade endpoint shifts towards the PRL location. On average, there was a 0.5° endpoint shift towards the PRL (Range=-0.3°-1.5°) between day 1-5 for the pursuit task, and 1° shift for the saccade task (Range=-0.5°-2.2°). Paired t-tests show significant endpoint shifts from day 1-5 in 11/20 participants for the pursuit task and 17/20 for the saccade task.

Overall, we found some level adaptation of saccade-pursuit interactive mechanisms and shifts in the oculomotor reference for most participants. These results provide a promising route for central vision loss rehabilitation, aimed at improving eye movements and encouraging PRL use, that could improve residual visual function and quality of life.

Poster Session: 4

Poster Board: 13

Tahsin Reza

Ewan Jordan, Kirtan Patel, Jessica Tang, Matthias Niemeier

University of Toronto

Spontaneous Emergence of Dorsal and Ventral Stream Properties Through Optimization in Neural Networks: Correlating With Human EEG Response

Visual information is processed in the brain through two distinct neural pathways: the dorsal stream, which governs visually guided actions such as grasping, and the ventral stream, which is responsible for recognition such as object classification. A prevailing hypothesis suggests that the differences between these two streams emerge from distinct optimization strategies. Supporting this, artificial neural networks (ANNs) trained for object classification exhibit different response patterns compared to ANNs optimized for grasp detection. However, direct comparison of these systems is complicated by variations in network architecture and training methodologies. To explore the influence of task-specific training, we designed a novel map-based ANN that integrates a task-agnostic double-log loss function, enabling the simultaneous execution of both object-recognition and grasp planning. Feature importance was assessed across convolutional layers using Neuron Shapley scores. Our results revealed that the first five layers exhibited task-dependent distributions of Shapley scores, with early layers showing strong correlations across tasks. However, deeper layers demonstrated a decline in correlation, highlighting the distinct representational needs of each task. Representational similarity analysis (RSA) was applied to compare ANN representations with EEG data from participants engaged in grasping and object recognition tasks. Statistically significant correlations were observed between EEG activity and the activations of the same neural network, which was branched into two outputs - one for object recognition and the other for grasp planning - with the EEG data for object recognition aligning closely with the classification output and grasping showing high similarity to the grasp planning output. These results suggest similar representational structures between biological and artificial neural systems. Our findings are the first to demonstrate that task-specific optimization in ANNs can lead to the emergence of properties analogous to the dorsal and ventral streams in humans, enriching our understanding into the computational mechanisms of the human visual cortex.

Poster Session: 4

Poster Board: 14

Tara Nichols

Fermin Retnavarathan, Lynn Turkstra, Riley Morgan, Dasnoor Saini, Andrew Silva, Xiaoxin Chen, Ben Thompson, Xiaoqing Gao, Haotian Lin, Agnes Wong, Daphne Maurer, Ewa Niechwiej-Szwedo, David Shore

McMaster University

Revealing Hidden Binocularity: A Case Study of Amblyopia

Amblyopia is characterized by abnormal binocular fusion, often resulting in lifelong absence of true depth perception. Individuals typically fail all standard clinical tests of binocular vision. Despite failing standard clinical binocularity tests, a subset of individuals with amblyopia demonstrated the Pulfrich effect, indicating "hidden binocularity" (Maehara et al., 2019). To elicit this illusion, a neutral density filter covers one eye while stimuli are moved across a display. To explore this further, we administered a novel battery of binocular vision tests—designed to be more precise measures of binocularity—to one individual with amblyopia and three controls. The individual with amblyopia initially demonstrated no binocularity on standard clinical tests. Despite this, the individual with amblyopia performed similarly to controls on the battery of developed binocular vision tests, demonstrating hidden binocularity. Remarkably, on day 11 of testing, the individual with amblyopia demonstrated normal performance on a standard clinical test by seeing 4 dots on the Worth 4 Dot test of stereoacuity. This result suggests that the newly developed binocular battery may have rehabilitative effects.

Poster Session: 4

Poster Board: 15

Taylor MacNicholas

York University

Is Causal Perception Iconic?

