



DJAVAD MOWAFAGHIAN CENTRE FOR BRAIN HEALTH

YEAR IN REVIEW 2019/2020

Advancing Brain Health Through Research and Care

NEW LEADERS FOR A NEW ERA: A MESSAGE FROM THE DIRECTORS

Since opening its doors in 2014, the Djavad Mowafaghian Centre for Brain Health has been home to ground-breaking scientific research which continues to advance understanding of the brain. In recent months, the Centre—like many research institutions around the world—has faced an unexpected challenge, with COVID-19 sweeping the globe and forcing a curtailment of on-campus research.

Despite this drastic change as we stepped into our new leadership roles, what we saw amazed us. Staff, faculty and trainees came together and found creative ways of carrying out essential research and moving programs online. Many of our team members quickly adjusted their focus and continue to lead the charge on exciting COVID-19 research. Dr. Cheryl Wellington is working with a physician at Vancouver Coastal Health to determine how the immune system responds in critically ill patients by testing blood samples. Dr. Terry Snutch is leading the genome sequencing component of a national viral genomics effort funded by Genome Canada. Dr. Sriram Subramaniam is working towards a vaccine, and Dr. Kurt Haas is looking at how genetic variation of a COVID-19 receptor protein affects its function. Other faculty members have also applied their expertise in unique ways, including Dr. Stephanie Willerth, who used 3D printers to produce face shields and Dr. Lakshmi Yatham, who has teamed up with fellow psychiatrists to improve mental health support for frontline workers.

Over the course of the past several months, it's been clear just how important collaboration is. The Centre acts as a hub for research, training and clinical practice and has established itself as a world leader in the field of neuroscience. In the years to come, we will focus on promoting interdisciplinary connections within UBC, across Canada and globally, and between other centres and universities, as a way of fostering collaboration and expanding research.

This year's Djavad Mowafaghian Centre for Brain Health inaugural grants competition for Kickstart awards and the Centre's Alzheimer's disease awards have served as effective catalysts to initiate new interdisciplinary collaborations between foundational and clinical scientists, as well as between neuroscientists, engineers, psychologists and social scientists. We look forward to



seeing the results of these new partnerships. On a national and international scale, the Centre is being represented by Dr. Judy Illes, a world leader in neuroethics, who is working with the International Brain Initiative and co-leading a team that will develop a Canadian Brain Research Strategy.

We will take the knowledge and experience gained from these national and international connections and share it beyond the borders of UBC. In order to do this, we will invest in public outreach and education in brain health, and support neuroscience education and research training at the undergraduate, graduate and postdoctoral levels. Our approach to achieving these goals will be centered around four newly developed working groups, each aimed at finding effective ways of fostering collaboration, translating knowledge and connecting with the community in order to advance neuroscience research.

A unique strength of researchers at the Djavad Mowafaghian Centre for Brain Health is their dedication to looking beyond traditional approaches to treatment and research. One such example is the BC Brain Wellness Program, spearheaded by Dr. Silke Cresswell and Dr. Jack Taunton, which promotes healthy aging by providing lifestyle approaches to complement medical treatment in our clinics. The Dynamic Brain Circuits in Health and Disease Cluster is also housed in the Centre, where many researchers focus on training in cutting edge microscopy tools, open data science platforms and complex analysis of brain images.

The Djavad Mowafaghian Centre for Brain Health will soon be home to the Preclinical Discovery Centre (PDC). This state-of-the-art facility will enable research to advance understanding of brain function in health. It will do so by helping to uncover mechanisms that drive impaired development, altered connections and plasticity which underlie addictions, mental health disorders and brain dysfunction in multiple sclerosis, stroke and neurodegenerative diseases. The PDC will also serve as a platform for testing new therapies before advancing to human clinical trials.

The future is bright as the Centre continues to expand its reach and recruit new scientists. Last year, we welcomed world-renowned clinician scientist Dr. Sophia Frangou, who leads the Translational Neuroimaging and Clinical Neuroscience Program in Mental Health. In early 2021, in collaboration with the School of Biomedical Engineering, we will welcome Dr. Manu Madhav, who will be leading a research program related to probing interactions between sensory cues, cognitive representations and navigation using augmented reality and closed-loop methods.

We continue to be amazed by the creativity and collaborative spirit of our faculty, staff and trainees, all of whom dedicate so much time and effort in advancing the field of neuroscience. We are honoured to lead this team and are incredibly excited to see what we can collectively achieve over the next four years together.



Dr. Lynn Raymond

Director, Djavad Mowafaghian Centre for Brain Health



Dr. Shernaz Bamji

Associate Director, Djavad Mowafaghian Centre for Brain Health

“Located at the heart of UBC’s Vancouver campus, the Djavad Mowafaghian Centre for Brain Health is an inspiring place – inspiring people, ideas and actions for a better world.

While it has been a challenging year in more ways than one, the innovation, commitment and teamwork of our faculty and staff to pull together has been exemplary.

As the largest integrated brain centre in Canada, I look forward to seeing the Centre continue to advance brain research and patient care, both locally and abroad. UBC is thankful for the Djavad Mowafaghian Foundation’s generous contributions in helping to build such a strong community of researchers and clinicians who are all striving for a world free of brain disease. “

Santa J. Ono, President and Vice-Chancellor,
University of British Columbia

“The Faculty of Medicine has a bold vision: to transform health for everyone. The Djavad Mowafaghian Centre for Brain Health exemplifies this vision as scientists, clinicians, staff and students work together in search of treatments and cures for a wide variety of neurological diseases affecting people from all walks of life.

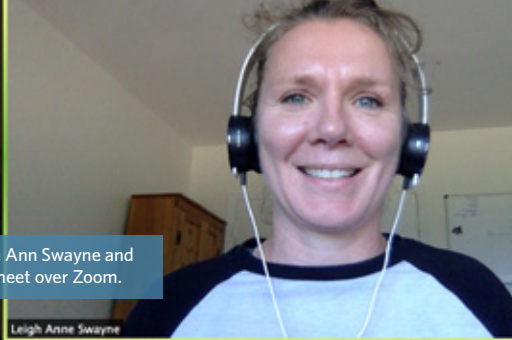
Even as the world has changed significantly over the past year, the Centre continues to put patients and communities first, regardless of one’s ethnicity, age, gender or socioeconomic status.

Under the leadership of Drs. Lynn Raymond and Shernaz Bamji, I am excited to see the Centre continue to collaborate in research across interdisciplinary areas and forge meaningful relationships to improve life for patients and their families throughout the province of British Columbia, and beyond.”

Dr. Dermot Kelleher, Dean, Faculty of Medicine and Vice-President, Health, University of British Columbia



Dr. Leigh Ann Swayne and her lab meet over Zoom.



