

**WHEN IT COMES TO UNRAVELLING
THE MYSTERIES OF THE HUMAN BRAIN,
WHERE DO WE START?**

**BY SEEING THE UNSEEN.
BY ASKING THE UNASKED.
BY DREAMING THE UNDREAMED.**

**MEET 28 UNCOMMON MINDS
REDEFINING THE FUTURE OF
BRAIN HEALTH.**

**THEY'RE NOT JUST RESEARCHERS.
THEY'RE DELVERS. DETECTIVES.
DARERS. PROBING DEEPER INSIDE
THE BRAIN BY THINKING FARTHER
OUTSIDE THE NORM.**

Canada's emerging brain researchers are beginning their careers just as technology is giving them the tools to explore the brain's vast complexity. Their bold work could unlock cures for anything from depression to Alzheimer's disease to brain injury, while revealing the hidden processes behind development, memory and learning.

That's why Brain Canada, with a generous anchor gift from the Azrieli Foundation, created the Future Leaders in Canadian Brain Research Program in support of the next generation of brilliant thinkers. Through the research we fund, the community we gather, and the programs we design, Brain Canada strives to elevate innovations that make visible the inner workings of the brain—that deeply complex universe governing our every thought and action.

**FUNDING TURNS THE POTENTIAL
INTO THE POSSIBLE.**

For this year's Future Leaders program, peer review was undertaken by two panels composed of neuroscientists with expertise in a range of research approaches and at different stages of their careers. Their selections will support trailblazing ideas that could answer unanswered questions about brain health, and launch tomorrow's breakthroughs.

Brain Canada's rigorous scientific review process gives donors and partners a trusted mechanism to ensure projects are chosen based on merit, innovation and potential for impact.

**THE SECRETS OF BRAIN HEALTH
SHOULDN'T STAY SECRET.**

There are more than 1,000 brain diseases and disorders: Parkinson's disease, epilepsy, stroke and brain cancer, to name a few. Together, they represent one of the most pressing health challenges in Canada and across the world. Supporting brain research plays a critical role in expanding our understanding of brain health conditions and opening new avenues of treatment.

DARE TO DISCOVER WITH US.

We live in a transformational time for brain health. Want to stay on top of advancements for diseases like Alzheimer's or MS, conditions like ADHD and depression, and incredible technology like AI? Learn more at braincanada.ca.



UNDERSTANDING HOW SEX DIFFERENCES PLAY ON OUR ANXIETIES.

The chances of women developing an anxiety disorder are twice as high as they are for men, yet only a minority of studies have focused on the sex-related differences. This research team recently identified a brain circuit that affects anxiety only in female mice. In this project, Amilhon will delve into this process and try to understand what the mechanism is for this sex-related difference. This research will clarify some of the sex-related differences in response to stress and open new avenues to treat anxiety disorders in men and women.

Dr. Bénédicte Amilhon
CHU Sainte-Justine Research Centre
Université de Montréal



UNLOCKING THE PAINFUL TRUTHS ABOUT PAIN.

Despite decades of research into the neuroscience of pain, our understanding of how pain is generated and modulated in the brain remains limited. Why do people feel pain differently, and why does it last longer for some even after healing? Coll is using brain imaging and mathematical modelling to explore the unique concept of how our expectations and knowledge can impact our experience of pain, and how our drive to achieve goals or learn new information can influence how we feel pain. The goal? To understand why pain persists in some individuals and identify treatment options for those suffering from chronic pain conditions.

Dr. Michel-Pierre Coll
Université Laval



DECIPHERING MS, DETECTING POTENTIAL RECOVERY.

Multiple sclerosis (MS) is a neurodegenerative disease affecting the brain and spinal cord which progressively worsens through life and diminishes quality of life. Canada has amongst the highest rate of MS in the world. Dong is studying the chronic tissue damage that is a feature of progressive MS to determine how the tissue becomes damaged over time, how immune cells in the brain and spinal cord contribute to the damage, and how recovery might be made possible.

Dr. Yifei Jeff Dong
University of Saskatchewan

MOVING FORWARD WITH PARALYSIS.