Iconicity is often taken to mark the border between perception and cognition, with perception being constitutively iconic and cognition non-iconic (Block 2023). But what counts as an icon? The two leading accounts—the parts principle and analog mirroring—both struggle to accommodate causal representations. According to the parts principle, a representation is iconic if parts of the vehicle represent parts of the content. Analog mirroring holds that a representation is iconic if degrees of change in the vehicle correspond functionally to degrees of change in the content (Block 2023). However, neither framework straightforwardly accounts for causation. Analog mirroring struggles to explain how causation might come in degrees (Beck 2023; Gross 2025), and the parts principle, in focusing on part-whole structure, risks excluding causation entirely.

This is a problem because empirical evidence suggests that perception represents causation. Adaptation effects—a marker of perceptual representation (Block 2023)—have been demonstrated for causal events (Rolfs et al. 2013; Kominsky & Scholl 2020). If perception is constitutively iconic, then any account of iconicity must explain how causation is iconically represented. The parts principle, in its standard form, relies on spatial parts, which fails to accommodate causal representations. A revised version, appealing to extensive magnitudes (Maley 2023), allows for spatial and temporal parts but does not clarify how causation might be included. Kulvicki's (2014, 2015, 2020) abstraction-based account can accommodate causal parts but requires that icons have only integral, non-separable features—contradicting evidence that perceptual representations include separable features (Cant et al. 2008; Fougnie & Alvarez 2011).

Thus, none of the three dominant versions of the parts principle satisfactorily accounts for causal representations in perception. While an alternative account may yet be found, the burden is on proponents of the parts principle to explain how causation can be iconically represented.

Poster Session: 4

Poster Board: 16

Umael Qudrat

Shirin Taghian Alamooti, Judith Fan, Kohitij Kar

York University

Probing the Neural Basis of Visual Abstraction: Macaques and ANN Models Achieve Similar Sketch Recognition Performance

Visual abstraction is the process of distilling complex visual scenes into their essential components. Such abstraction is exemplified by the production and recognition of sketches, which can be effective in conveying the content of a scene while omitting many details. To what degree does visual abstraction also manifest in non-human primates, and what neural computations are responsible? To answer this question, we measured how well macaque monkeys (N=2) could identify the visual concept conveyed in human-drawn sketches and evaluated how well their behavior and ventral stream neural responses could be predicted by an artificial neural network (i.e., AlexNet).

Both macaques performed a sketch-recognition task using stimuli (1000 images, 10 object categories) from the Google Quick Draw dataset. In each trial, we briefly presented (100 ms) a sketch, followed by a choice screen where monkeys selected which of two object images the sketch represented. Both monkeys achieved accuracies exceeding 70%, demonstrating that even simple sketches convey sufficient information for robust object identification by non-human primates. The monkeys' image-by-image recognition accuracies significantly correlated with those predicted by AlexNet ($R = 0.42$, $p<0.001$). This correlation matched the monkeys' noise ceiling (~0.4), indicating that AlexNet strongly approximates the abstraction strategies employed by the primate visual systems, given intrinsic variability in the current dataset. We also recorded population activity (384 sites) from inferior temporal (IT) cortex as monkeys viewed line drawings and sketches. Using linear classification on IT responses, we found that distributed neural activity patterns strongly predicted (accuracy~0.83, chance-level=0.5) object identity, providing evidence that IT cortex encodes the abstract visual features underlying sketch recognition.

These findings establish macaques as a powerful model for investigating the neural computations that support sketch recognition.

Poster Session: 4

Poster Board: 18

Viquar Unnisa Begum

Michael Perrier, Kylee Rene graham, Jessica Elaine Vander Vaart, Sean Meehan, Michael Barnett-Cowan

University of Waterloo

Age-Related Changes in Cortical Excitability and Audiovisual Integration: A TMS Study of Occipital and Motor Areas

Introduction:
This study investigates age-related differences in audiovisual (AV) integration, focusing on cortical excitatory and inhibitory mechanisms across young and older adults. Behavioral studies suggest a broader temporal binding window (TBW) in older adults, potentially linked to reduced GABAergic inhibition (Bedard & Barnett-Cowan, 2016; Setti et al., 2011; Basharat et al., 2018). We used transcranial magnetic stimulation (TMS) to explore this relationship, in the visual and motor cortices.