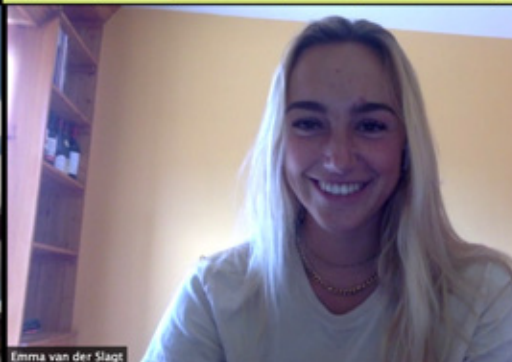
Leigh Anne Swayne



Dr. Robin Hsiung



z-Arias



Emma van der Slagt



The Galea lab does the Grouse Grind!



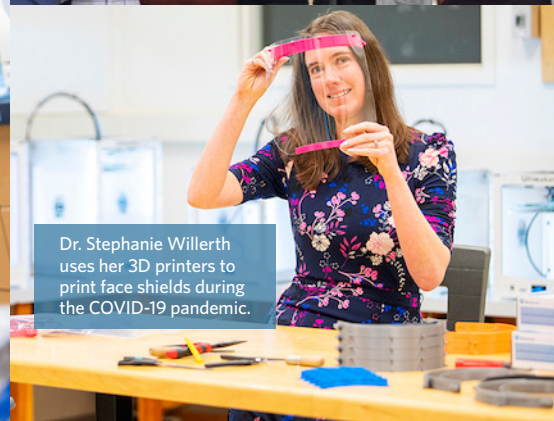
The Neuroscience Graduate Student Association welcomes new students virtually.



The Weihong Song laboratory.



Ice cream crew pre-COVID!



Dr. Stephanie Willerth uses her 3D printers to print face shields during the COVID-19 pandemic.

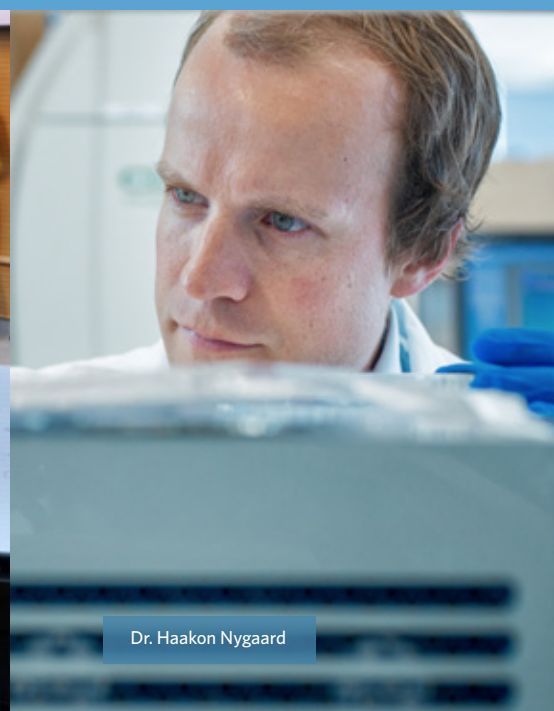
BY THE NUMBERS

The Djavad Mowafaghian Centre for Brain Health continues to expand and produce research that has impacts on a global scale, with research funding topping more than \$33 million. The Centre is now home to 18 Canada Research Chairs, supported by Government of Canada funding for the world's most accomplished and promising researchers. It is also home to 40 master's students and 68 PhD students who are making significant contributions in brain health research.

The work published by our researchers is extremely well cited. A newly developed database highlights over 100,000 of the most-cited researchers in the world in all fields of science, with 43 of the Centre's researchers on the list. With more than 6 million researchers worldwide included, this puts our faculty members in the top 1.5% of cited researchers globally, an amazing feat for a Centre with just over 100 members!



Brain Wellness leads a musical exercise.



Dr. Haakon Nygaard



Dr. Louis-Philippe Bernier of the MacVicar lab.



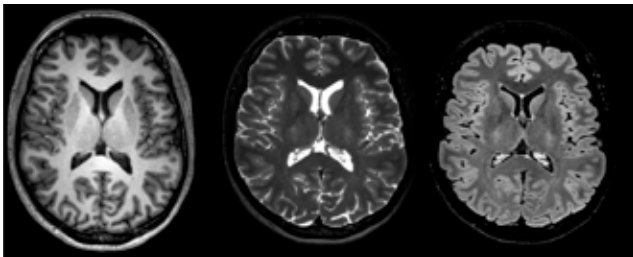
Graduate student Alyssa Ash and Lab Manager Melanie Bertrand help coordinate PPE donation at the beginning of the pandemic.



FACILITY & EQUIPMENT HIGHLIGHTS

EXPANSION OF CHIMERA

Closed-Head Impact Model of Engineered Rotational Acceleration (CHIMERA) is a tool developed through a partnership between Djavad Mowafaghian Centre for Brain Health researcher Dr. Cheryl Wellington and UBC's School of Biomedical Engineering researcher Dr. Peter Cripton. CHIMERA provides conditions that are clinically similar to traumatic brain injury, reproducing concussion-like injuries in animal models that are similar to most human concussions. Drs. Wellington and Cripton have delivered 21 copies of the model worldwide, including across North America, Australia and Japan.



Anatomical image of the brain from the new MRI machine.

THE CHARLES E. FIPKE NEUROIMAGING SUITE

The Charles E. Fipke Integrated Neuroimaging Suite officially opened its doors in 2019 and is home to a GE Signa PET/MRI hybrid scanner designated for brain-related research, a state-of-the-art Philips Ingenia Elition MRI and a Neurophysiology Suite. Researchers have been working hard to develop new research tools and sequences that leverage the advantages of the technologically advanced MRI and PET/MRI scanners. Over the past year, studies from the old MRI and PET scanners were transitioned to the new facility and in August 2020, the MRI scanner at the Purdy site was decommissioned after 17 years of use. The Neuroimaging Suite remains open during the COVID-19 pandemic in order to continue time-sensitive research and allow for monitoring of patients participating in clinical trials. The new Suite will provide innovative opportunities to study many neurological diseases, including Huntington's, Alzheimer's and Multiple Sclerosis.



Philips Ingenia Elition MRI

THE CENTRE'S **RESEARCHERS**

LEADING THE CHARGE ON COVID-19 RESEARCH

When the COVID-19 pandemic struck North America, many Djavad Mowafaghian Centre for Brain Health members were quick to pivot their research programs to focus on the virus. Below are just some examples of the COVID-19 work our faculty has been doing since March 2020.