This project is investigating options for people with paralysis (such as following stroke) to be able to use brain-computer interfaces to regain control over their muscles and movement. Most of the currently available technology 'connects with' the region of the brain known as the motor cortex, reads what the brain is signalling the muscles to do, and makes the connection to the muscles for movement to occur. However, in cases where the motor cortex is damaged, this technology is unable to help and these individuals cannot use it. Bonizzato is looking at whether similar movement intention signals can be read by the machine from an alternate region of the brain (the midbrain) to allow for the signals to be translated to movement for these patients.

Dr. Marco Bonizzato
Polytechnique Montréal



USING AI TO RECOGNIZE CHANGES IN COGNITION.

Over 600,000 Canadians currently live with different types of dementia, and more than 76,000 new dementia cases are diagnosed each year. In over 75 per cent of the cases, there is evidence of damage to the blood vessels in the brain. In this project, Dadar is using artificial intelligence to combine data from brain imaging with analysis of post-mortem brain tissue samples to be able to study the brains of dementia patients, find out what causes these brain changes, and determine how different types of changes can affect a patient.

Dr. Mahsa Dadar
The Douglas Research Centre
McGill University



FOR AUTISM SPECTRUM DISORDER, 5,000 BRAIN SCANS COULD LEAD TO COUNTLESS BREAKTHROUGHS.

Dumas aims to understand the underlying biology of neurodevelopmental disorders by studying the brain scans (EEG) of 5,000 patients, looking for patterns as well as which regions of the brain are involved in brain activity changes. The study will also evaluate the genetics of patients with neurodevelopmental disorders to see what interplay might exist between patterns of brain activity and genetics.

Dr. Guillaume Dumas
CHU Sainte-Justine Research Centre
Université de Montréal



SERVING A NEW COURSE TO LIMIT SEIZURES.

Proper nutrition is essential for good health, including brain health. Recent scientific evidence has shown that specific dietary amino acids play an important role in the activity of pathways in cells that influence brain activity. The genes encoding one of these pathways are mutated in approximately 11 per cent of familial forms of epilepsy and autism spectrum disorders (ASD), as well as those lost to a condition known as 'sudden unexpected death in epilepsy'. In this project, Dutchak will investigate how nutrition and metabolism can affect this pathway, with the aim of helping to guide nutritional strategies as therapy to limit seizures in patients with epilepsy and ASD.

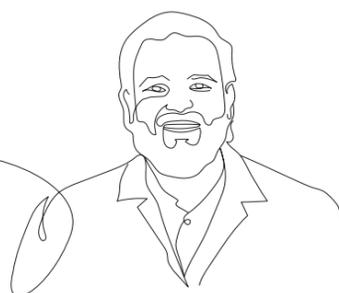
Dr. Paul A. Dutchak
Université Laval



GETTING ESTRANGED NEURONS TALKING TO EACH OTHER.

Some neurodevelopmental and neuropsychiatric conditions share similar challenges in the way neurons communicate with each other. Typically, neurons communicate through a physical junction called a synapse. In this project, Dunn is investigating a gene that is mutated in some patients with neurodevelopmental disease causing a defect at the synapse, in order to understand whether this can reveal new options for therapies.

Dr. Henry A. Dunn
The University of Manitoba



TO COMBAT MS, A DEEPER DIVE INTO THE BRAIN'S SURFACE.

Most nerves in the brain are surrounded by myelin, an insulating cover that allows them to communicate efficiently. In patients with multiple sclerosis, immune cells errantly attack the myelin that protects these cells and the brain cells themselves are also gradually lost. These cause worsening physical and mental symptoms for patients. The pattern of damage tends to be worse at the surface of the brain, leading researchers to wonder whether potentially harmful factors may be entering from the fluid surrounding the brain. Fadda wants to discover what causes damage at the brain's surface, develop tools to predict the effect on patients' health, and inform the development of therapies to stop disease progression.

Dr. Giulia Fadda
The Ottawa Hospital Research Institute



HELPING PREVENT STROKES FROM STRIKING TWICE.

Ischemic stroke, caused by a blood clot in the brain, is a leading cause of death, disability, and dementia. One in four of these strokes happens in patients who already had a prior stroke or mini-stroke, but it is currently difficult for doctors to predict which patients will have another stroke. In this project, Ganesh will use brain imaging and clinical records for patients who have had a stroke together with computational tools to identify risk factors to predict who is likely to have a recurrent stroke and what effect specific treatments may have in modifying that risk to ultimately prevent stroke.