Methods:
Thirteen young adults (aged 18-60) completed simultaneity judgment (SJ) and temporal order judgment (TOJ) tasks to assess AV integration. Perception of phosphenes elicited by single and paired pulse TMS applied to the visual cortex to assess cortical excitability and different forms of GABA-mediated inhibition, indexed by short-interval intracortical inhibition (SICI) and long-interval intracortical inhibition (LICI).

Results:
Preliminary data in younger adults showed a significant negative correlation between LICI at 100ms and TBW in the SJ task ($n=9$, $r = -0.79$, $p = 0.05$). Although SICI at 2 and 3ms and LICI at 200ms also showed negative trends with SJ and TOJ tasks, these were not statistically significant. These results suggest that decreased cortical inhibition may be linked to a broadened TBW in AV integration. We hypothesize that older adults will exhibit similar, but more pronounced, negative trends, further supporting the role of GABAergic inhibition in auditory-visual (AV) perception.

Conclusion:
Initial findings support the hypothesis that GABAergic inhibition plays a key role in AV processing. Further data from both the visual and motor cortices are needed to better understand the mechanisms behind age-related declines in AV integration.

Poster Session: 4

Poster Board: 19

Wanyi Lyu

Jeffrey D. Schall

York University

Mapping Visual Search Errors to Covert Operations with Frontal Eye Field Neurophysiology and Double Factorial Design

Behavior is the outcome of covert perceptual, cognitive, and motor operations that can be described by mathematical models and are produced by brain circuitries. To resolve the processing stages underlying visual decision-making, we designed a task to independently modify two critical operations — target localization ("Where is the informative item?") and response selection ("What does that item instruct me to do?"). Two macaque monkeys were trained to search for a color singleton among distractors. Target localizability was manipulated by varying the similarity of singleton and distractor colors. Response selection was manipulated by varying the discriminability of search array shape, signaling GO/NOGO response. The organization and termination rule of the two operations were determined using System Factorial Technology (SFT). However, the logic of SFT is confounded by errors, so we describe the neural origin of errors with single-units in Frontal Eye Field (FEF). Monkeys made two common errors: failure to locate the target on GO trials and failure to inhibit the saccade on NOGO trials. Localization and response inhibition errors arise through distinct neural processes. This shows that visual attention and decision making are distinct, which challenges the canonical accumulator model of decision-making.

Poster Session: 4

Poster Board: 20

William Fisher

Andrée-Ann Cyr, Buddhika Bellana

York University

Scrambled Narratives and Changes in the Composition of Memories Over Time

An event memory typically reflects a combination of both episodic and schematic contributions (Renoult et al., 2019), but importantly, these types of contributions change in different ways over time. Episodic details tend to be more susceptible to rapid forgetting than schematic details (Sacripante et al., 2022), and changes in memory are often characterized as becoming less episodic and more schematic over time (Wiltgen & Silva, 2007). Importantly, schematic details are not only better preserved but may replace episodic details in recall when those episodic details are uncommon or forgotten (Bartlett, 1932; Schacter, 1999). We propose a new and efficient experimental paradigm to quantify changes in episodic and schematic contributions to recall over time. Participants read a short story with the order of events randomly scrambled. After a delay (five delay conditions), participants were asked to reorder brief descriptions of each story event from memory. If schematic details are increasingly relied upon over time, the remembered order of events should increasingly reflect prior knowledge of story structure, as opposed to detailed episodic memory, over time. We hypothesized that this shift towards prior knowledge could be quantified as the Spearman correlation between the order of participants' recalled events and the original order of events before scrambling (schematic signal). Higher correlations would indicate a greater reliance on the participants' understanding of how stories tend to unfold (i.e., schematic), rather than the order in which it was presented (i.e., episodic). Results revealed: (i) episodic contributions decrease over time and reflect the common Ebbinghaus curve, (ii) evidence of above-chance schematic signal in all conditions, (iii) schematic contributions significantly increase over time.