SEQUENCING THE COVID-19 GENOME

Genome Canada has established a \$40 million federally funded genomics project to understand both the SARS-CoV-2 virus and the genomes of infected patients.

The project involves two parts: the first, sequencing the entire genomes of up to 10,000 patients infected with the virus (termed the host genome project). The second is being led by Djavad Mowafaghian Centre for Brain Health researcher Dr. Terry Snutch with the goal of sequencing up to 150,000 viral genomes isolated from infected people.

The genome sequencing aspect of the project being led by Dr. Snutch will focus specifically on the virus' genome. Currently, DNA sequencing is used to diagnose a person with COVID-19, where a nasal swab is taken and a small region of the virus' genome is sequenced. The full genome sequencing that Dr. Snutch and the Canadian COVID-19 Genome virus project team are undertaking will test samples to determine the entire virus genome from thousands of infected patients.

The goal of sequencing the virus' genome is threefold: the first, is to be able to "watch" the virus as it mutates and accumulates changes in the genome. This can be used to track in near real time where a particular variant arose in both time and place, which in turn tells health authorities whether that particular strain of the virus came into a community via external travel or if was already there and is now being spread within a community. The second, is to identify any mutations that pop up which might affect ongoing vaccine efforts or make the virus drug resistant. The third, is to detect any mutations that could impact how efficiently the virus can spread and infect people.

FROM BENCH TO BEDSIDE: A COVID-19 COLLABORATION IS SAVING LIVES

At the beginning of the pandemic, Djavad Mowafaghian Centre for Brain Health researcher Dr. Cheryl Wellington and her lab, along with Vancouver General Hospital intensive care physician Dr. Myp Sekhon, quickly launched a study looking at how the immune system can overact in the presence of COVID-19 and attack the lungs.



Dr. Terry Snutch



Dr. Cheryl Wellington

Initial tests performed in Dr. Wellington's laboratory at the Centre indicated COVID-19 patients had elevated presence of inflammatory and immune biomarkers—a substance in the blood that indicates specific biological processes—which led them to investigate the possibility of using existing immune suppressant medication.

The research team worked around the clock, completing analyses within 48 hours of receiving each patient's samples, whereas this type of analysis could take up to 4–6 months in previous studies.

So far, 58 patients have taken part in the study which has resulted in a primary publication in the *British Journal of Hematology* as well as six follow up publications. The study represents a unified collaboration between UBC and VGH that could prove to be a blueprint for future partnerships between clinicians and scientists, setting the stage for a British Columbia-wide biobank that now has over 700 specimens from approximately 58 COVID-19 patients.

FOUNDATIONAL RESEARCH: STUDYING THE ROLE OF THE ACE2 RECEPTOR GENE IN COVID-19

The main focus of the Haas lab has been to better understand autism, by studying how single nucleotide polymorphisms—substitutions of one nucleotide in the genome—change protein function in autism-associated genes.

In March, the team realized they could apply their research process to studying the virus. They began studying the gene ACE2, which makes a protein that acts as a receptor and binds the COVID-19 virus on the surface of cells lining the lung.

“We realized that one of the big questions in this pandemic is why people have such different expression of the disease, ranging from no symptoms at all to life threatening pneumonia,” says Djavad Mowafaghian Centre for Brain Health researcher Dr. Kurt Haas. “One reason why this is happening may be due to variants of the ACE2 gene, which is why we want to study it.”

Dr. Haas' team has secured CIHR funding to support the project and his lab will be making all possible mutations of the ACE2 gene and testing how each variant binds to the viral protein.

There are two main goals of this research. The first, is to gain a better understanding of the role ACE2 plays in how severely the virus infects a person. The second, is to use this research to aid in the development of new therapies. By better understanding ACE2's function, new drugs could be designed that would block the virus from binding to it.



Dr. Kurt Haas

RESEARCH COLLABORATIONS



Drs. Fabio Rossi, Freda Miller and Brian MacVicar.

TEAMING UP TO BETTER UNDERSTAND THE BRAIN

The meninges is a highly specialized membrane that encases the brain, providing structural support while also acting as a barrier to protect unwanted pathogens from entering it. But this important part of the brain isn't well understood and very little work has been done trying to describe its role in brain-related injuries such as stroke and concussion. Drs. Brian MacVicar and Fabio Rossi have teamed up with SickKids Senior Scientist Dr. Freda Miller to gain a better understanding of the meninges. Each researcher has a unique area of expertise which they will leverage in this partnership, looking at the meninges in terms of molecular characterization all the way up to whole animal imaging studies. "If you, like me, truly believe that collaboration is the way from here on out, then what you need are people who are not only really smart and really good at what they do, but who also like to collaborate," says Dr. Miller. "The neuroscience community at UBC embodies these qualities, and I'm really excited about being a part of it."

IMPLEMENTING TECHNOLOGY TO SELF-MANAGE DEPRESSION

A team of UBC researchers is working with colleagues in Shanghai to implement the use of technology when it comes to treating and managing depression.

Drs. Raymond Lam, Erin Michalak and Jill Murphy have partnered with the Shanghai Mental Health Centre as part of a five-year grant funded jointly by CIHR and the National Natural Sciences Foundation of China. The team is looking to implement enhanced measurement-based care through an app to help people in Shanghai self-manage mild to moderate depression. They are also adapting a Canadian program called Bounce Back to be suitable for use in China. Bounce Back is delivered by the BC Chapter of the Canadian Mental Health Association and is intended to help people self-manage mild to moderate depression and anxiety. It's delivered online through a series of workbooks and videos, and participants also have access to a coach. Dr. Lam and his team are working to create similar workbooks and videos in Mandarin.

BIOPRINTING BRAIN CELLS TO STUDY ALZHEIMER'S DISEASE

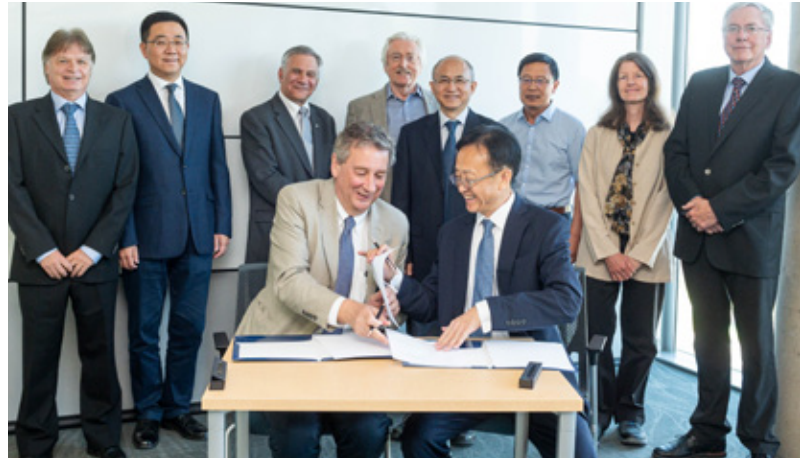
The Centre is now home to its first 3D bioprinter—an innovative tool that provides researchers with a realistic replica of the brain in order to study neurological diseases. The new printer will aid in an ongoing collaboration between Djavad Mowafaghian Centre for Brain Health researchers Dr. Haakon Nygaard and Dr. Stephanie Willerth as a way to better understand Alzheimer's disease and potentially aid in the development of new drug therapies. "There aren't very good tools for predicting how effective a drug will be at treating a neurological disease or disorder," says Dr. Willerth. "Many drugs have failed and it's partially because we're testing them on animals, so we can potentially use bioprinting as a tool for drug screening."



