



PERFORM Centre

ACTIVITY REPORT 2016-2017

ABOUT THE PERFORM CENTRE

The PERFORM Centre is a unique research facility that houses eight inter-related large equipment platforms devoted to prevention research through lifestyle intervention and impact assessment (Athletic Therapy Clinic, Cardio-Pulmonary Suite, Clinical Analysis Suite, Conditioning Floor, Functional Assessment Lab, Imaging Suite, Nutrition Suite and Sleep Laboratory).

PERFORM's 50 research members and specialists in health and disease prevention play an important role in cultivating interdisciplinary and collaborative research that creates links between a variety of traditional and non-traditional disciplines in an effort to improve health across the population. At PERFORM, we also strive to advance knowledge and train future generations of researchers. In addition to fostering multidisciplinary collaborations, we also teach for tomorrow in generating training opportunities for the next generation of health-care professionals and practitioners. In support of this endeavour, we promote research knowledge transfer by hosting research talks and an annual international conference.



The PERFORM Centre was made possible through an investment from the Government of Canada and the Quebec Ministry of Economic Development, Innovation and Export Trade through the Knowledge Infrastructure Program.

MESSAGE FROM THE INTERIM SCIENTIFIC DIRECTOR



When I first came to Concordia a year ago, I was immediately struck by the immense interdisciplinary research opportunities the PERFORM Centre's eight inter-related platforms offered. I was also drawn to our members' passion for their research, as well as to their drive to generate impactful research that transcends traditional disciplines and empowers future generations of academics and practitioners.

As we look to the future, we will continue to build on PERFORM's unique positioning to expand our contribution to science and community through interdisciplinary collaborations and integration of our platforms, and cohort development to create links between engineering, science, technology, psychology, exercise science, creative arts therapies and more.

As you will read in this year's annual activity report, we have already started the process of bringing together our pillars of education, community and research to create links between our members, platforms and programs. For example, our teams in both the Cardio-Pulmonary Suite and Functional Assessment Lab worked with community groups to develop and offer programs for their target populations while overseeing a number of projects in support of our members' preventive health research.

"Don't be afraid of hard work.
Nothing worthwhile comes easily.
Don't let others discourage you or tell
you that you can't do it. In my day I was
told women didn't go into chemistry.
I saw no reason why we couldn't."

Gertrude Elion

(Nobel Prize-winning biochemist
who developed medications to treat leukemia,
malaria, meningitis, herpes, and more)

This year, in support of our strategic goal to maximize use of PERFORM's unique multi-disciplinary capabilities to expand its contribution to science and community, we will create a new scientific committee with the mandate of fostering research collaborations that use multiple platforms (Athletic Therapy Clinic, Cardio-Pulmonary Suite, Clinical Analysis Suite, Conditioning Floor, Functional Assessment Lab, Imaging Suite, Nutrition Suite and Sleep Laboratory). We will also create opportunities for dialogue and exchange so that our members can come together to create research cohorts and define scientific investigations for understanding and modelling of humans.

We have built a strong and solid foundation on which to create links between research programs; educational opportunities and community engagement/outreach. This integrated, whole approach will serve as a roadmap to enabling research to predict "healthy life" at the individual level which is the future of preventive health.