Poster Session: 4

Poster Board: 21

Xue Teng

Laurie M. Wilcox & Robert S. Allison

York University

Adaptation to Motion Gain in Virtual Reality

Virtual reality (VR) can immerse individuals into digitally-generated environments, providing effective, tailored, yet safe interactions that are ideal for training applications. However, mismatch between physical and virtual space and motion makes sensory conflict in VR very common. We speculate that adaptation to gain distortions in VR would increase the chance of motion sickness and impact postural stability. To test participant's stability, we created a virtual version of our lab space and immersed them in this environment while it oscillated sinusoidally (0.5 m peak, 0.2 Hz) either in the front-back or left-right directions. As a baseline, participants stood in quiet stance for 60 seconds and their postural sway was recorded. We repeated these tests after participants adapted to motion gains of 0.667, 1, and 2. Motion gains scaled the visual motion presented in VR relative to their physical motion. The adaptation blocks were presented in counterbalanced order and consisted of an initial 10-minute adaptation period , followed by four test segments interleaved with three 2-minute top-up adaptation periods. During adaptation participants continuously walked to grab objects and aligned them with corresponding markers at other locations. Upon finishing each adaptation condition, we asked the participant to rate their motion sickness on a scale of 0 to 20 (fast motion sickness scale, FMS). Results showed that neither the FMS nor the root mean square variability of postural sway increased after adaptation, while power analysis at 0.2 Hz suggested that visually-elicited synchronous front-back postural sway was larger after adapting to gain of 2. Combined with our previous experiments, these results suggest that increased gain leads to adaptation in visually-elicited postural responses without a corresponding increase in motion sickness ratings or perceived stability. This dissociation suggests that postural recalibration to gain adaptation operates independently of perceptual mechanisms.

Poster Session: 4

Poster Board: 22

Yara Iskander

Christopher Lee, Sebastian Bosse and Peter J. Kohler

York University

Spatial Tuning of Visual Responses to Symmetries in Textures

Symmetry is a biologically significant feature that relies on the visual grouping of spatially separate elements. It has been shown to play a role in numerous domains of visual perception in both humans and other animals. Neuroimaging studies have revealed that several regions in the visual cortex exhibit robust and precise responses to different types of symmetry. The current study explored spatial mechanisms that mediate symmetry perception by measuring Steady-State Visual Evoked Potentials using high-density EEG. Our stimuli were taken from a class of regular textures, known as wallpaper groups, which are a set of 17 unique combinations of symmetry types in 2D images. Specifically focusing on groups PMM and P4, we generated examples from each group based on random noise patches that varied in spatial frequency between 1 to 8 cycles per degree. All wallpaper groups contain translation symmetry, which is expressed as a lattice structure that is repeated to tile the plane. We assessed the influence of this repeating structure by varying the ratio of the lattice to the overall wallpaper area between 1/12 and 1/2. Consistent with previous findings, symmetry-specific responses were weaker overall for rotation compared to reflection. We also found a clear modulation of responses by spatial frequency and lattice ratio, such that responses were weaker with increasing spatial frequencies. Interestingly, the differential responses in both spatial frequency content and lattice scale could possibly suggest a distinct mechanism for each symmetry type, which we will probe further in future research.

Poster Session: 4

Poster Board: 18

Yong Zhong Liang

Tyler Roberts, Gerald C. Cupchik, Jonathan S. Cant, Adrian Nestor

University of Toronto Scarborough

Video Reconstruction of Dynamic Expressions From EEG Signals

Expression recognition relies on the ability to distinguish among subtle visual differences across a range of facial expressions. Our study examines the neural representation of dynamic expressions as reflected by electroencephalography (EEG) data in healthy adults. We find that a wide range of expressions (i.e., 14 emotional and 10 conversational expressions) can be decoded from neural signals, and that their representational structure evinces the classic dimensions of valence and arousal. Critically, we recover, through EEG-based video reconstruction, dynamic representations whose content succeeds in capturing even fine differences across related expressions (e.g., happy-satiated versus schadenfreude). Further, time-resolved decoding reveals anticipatory dynamics that maximize accuracy before the occurrence of an apex expression in the visual stimulus. These results are validated against behavioral data, which yield static reconstructions consistent with their neural counterparts. Thus, our results shed light on the representational basis of expression recognition and help to recover the dynamic content of visual experience.