Dr. Stephanie Willerth

FORGING INTERNATIONAL PARTNERSHIPS TO BETTER UNDERSTAND BRAIN HEALTH

An agreement between the UBC Faculty of Medicine and the Shenzhen Institutes of Advanced Technology (SIAT) has formalized an academic partnership between the two groups. The agreement, which connects those members of the Royal Society of Canada primarily located in the Djavad Mowafaghian Centre for Brain Health with members of the Chinese Academy of Sciences (CAS) in Shenzhen, represents a commitment to scientific diplomacy and an effort to solve some of the biggest challenges in brain research together. The UBC-SIAT partnership aims to employ complementary research skills and knowledge from well-established research teams at both institutions in order to improve our understanding and ability to treat and prevent some of the greatest challenges to brain health, including Alzheimer's disease and dementia, addiction, brain injury and stroke, and neurodevelopmental disorders including autism.



Dr. Dermot Kelleher (front, left) and Dr. Jianping Fan (front, right) sign an agreement between UBC and SIAT.

BC BRAIN WELLNESS PROGRAM

Brain wellness is about more than the right dose of medicine and regular check-ins with clinical teams. It is about enhancing an individual's lifestyle to nurture the whole person; clinical care is important, and so is exercising, wholesome nutrition, making time for friends and family, enjoying music and art, mindful living and spending time in nature. With that in mind, Dr. Silke Cresswell and sports medicine luminary Dr. Jack Taunton, along with numerous colleagues, launched the BC Brain Wellness Program in October 2019 to provide complementary support for people who access the clinics at the Djavad Mowafaghian Centre for Brain Health and their care partners, as well as the larger community to support healthy aging.

The Program brings together partners from across UBC including from Sports Medicine, Physiotherapy, the School of Music, Kinesiology, Neurology, Psychiatry, Neuroscience, and Nutrition, as well as several community partners and Vancouver Coastal Health. By combining clinical care with interventions that support healthier lifestyles, the goal is to improve and sustain quality of life for people living with brain disorders and their care partners.

"We are not caring for a disease, we are caring for a person," says Dr. Cresswell. "This means we need to provide sustainable ways for people to participate in



physical activities, as well as in arts and music, in order to keep them active in their communities and provide networks of support and socialization."

Since launching last year, the Program has expanded from offering four classes to now offering 24 classes, including gardening, improv, exercise and dance, with more than 450 people registered. When COVID-19 struck in March, the team quickly adapted and started offering classes virtually. In total, the Brain Wellness Program has offered over 200 hours of free programming to participants from across British Columbia.

The Program has also held many successful events including a virtual World Brain Day celebration and monthly Wellness Wednesday presentations, each focused on a unique wellness topic such as the importance of social connections and exercise. The team has been able to offer all of their programming free of charge thanks to support from donors.

RESEARCH HIGHLIGHTS

WELCOMING NEW RESEARCHERS

Dr. Sophia Frangou, Department of Psychiatry, President's Excellence Research Chair in Brain Health

Dr. Sophia Frangou is a Professor of Psychiatry and President's Excellence Research Chair in Brain Health at the Centre. She leads the Translational Neuroimaging and Clinical Neuroscience Program in Mental Health, which aims to characterize the brain mechanisms that underpin mood and psychotic disorders and identify genetic and environmental factors underlying mood disorders.



Dr. Sophia Frangou

Dr. Sriram Subramaniam, Department of Biochemistry and Molecular Biology

Dr. Subramaniam is globally known for his contributions in cryo electron microscopy (cryo-EM), and was the first to use cryo-EM in precision medicine with structure of a drug bound to a patient mutant in cancer. He leads the Program in Cyro-EM Guided Drug Design which aims to accelerate the development of effective therapeutic agents.



Dr. Sriram Subramaniam

SCIENTISTS DISCOVER GENE THAT INCREASES RISK OF ALZHEIMER'S DISEASE

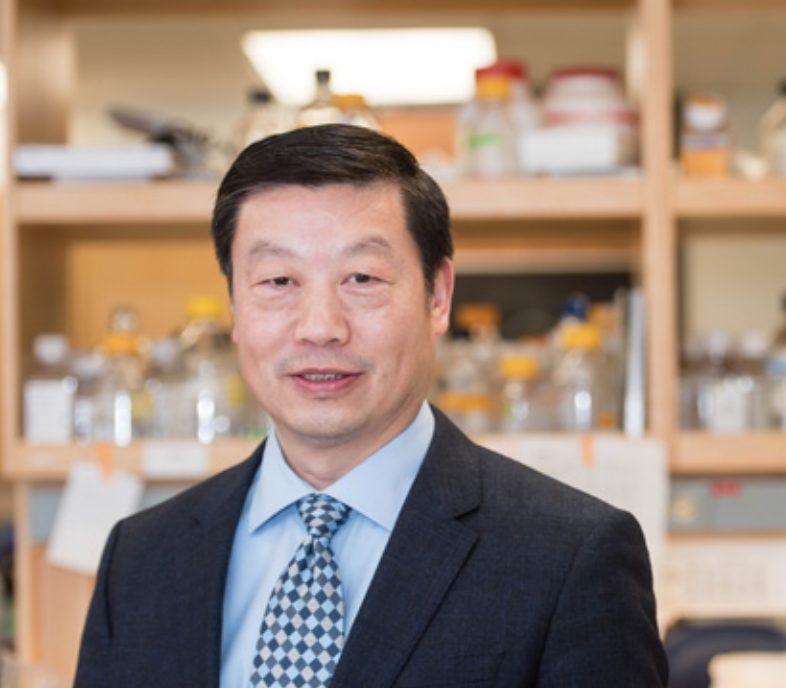
Researchers from the University of British Columbia and the Central South University (CSU) in China have for the first time identified a gene that increases the risk of Alzheimer's disease.