Dr. Aravind Ganesh
University of Calgary





FLIPPING THE SWITCH ON SPINAL INJURY RECOVERY.

Nerve cells connecting the brain with the rest of the body lose their capacity to regenerate as they mature during brain development in early life. Despite decades of progress, we don't know how the process of shutting off the ability to regenerate happens, and this has stalled the development of regenerative therapies for individuals living with spinal cord injuries – this is a major unmet need of the Canadian health care system. This study is investigating a molecular switch Hilton found to be vital for nerve cell regeneration but is turned off in mature nerve cells. The hope is to discover not only how the switch gets turned off, but how we can turn it back on to stimulate recovery.

Dr. Brett Hilton
The University of British Columbia

DECODING THE SECRET BEHIND THE GENES BEHIND THE CELLS BEHIND THE SYMPTOMS.

mTOR is an important gene pathway that regulates brain development and activity. When the pathway is dysregulated, it can affect many aspects of brain function. Huang is investigating genetic mutations that cause overactivity of the mTOR pathway in patients with tuberous sclerosis by looking at thousands of brain cells and how their function relates to their genetic makeup. By understanding how the genetics relate to changes in cognition and epilepsy, researchers can shed light on potential ways to alleviate symptoms and improve quality of life.

Dr. Wei-Hsiang Huang
Research Institute of the McGill University Health Centre



TAMING PARKINSON'S BY FINDING OUT WHY PROTEINS STRAY.

Parkinson's disease is a neurodegenerative movement disorder. Two of the main features of Parkinson's disease are the clumping of a protein called alpha-synuclein, and a defect in the regulation of lipids (fat-like molecules). Lipids form the outer layer of every cell in the body and when their regulation is defective, they can sometimes excessively pinch off in tiny bubbles. Here, Ioannou believes that the clumped alpha-synuclein proteins may be getting trapped in these lipid bubbles and spreading across cells in the brain; when the clumped proteins spread, the disease gets worse. In this project, researchers will test whether this is indeed how the clumped proteins spread and if so, how it can be prevented to limit the progression of Parkinson's disease.

Dr. Maria Ioannou
University of Alberta



AWAKENING THE BRAIN'S ABILITY TO REMEMBER DURING SLEEP.

During sleep, memories of our experiences get stored through a series of complex processes that require precise synchronization between brain regions to communicate effectively. Jackson is trying to unlock one piece of the memory storage puzzle by investigating a small brain region called the claustrum, and how it communicates with other brain regions to help store memories. Memory loss is associated with many neurodegenerative conditions, and by understanding how memories are stored and retrieved, we can work toward enhancing these processes and preventing loss.

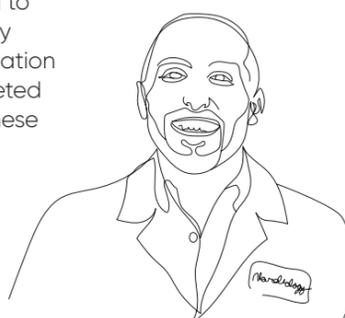
Dr. Jesse Jackson
University of Alberta



A NEW UNDERSTANDING OF PREMATURE INFANT BRAIN INJURY IS BORN.

Infants born prematurely are at risk for brain injury and long-term brain development challenges, including delays in walking, language development and school-aged cognitive performance. Pre-term brain injury is complex, but a major contributor to abnormal brain development is low oxygen intake due to under-developed lungs. Kalish is working to understand the developmental trajectory of brain injury and recovery in premature babies and how communication between brain cells is affected, and test whether targeted therapy can improve outcomes to better the lives of these newborns.

Dr. Brian Kalish
The Hospital for Sick Children
University of Toronto





AUTISM SPECTRUM DISORDER RESEARCH THAT'S OPENING EYES TO FACIAL RECOGNITION.