Poster Session: 4

Poster Board: 23

Zacchary Nabaee-Tabriz

Parmin Rahimpoor-Marnani, Bernard Marius ’t Hart, Denise Y.P. Henriques

York University

Characterizing Early Implicit Visuomotor Adaptation

While implicit visuomotor adaptation has been widely studied, most research has focused on learning accumulated after hundreds of trials, leaving the earliest stages of adaptation—particularly the role of different error signals, error magnitude and their timing—poorly understood. To address this gap, we conducted a series of studies to quantify the initial implicit changes in classic, movement-contingent adaptation of a hand cursor, using a single-trial learning approach. We assess initial implicit changes across varying perturbation magnitudes, varying error signals as well as the timing of feedback to isolate the specific contributions of error processing to early visuomotor recalibration. We find that initial reach deviations ramp up for smaller rotations but are stable at ~6° for larger rotations (15–90°). This suggests that implicit adaptation isn’t attenuated for larger errors as expected by causal inference, but instead seems capped, like asymptotic levels of implicit adaptation. Removing task error by changing the target from a dot to a wide arc—which was never missed—still evoked significant reach aftereffects (~4°), showing that task error does play a role in initial implicit adaptation, along with sensory prediction error. Finally, changes made to error timing by only providing endpoint feedback reduced reach aftereffects to ~2°. Since this was not further reduced by delaying feedback by up to 1.6s, this suggests that delayed feedback does not affect initial implicit adaptation. Our results highlight that early implicit adaptation processes are so robust, they can be studied after a single trial of training, as well as the nuanced role of error type and timing in shaping initial visuomotor recalibration.

Poster Session: 4

Poster Board: 24

Zahra Wakif

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York University

The Moderating Role of Polygenic Risk Among Maternal Depression and Infant Neurodevelopment

Previous research has explored how early adversity such as poverty and caregiver depression can affect infant neurodevelopment, as seen through electroencephalography (EEG). However, very few studies have examined the role of polygenic risk (PRS). The current study looks at 116 samples of two-month-old infants from Boston Children's Hospital and Children's Hospital Los Angeles, testing whether environmental and genetic risk interact to predict neurodevelopment. Linear regression analyses will be conducted to test the associations between PRS, environmental variables (i.e. maternal depression and socioeconomic variables) and neurodevelopment, particularly frontal alpha asymmetry (FAA). A moderation analysis will be conducted to test whether PRS is a moderator between environmental risk and neurodevelopment. We hypothesize that environmental risk will predict increased levels of FAA as will PRS, and PRS will be a moderator among the association between environmental risk and FAA. By exploring the interaction between genetic and environmental risk, the current research bridges current gaps in the literature to help inform the role of both genetics and the environment for early development, with implications for early detection of who may be at higher risk for depression later in life.

Poster Session: 4

Poster Board: 25

Zainab Haseeb

Anna Kosovicheva

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Individual Differences in Visual Sensitivity and Distribution of Covert Attention around the Visual Field

Visual performance varies across the visual field and differs between individuals, potentially contributing to errors in everyday tasks. These variations may stem from anatomical factors, like photoreceptor density, as well as attentional factors, including the allocation of covert attention. This study investigated the relationship between individual differences in low-level spatial resolution and the distribution of covert attention across the visual field. In addition, we examined participants' awareness of these performance differences across the visual field. Participants performed two distinct tasks: a line bisection task to evaluate low-level spatial resolution, and a visual search task to examine how covert attention is distributed across the visual field. Stimuli were presented at 4º eccentricity across 4 vertical, horizontal, and 4 diagonal locations. The bisection task measured spatial resolution by having participants judge whether the stem of a T-shape was offset to the left or right across ten levels (-0.12-0.12 DVA). The second task assessed allocation of covert attention with a search task in which participants reported the location of a rotated T among Ls. All stimuli were presented at the same 4º eccentricity. To assess whether participants were aware of their performance differences around the visual field, participants provided confidence ratings for their responses in both tasks. Results revealed no significant relationship between spatial resolution in the T-bisection task and accuracy in the search task, suggesting these measures reflect distinct aspects of visual processing. This was further supported by confidence ratings, which tracked accuracy in the search task, but did not correlate with accuracy in the bisection task. Together, these findings point to distinct mechanisms underlying performance asymmetries around the visual field.

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