Djavad Mowafaghian Centre for Brain Health researcher Dr. Weihong Song teamed up with Dr. Lu Shen at Xiangya Hospital at CSU and found two mutations in the gene endothelin-converting enzyme 2 (ECE2) which impaired its ability to break down amyloid beta protein. These mutations were present significantly more often in people with Alzheimer's than in controls—suggesting that the genetic variants in ECE2 could be causing, or at least contributing to, Alzheimer's symptoms.

"Since amyloid beta protein is unique to Alzheimer's disease, the majority of drug development is targeted here," says Dr. Song. "If we can prevent amyloid beta protein build up or at least find a way to get rid of some of it, we could prevent and treat the disease."

Dr. Song's lab focuses their efforts on looking at the role amyloid beta protein plays in Alzheimer's. It's well established that increased production (or reduced degradation) of amyloid beta protein results in the formation of neuritic plaques in the brain, which is a hallmark of Alzheimer's disease neuropathology.

The team injected the mutated forms of the ECE2 gene into animal models. They found mice with the mutation had increased levels of amyloid beta protein and plaque formation, and also exhibited some signs of Alzheimer's



Dr. Weihong Song

such as memory loss. When they expressed the wildtype form of the gene in the mice (i.e. the non-mutated form), amyloid beta protein levels decreased and the mice recovered some of their learning and memory deficits.

"These findings mean that ECE2 is a risk gene for people to develop Alzheimer's later in life," says Song. "Moving forward, we can try to target this gene and increase its expression as a way to treat Alzheimer's."

HOME EXERCISE PROGRAM REDUCES FALLS RISK

An in-home exercise program reduced subsequent falls in high-risk seniors by 36 per cent, according to the results of a 12-month clinical trial led by Djavad Mowafaghian Centre for Brain Health researcher Dr. Teresa Liu-Ambrose. The study, conducted in partnership with clinical teams at the Falls Prevention Clinic at Vancouver General Hospital, found a reduction in fall rate and also a small improvement in cognitive function.



Dr. Teresa Liu-Ambrose

The study engaged adults aged 70 years and older who had been referred to the Falls Prevention Clinic following a fall that resulted in a visit to a medical facility such as an emergency room. Participants had a history of falls, with an average of three prior falls per person. Participants were living in the community and generally had symptoms of frailty and limited mobility.

Participants in the 12-month study performed modified activities from the Otago Exercise Programme, a program of balance and muscle re-training exercises that can be tailored by a physical therapist to an individual's skill level. Over the course of six months, a physical therapist would make five home visits to prescribe exercises, ensure that exercises were done properly, and progress participants through the exercises. For those who completed the program, the results were notable: people were less likely to experience repeat falls, and as a secondary benefit, they improved in some markers of cognitive function.

"It is well known that exercise benefits older people in general, but what was special about this study group was that they are at very high-risk for losing their independence—they had both mobility and cognitive impairments and another fall may leave them unable to continue to live in their own homes," said Dr. Liu-Ambrose, who holds a Canada Research Chair in Aging, Physical Activity, and Cognitive Neuroscience. "Older adults who experience falls that require medical attention are medically complex and at high risk for both morbidity and mortality, and we demonstrated that exercise is a practical and cost-effective intervention that can improve older peoples' outcomes after a significant fall."

FIRST EVIDENCE OF REROUTING PATTERNS IN THE BRAIN POST-CONCUSSION

Research led by Dr. Naznin Virji-Babul is the first to show how information is rerouted in the brain following concussion in adolescents. It's known that after a brain injury the number of connections in the brain increases and the flow of information changes. But until recently, it was unclear exactly how the information flow was being altered post-concussion.



Dr. Naznin Virji-Babul

The team looked at 32 healthy adolescent athletes who had never had a concussion and compared them to adolescent athletes who were one-week post-concussion. The researchers found four alternative pathways by which the brain was redirecting information in the concussed group compared to the control group, suggesting that these detour pathways were a consequence of prior connections being disrupted by concussion.

“The kids we studied were all within one week of having a concussion and they’d only ever had one concussion, yet we could see that the way their brain sends information had totally changed,” says Dr. Virji-Babul. “This is the first time we’ve actually been able to see these changes which is what makes this study so exciting.”

The study has many future implications, one of which is the potential to eventually aid in concussion diagnosis.

NEUROETHICS RISES TO THE CHALLENGE

When it comes to studying the brain, it’s essential to consider the many ethical questions that often arise. Neuroethics Canada is a research group that’s part of the Djavad Mowafaghian Centre for Brain Health and led by Dr. Judy Illes. This year, her team has worked on several projects, including the exciting launch of the Canadian Brain Research Strategy with a \$1.5 million CIHR grant.

Dr. Illes is co-leading the strategy with Professor Yves de Koninck and early career researcher Dr. Caroline Menard at the University of Laval. It already involves more than 30 teams from across the country. Canada’s participation is part of a larger International Brain Initiative, which brings together the world’s major brain research projects, all aimed at better understanding the human brain and discovering new treatments to address neurological and psychiatric disorders.

“This funding has provided us with the opportunity to create a strategy that has a truly Canadian signature and draws upon our commitment to trans disciplinary and our collaborative spirit,” says Dr. Illes. “We will focus on our early career researchers for capacity building in making this uniquely Canadian enterprise not only successful, but a way in which we can be global leaders in neuroscience.”

The Canadian Strategy will specifically look to address the question of how the brain learns, remembers and adapts. Understanding this is at the root of treating neurological and psychiatric disorders and neuroethics is a core part of answering these questions.

“Every strategy under the International Brain Initiative has a neuroethics component, but neuroethics is an anchor to Canada’s strategy rather than just a part of it,” says Dr. Illes. “This is definitely a unique strength.”

Another exciting project underway by the Neuroethics Canada team is exploring ethical issues facing families and clinicians when considering new treatment options for drug-resistant epilepsy in children.

Thirty per cent of children with epilepsy don’t respond to drugs, so neurotechnologies such as deep brain stimulation—where electrodes are implanted in the brain and send off electrical signals to prevent seizures—are currently being used. But there isn’t much research around some of the ethical issues this presents in children.

“When it comes to children whose brains and bodies are still developing, how can people conceivably make decisions about invasive brain procedures without guidance?” says Dr. Illes, who is a leader in this area and gave a TEDx Talk on it earlier this year. “This is what we’re trying to address, and what’s incredibly important about our method is that we’re drawing on guidance from groups of people who are directly impacted.”