Recognizing emotions and intentions from facial expressions is crucial for human communication and social interaction. Individuals with ASD often face challenges in this area, likely due to differences in how the brain processes sensory information. In this project, researchers will study the recognition of facial expressions, and use computational modelling to gain a deeper understanding of how the process differs in neurotypical and neurodivergent individuals. Researchers hope to uncover new insights that could improve the lives of those living with ASD.

Dr. Kohitij Kar
York University



SOLVING AGELESS QUESTIONS ABOUT THE AGING BRAIN.

Even in healthy brains, aging is commonly associated with cognitive decline. However, different individuals can vary greatly in the amount of cognitive decline they experience with age, and these differences are still poorly understood. In this project, Lavoie-Cardinal explores how changes in the way brain cells connect to and communicate with each other throughout the aging process affect cognitive decline, and which prevention approaches could be developed.

Dr. Flavie Lavoie-Cardinal
Université Laval

TAKING DEEP-BRAIN RESEARCH BEYOND THE DEPTHS OF KNOWLEDGE.

This project is investigating the effect of deep-brain stimulation – which is a technique used to reduce symptoms of Parkinson's disease – on how the brain processes information. Although the technique is quite successful at reducing symptoms, here the goal is to understand how it changes neural activity in different regions of the brain. Lankarany's research will help shed light on how this therapy affects different aspects of patients' lives beyond what is specifically being treated.

Dr. Milad Lankarany
University Health Network
University of Toronto



IDENTIFYING THE EARLY WARNINGS IN EARLY-BORNS.

Babies born prematurely between 32-36 weeks are called moderate-late preterm (MLPT) babies and are more likely to have problems with development and behaviour than term-born babies. However, MLPT babies are mostly seen as healthy babies and are not screened for problems in development or behaviour when they grow up. As a result, their problems are often identified at an age when therapies become less effective, and MLPT children and families may need to deal with developmental challenges for the rest of their lives. Leijser's challenge is to identify MLPT babies at high risk for later problems early in life, and guide improvements in care that will lead to healthier brains and better lifelong outcomes.

Dr. Lara Leijser
University of Calgary



SEX IN THE CIRCUITRY: HIS AND HER BRAINS.

There are many neurological and neuropsychiatric diseases that affect men and women differently, but we don't have a clear picture of why. One factor that may be important is the influence of hormones during puberty, which can change the way in which genes are used by brain cells, affecting their function. In this project, Nagy will use a rodent model to investigate how sex chromosomes and hormones interact in different combinations and look at the sex-specific effects on the brain. The overall goal is to understand the complex interactions between genetics, hormones, and brain development that contribute to sex differences in the prevalence of neurological and neuropsychiatric diseases and to develop approaches to care that take into account sex-specific differences.

Dr. Corina Nagy
The Douglas Research Centre
McGill University



GETTING THE BIG PICTURE ON A COMMON DEPRESSION THERAPY.

Repetitive transcranial magnetic stimulation (rTMS) is used for patients that do not respond to conventional antidepressants. It is effective in about two-thirds of patients. Nestor uses various brain imaging techniques to specifically evaluate the synapses in patients' brains before and after rTMS to see whether there is a pattern that can predict who will benefit from rTMS and also whether these synapses change after therapy.

Dr. Sean Nestor
Sunnybrook Research Institute
University of Toronto



DIVERGENT BRAINS, EMERGENT RESEARCH: ANIMAL MEETS AI.

During development, brains create highly specialized features that generate cognition and behaviour. Many of these features are remarkably preserved throughout the animal kingdom, suggesting a common evolutionary origin across species. Perich uses brain recordings from different animals together with artificial intelligence to identify commonalities in brain function across species. This level of understanding will enhance the direct interpretation of fundamental research being done all over the world to help us study the brain in health and in disease.

Dr. Matthew Perich
Université de Montréal



THE TREADMILL BLAZING NEW TRAILS FOR STROKE SURVIVORS.

Thinking, memory, and concentration problems, along with balance and walking difficulties, affect the lives of many stroke survivors. In this project, researchers will test the use of a new omnidirectional treadmill that allows for movement in all directions, together with virtual reality, as an enjoyable and engaging rehabilitation training in a safe environment for stroke survivors. If successful, this affordable and accessible technology could be used to improve rehabilitation of stroke survivors and may change our understanding of how the brain works during real-world activities like walking and talking.