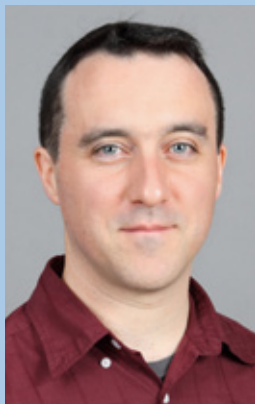
Moving into their third year of funding, the team intends to develop a multimedia tool that will inform affected children, care givers and clinicians of the ethical questions and values they should consider when it comes to these advanced neurotechnology treatments. The team is also looking at access and cultural sensitivity of these technologies in Indigenous communities.



Dr. Judy Illes

STAFF HIGHLIGHT

JEFF LEDUE



Jeff LeDue wears many “hats” at UBC—he’s a research associate, coordinator of the UBC Dynamic Brain Circuits in Health and Disease Research Excellence Cluster and managing director of the NeuroImaging and NeuroComputation Centre (NINC), a shared research platform at the Djavad Mowafaghian Centre for Brain Health.

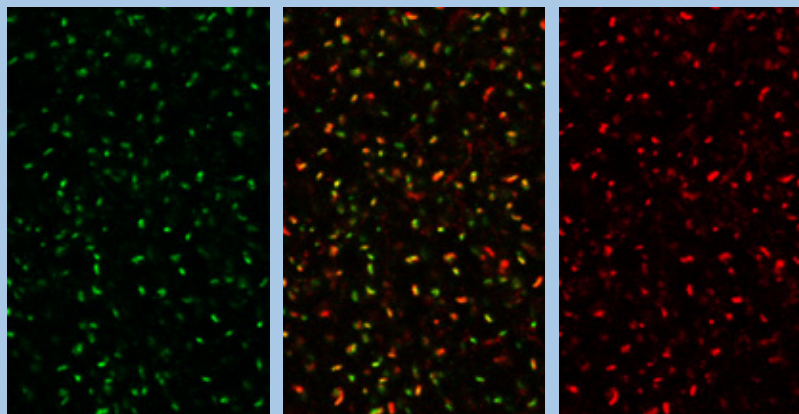
Upon joining UBC in 2010, LeDue was interested in getting a neuroscience-based imaging and computation facility started at UBC. This type of resource

was essential in his previous role at UC Berkeley and he began to advocate for the creation of such a facility. When the Djavad Mowafaghian Centre for Brain Health opened its doors in 2014, LeDue got to work on securing and renovating an appropriate space. By 2015, with support from Drs. Tim Murphy and Kurt Haas, the NINC was fully functioning and is now considered a core facility of the Centre.

“Jeff is an amazing resource not only for our Centre, but for the larger neuroscience community,” says Dr. Murphy. “He truly cares about the success of the Centre, but also advancing our field through training and sharing of the unique resources that we can now generate thanks to him. I cannot imagine where we would be without this outstanding colleague who feeds off helping others, but also pushes the intellectual envelope of today’s global neuroscience.”

LeDue also coordinates the Dynamic Brain Circuits in Health and Disease Research Excellence Cluster, which is supported by the Office of the Provost and Vice-President, Academic and the Vice-President, Research and Innovation. The Cluster is led by Dr. Tim Murphy with the goal of accelerating innovation with open science and open data and aiding both clinicians and basic scientists in translating discoveries.

Over the past several years, LeDue has found great success in merging his roles and finding creative ways of being involved in research. Four years ago, he and Dr. Murphy spearheaded the launch of Databinge—an opportunity for students and faculty to drop into the NINC with active research problems, or any project they are working on, and present it to others to troubleshoot issues with data or code, or to bounce ideas off of colleagues.



Expansion microscopy images taken with support from Jeff LeDue.

“Databinge was seen as an opportunity to build community around the NINC and get people talking about methods at an early point in their projects,” says LeDue. “This embodies the principles of open science, where you talk about the work you’re doing very early on in the process, embrace new methods and make sure people are being supported in their efforts.”

LeDue works with students and faculty each week to help them troubleshoot any challenges they’re having with projects. When COVID-19 struck, Databinge quickly pivoted online and is now offered via Slack and Zoom.

“Now that we’re online, Databinge is live 24/7 which means people are asking questions all the time, they’re changing code, they’re connecting with their peers; there’s just a lot of continuous activity which is great,” says LeDue. “Plus, we’ve been able to connect with more people because meeting at one time and place is no longer a barrier.”

Another highlight of LeDue’s time at UBC was back in 2017, when he helped introduce the use of expansion microscopy at the Centre. It started as an expansion microscopy workshop partnering with the NeuroFutures2017 conference in the NINC and attracted over 70 attendees. With the help of trainees, he was able to launch a step-by-step demo and analysis package and encourage other labs at the Centre to start using this technique.

“Expansion microscopy has revolutionized the study of synaptic connections in brain circuits, allowing individual synapses in dense circuits to be resolved and their molecular compositions mapped,” says faculty member Dr. Ann Marie Craig. “Jeff LeDue was instrumental in establishing expansion microscopy at UBC, from helping coordinate the first workshop to printing gelation and imaging chambers, testing various imaging systems, and organizing coding tutors to aid in analysis.”

TRAINING THE NEXT GENERATION

Great people in an inspiring space. This combination has allowed the Djavad Mowafaghian Centre for Brain Health to provide UBC students with exceptional training and support and attract the world's leading minds to create lasting and meaningful advancements in brain research and care.

STUDENT PROFILES

HONG LU | PhD

Hong Lu was always interested in studying the brain. After completing his undergraduate degree at UBC, he decided to take a year to explore how he could further his interest. During this time, he began volunteering in Dr. Ann Marie Craig's lab.

"From the beginning, the lab's energy was different, and it was exciting to be around people who thought about science all the time," says Lu. "Back then, there were a lot more postdocs than graduate students, so I always felt like I had to earn my spot. I feel like that pushed me to be a better researcher."

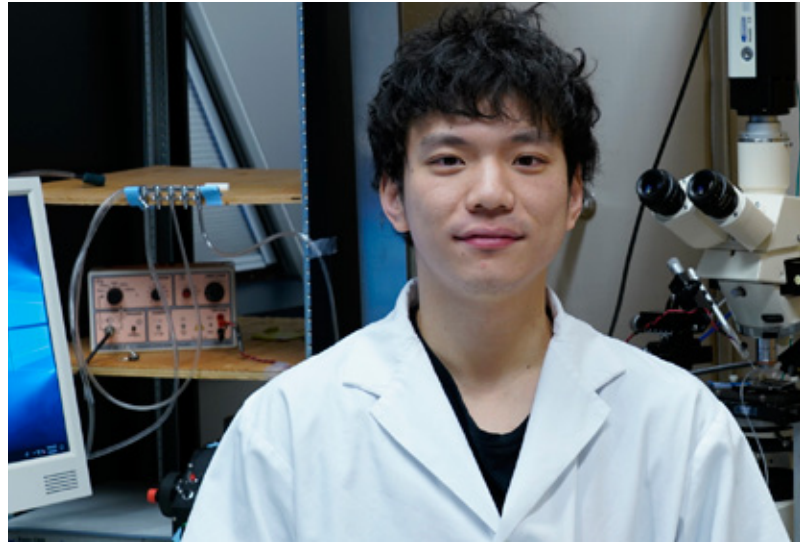
Lu started his master's in the Craig lab the following year and by 2017, he loved the work so much he switched over to the PhD stream. His project involves looking at high-risk mutations that are involved in the genetic pathways of Autism Spectrum Disorders (ASD) and schizophrenia. Specifically, he studies how these mutations functionally and morphologically affect the brain.

The first part of his project aims at gaining a better understanding of the mechanisms behind these mutations—in other words, figuring out what is happening at the protein level, and how this relates to autism and schizophrenia symptoms. The second part of Lu's work is to find a therapy that will treat the deficits observed as a result of these mutations.

In 2019, Lu was awarded a Vanier Scholarship, which is \$50,000 per year for three years, with the intent of supporting PhD students who demonstrate leadership skills and a high standard of scholarly achievement in their graduate studies.

"Working in Dr. Craig's lab has been very rewarding," says Lu. "She's very good at knowing when to push your potential and when to remind you to not be too hard on yourself. Scientifically, there is still much to learn from her."

Lu says one of the biggest thrills of his time in the lab was not receiving prestigious awards or publishing in high impact journals. Instead, it was a moment he had in collaborator Dr. Rachel Wong's lab at the University of



Washington while working with lead author Dr. Peng Zhang on three-dimensional reconstructions of wild type and mutant neurons for a paper in the journal *Cell*.

"We were using electron microscopy to look at the effects of a post-translational modification on an ASD risk gene and it was amazing how a simple modification of a sugar chain could result in such a robust change in neural structure," said Lu. "Peng and I were exhausted after having spent every waking moment working for almost a month. But it was a powerful moment when we finally saw those 3D models. I don't think we said much, we just sat there for a really long time. That was probably more exciting than when we heard our work was accepted for publication!"

Outside of the lab, Lu enjoys playing piano and violin, and hopes to make it to Poland one day to visit the old stomping grounds of his favourite composer, Chopin. Lu is also co-president of the Neuroscience Graduate Student Association and co-editor of *Neuropsyché*, a digital magazine created by UBC neuroscience students.

"There's so much that I've enjoyed about my time at UBC as a graduate student," says Lu. "I feel like the community of trainees is close knit, and I really enjoy that aspect of the Graduate Program in Neuroscience."

ASMA BASHIR | PhD

Dr. Asma Bashir joined the Djavad Mowafaghian Centre for Brain Health in 2015, shortly after completing her undergraduate degree in Boston. She joined Dr. Cheryl Wellington's lab as a PhD student and studied traumatic brain injury (TBI).

Dr. Bashir's project was focused on the Closed-Head Impact Model of Engineered Rotational Acceleration (CHIMERA) — a tool developed in 2014 in collaboration between Dr. Wellington and Dr. Peter Crompton at UBC's School of Biomedical Engineering — which allows researchers to generate TBIs in animal models to help study the consequences of head impacts over acute and chronic time-points.

Several animal models to study TBI exist, but most don't generate head injuries that accurately represent what happens when humans hit their head. This was Dr. Bashir's challenge: validation of multiple human TBI phenotypes using CHIMERA. The first part of her PhD project involved identifying the phenotypes missing from the injuries generated using CHIMERA. Cerebrovascular damage, a key component of human TBI regardless of injury severity, was noticeably absent. Dr. Bashir worked to expand the platform to be able to generate injuries that affected the cerebrovasculature. In this study, deficits in memory and neurophysiology were also found, closely mimicking findings in people who have hit their head.

An exciting moment in her research was discovering that rats exposed to repetitive head impacts showed signs of impulsivity — in other words, rather than waiting longer for more food, injured animals chose to receive less food sooner compared to uninjured animals. This clearly mimicked human behaviour, as some people who have experienced several head injuries become more impulsive over time.

"We really paid attention to the most prevalent behavioural and neuropathological TBI phenotypes in humans and attempted to recreate them in rodents, because you need a good model that represents what's happening in humans before investigating promising therapeutics; otherwise you just end up curing rodent head injuries and not human head injuries," says Dr. Bashir. "CHIMERA is poised to become a very valuable model of human head injury which, in the near future, will be important for studying potential therapeutic options for TBI."

The Wellington lab has shipped 21 CHIMERA tools across the world and provided other researchers with training, backed by Bashir's research demonstrating its value in understanding a range of outcomes across the severity spectrum of brain injuries.



"What I enjoyed most about working with Dr. Wellington is that it's her goal to make sure you're a quality, independent researcher with rigour and integrity and she never wavered from that," says Dr. Bashir. "I took that very seriously and now I see how much more independent I am as a researcher."

Outside of the lab, Dr. Bashir has many interests, including science communication. In 2019, with support from the Djavad Mowafaghian Centre for Brain Health, she launched "Her Royal Science," a podcast which looks at the lives of scientists inside and outside of the lab. She saw it as an opportunity to introduce listeners to some of the most interesting people working in science, technology, engineering and math-related (STEM) fields, but also as a chance to dig into individual life stories and learn about the variety of experiences that make people who they are.

"I've always been intensely curious about people's lives and what led them to where they are today, so I thought it would be a great idea to bring the conversations I was already having in private to a wider audience," she says.

The project also aims to bring awareness to the lack of diversity that exists in STEM fields, through talking about individual experiences. The science is important, certainly, but Bashir wants to uncover life stories and humanize scientists in order to expand the public's perceptions about what it means to be in research and academia.

Dr. Bashir graduated in December 2019 and is now a postdoctoral fellow at the University of Edinburgh, but the podcast lives on! New episodes continue to launch at herroyalscience.com.

NEW UNDERGRADUATE PROGRAM IN NEUROSCIENCE EYES 2022 START

Students interested in brain research have been eager for an undergraduate neuroscience program at UBC and the program is moving closer to reality, with the goal of launching in fall 2022.

There are currently a number of neuroscience courses available to undergraduate students, and a Behavioural Neuroscience BSc degree was established in 2017. However, this BSc is focused exclusively on behavioural neuroscience. The idea is to create an undergraduate program that has a wider reach and will enable access to cellular and molecular neuroscience courses that are currently scattered across the Faculties of Science and Medicine. The new degree will also feature lab-based courses in neuroscience laboratories and courses in neuroethics, as well as clinical neuroscience.