Dr. Adria Quigley
Dalhousie University



THE LATEST WORD ON POST-STROKE SPEECH THERAPY.

In Canada, one individual suffers a stroke every seven minutes. Of those who survive, roughly 30 per cent will have aphasia, a difficulty speaking with or understanding others. Aphasia can have a significant negative impact on mood, quality of life and day-to-day functioning. Speech therapy can help patients recover their ability to find the right words in conversation, but it is only effective for some. In this project, researchers will use computational modelling of speech error to evaluate how well different types of word-finding speech therapies work and learn which language processes are being trained by which therapy to be able to tailor therapy to the patient. This ability to effectively improve communication with a simple solution can have a profound impact on a person's quality of life.

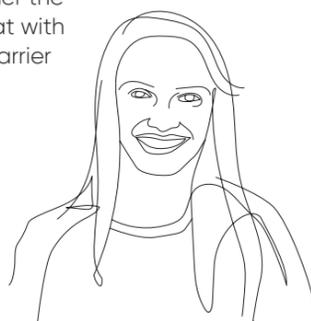
Dr. Tijana Simic
University of Toronto



THE FUTURE OF PARENT-BABY BONDING MAY REST IN A BABY CARRIER.

Approximately a quarter to one-third of pregnant people experience anxiety and depression, and it is very common postnatally as well. Most medical interventions treat the parent in the short term, but this doesn't always translate to increased parental sensitivity, and the reduction in that sensitivity over time can have longer lasting effects on the child's development through adolescence. This project will evaluate whether the simple use of a baby carrier can promote sensitivity, and couple that with brain imaging techniques to understand whether use of the baby carrier physiologically improves the connection between parent and baby.

Dr. Eszter Szekely
Lady Davis Institute
Jewish General Hospital





GETTING THE BRAIN IN ORDER BY GETTING MEMORIES IN ORDER.

Typically, we remember our experiences in the correct order and we can assess the elapsed time between them. Those with some neural disorders, such as schizophrenia, can have damage in a specific region of the brain leading to 'disorganized memories' – they can often remember events, but maybe not the order of events their distance in time. Here, researchers are investigating a possible mechanism for memory organization that involves activating groups of brain cells in a particular sequence, and what happens when that precise coordination is disrupted. The overall goal is to gain insights on how to restore dysfunctional activity in the brain.

Dr. Jiannis Taxis
The Hospital for Sick Children
University of Toronto

FINDING THE READY, SET, GO IN HEALTHY SYNAPSES.

This project is investigating the basic biology of how brain cells known as neurons connect with each other to carry out key functions. Neurons connect at junctions called synapses, and when a connection is established, a series of events has to happen within each cell in order for the cells to communicate with each other. There are a number of neurodegenerative diseases and symptoms (including loss of memory formation) that stem from a brain's inability to form healthy synapses. Here, researchers want to get a deeper understanding of the events necessary within brain cells to achieve those functional synapses.

Dr. Maria Vera Ugalde
McGill University



NO MODELS EXIST TO STUDY THIS DISEASE. TIME TO INVENT ONE.

Progressive Supranuclear Palsy (PSP) is a deadly disease of the brain with no cure. The brains of these patients contain toxic deposits of a protein called tau in a specific pattern of distribution that distinguishes it from other diseases. To better understand the causes of PSP and to test new treatments, scientists need to use animal models, but no animal model currently exists that reflects this unique distribution of tau deposits. Using highly specialized techniques, this research team will develop one. If successful, this model can be used to study the underlying causes of toxic tau and how it spreads, and test potential treatments for this devastating disease.

Dr. Naomi Visanji
University Health Network
University of Toronto



OUR PARTNERS' SUPPORT TODAY IS HELPING CREATE THE LEADERS OF TOMORROW.

This program has been made possible by the Canada Brain Research Fund (CBRF), an innovative arrangement between the Government of Canada (through Health Canada), Brain Canada Foundation and the Azrieli Foundation, with support from the Hewitt Foundation, The Erika Legacy Foundation, The Arrell Family Foundation, the Alvin Segal Family Foundation, and the Canadian Institutes of Health Research (CIHR).

For more information, visit braincanada.ca