The undergraduate neuroscience specialization will consolidate neuroscience education under a single banner and will grant students access to conduct research across more than 90 neuroscience research laboratories at UBC.

The program is still under development and the working group consisting of Steven Barnes (Psychology), Tim O'Connor (Cellular and Physiological Sciences), Vanessa Auld (Zoology) and Liisa Galea (Psychology) has been in place for over a year. It was established to work with the Provost's office and the Deans of Arts, Science and Medicine to determine program requirements and develop the curriculum.



Dr. Liisa Galea, Director of the Graduate Program in Neuroscience.

"There's been a lot of interest in an undergraduate program in neuroscience at UBC for at least 20 years," says Dr. Liisa Galea, Director of the Graduate Program in Neuroscience. "In 2018, the UBC Neuroscience Club ran a survey with 130 responses which overwhelmingly endorsed a new degree. We in the Djavad Mowafaghian Centre for Brain Health community are very eager to get all the kinks worked out so we're able to deliver what will undoubtedly be a popular degree. It's important to give students who are interested in neuroscience the opportunity to explore the wonderful world of brain science at the undergraduate level."

NEUROSCIENCE STUDENTS SUPPORTED TO STUDY MENTAL HEALTH

Thanks to generous funds from donors, students based out of the Djavad Mowafaghian Centre for Brain Health who were working on projects related to mental health were given more opportunities to expand their research. Sunny and Steward Marshall committed to support five post-graduate fellows and 15 graduate scholars through the establishment of the Marshall Scholars and Fellows Program in Mental Health. In 2019, two post-doctoral fellows supervised by the Centre's researchers were Fellows and 11 students in the Graduate Program in Neuroscience were Scholars. These grants will continue to be offered annually to support students who are training to be the next generation of leaders in mental health.



Dr. Travis Hodges, 2019 Marshall Fellow.

RESEARCH AWARDS PROMOTING COLLABORATION

Djavad Mowafaghian Centre for Brain Health Alzheimer's Disease Research Competition

The Centre is home to a unique array of researchers, including both foundational scientists and clinicians, and igniting collaborations is one of its core goals. This year, the Centre's competition brought together many researchers studying Alzheimer's disease. Six teams of scientists were awarded funding for their projects, including Drs. Liisa Galea, Teresa Liu-Ambrose, Vesna Sossi and Roger Tam, who have teamed up to launch a study looking at the impact of high-intensity exercise on cognition, Alzheimer's disease indicators and brain function in perimenopausal women.

Innovation Fund Kickstart Research Grant

The Djavad Mowafaghian Centre for Brain Health Innovation Fund Kickstart Research Grant was created to launch new research collaborations, directions and technological developments. It supports new projects that generate preliminary data for future grant applications to external funding agencies. This year, five teams of researchers received this award, including Drs. Trisha Chakrabarty, Rebecca Todd, Stan Floresco and Luke Clark, who are looking at the neurophysical and behavioural markers behind avoidance behaviour and how this relates to major depressive disorder.

SCIENCE COMMUNICATION TAKES OFF

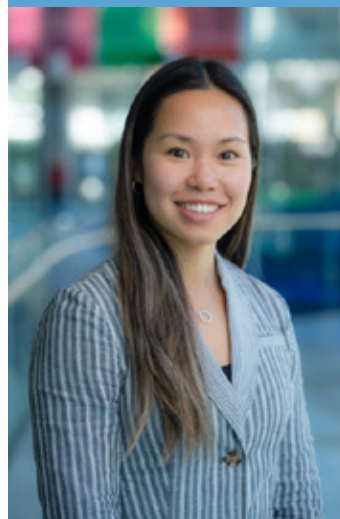
There is no shortage of exciting research happening at the Centre, and it's important to share our findings with the public. This year, several science communication initiatives were launched by neuroscience graduate students to give the community an opportunity to flex their writing, editing and podcasting muscles and to learn how to share science in accessible ways.

The Brainiac Blog was launched in the midst of the COVID-19 pandemic, when many students and trainees were unable to access their labs. It was the perfect opportunity for many to take some time and write about their research and offer commentary and advice on life as a grad student.

"The Brainiac Blog is an initiative that we designed to provide trainees with a fun opportunity to practice their writing and sci-comm skills," says Heather Gerrie, master's student in the Graduate Program in Neuroscience who led the blog's launch. "The influx of submissions we've received so far shows that UBC neuroscience trainees really care about science communication and want to share discoveries in the neuroscience field with a broad audience." Check out the blog at: neuroscience.centreforbrainhealth.ca/blog.

Another initiative called **NeuroPsyched**, an e-magazine created by six UBC neuroscience graduate students, released their first issue in July 2020, which highlighted new researchers, students and resources available at the Centre. The idea was born with the intention of shining a spotlight on the Djavad Mowafaghian Centre for Brain Health community and bringing scientists-in-training together. Visit neuropsyched.squarespace.com to learn more!

The podcast **A Month in Neurodegenerative Disease Research** kicked off this year, led by a team of current and past UBC and McGill University graduate students. The podcast focuses on Alzheimer's disease research and highlights the latest primary research articles over the course of a month. The idea is to help scientists stay up to date on the latest in Alzheimer's studies as a way of conducting better research. Listen now at amindr.com!



The Brainiac Blog editors
(top left: Amanda Cheung; top right: Hannah Phillips;
bottom left: Doris Chow; bottom right: Heather Gerrie)

PARTNERSHIPS

The Djavad Mowafaghian Centre for Brain Health represents a partnership between Vancouver Coastal Health and the Faculty of Medicine at the University of British Columbia. The Centre was made possible with a generous donation from the Djavad Mowafaghian Foundation, as well as contributions from other philanthropists and leaders, in addition to those of the federal and provincial governments.



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Vancouver Coastal Health (VCH) is responsible for the delivery of \$3.6 billion in community, hospital and long-term care services to more than one million people in communities including Richmond, Vancouver, the North Shore, Sunshine Coast, Sea to Sky corridor, Powell River, Bella Bella and Bella Coola. VCH also provides specialized care and services for people throughout BC and is the province's hub of health care education and research. www.vch.ca



Vancouver Coastal Health Research Institute (VCHRI) is the research body of the Vancouver Coastal Health and a world leader in translational health research. VCHRI is academically affiliated with UBC Faculty of Medicine and includes three of BC's largest academic and teaching health sciences centres—Vancouver General Hospital, UBC Hospital, and GF Strong Rehabilitation Centre—as well as other hospitals and public health agencies across Vancouver Coastal Health. As one of Canada's top funded research institutes, VCHRI receives over \$100 million in research funding annually to support health research and discoveries with direct health, economic and social impact on British Columbians. www.vchri.ca



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