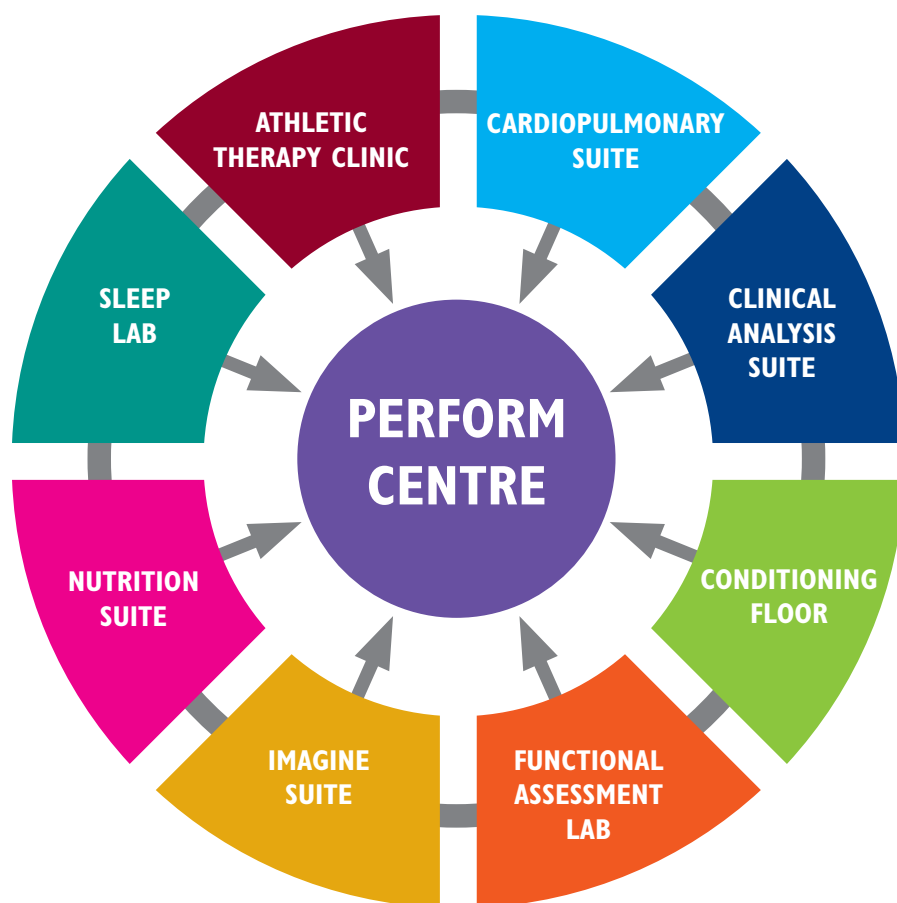
A handwritten signature in black ink, appearing to read 'Habib Benali'.

Habib Benali
Interim Scientific Director
PERFORM Centre



**RESEARCH AT
PERFORM**

RESEARCH AT PERFORM



RESEARCH INFRASTRUCTURE

PERFORM's well-appointed facilities support cutting-edge research that transcends disciplines to advance preventive health research, shape future generations of researchers and practitioners, and empower individuals through community activities and services. Since opening in 2011, the PERFORM Centre team has built a solid foundation on which to advance research in preventive health.

This year, the supervisors of our eight integrated platforms oversaw more than 50 research projects that have set the stage to foster interdisciplinary research collaborations. In a similar vein, our members held a one-day retreat in March that laid the groundwork and set the course for our research priorities in the years to come.



IMAGING SUITE

The Imaging Suite is exclusively dedicated to human research, helping PERFORM members to better understand normal physiology and anatomy, as well as changes associated with disease or injury. The facility is equipped with a 3T MRI machine configured for neurological imaging but also capable of performing studies of any region of the human body, PET- and SPEC-CT scanners for molecular imaging used to understand both normal and pathological function of multiple organs at the sub-cellular level in a non-invasive fashion in vivo, as well as ultrasound units that are currently used to evaluate the musculoskeletal system, the heart and blood vessels. The suite also has a dual-photon X-Ray system to measure tissues density at multiple sites in the body, which allows researchers to run studies on important health problems such as obesity.

In addition to numerous on-going projects, the Imaging Suite team is expanding the range of studies that can be performed in the centre. For instance, through a research collaboration with Montreal's Douglas Mental Health University Institute and King's

College in London, a multi-press sequence software (MEGA PRESS) was recently installed in the MRI lab. With this important acquisition, PERFORM researchers are now able to fine tune spectroscopy sequences to more accurately assess the chemical composition of the brain when studying fundamental metabolic processes in the brain. One of the first applications will be a study on the response of brain energy metabolism in subjects during exercise.

Looking ahead, a new 'lab-on-a-chip' laboratory will be developed to harness the power of microfluidics, which deals with moving and manipulating very small volumes of fluid. The development team on this project aims specifically to create new approaches that will allow the on-site fabrication of radioactively labelled agents for PET imaging, both on demand and at a low cost. This facility will allow PERFORM members to independently prepare radiopharmaceuticals without the need for a large-scale radiochemistry facility, with all of its complex and costly operations.



CLINICAL ANALYSIS SUITE

The Clinical Analysis Suite is fully equipped to facilitate combining a diverse range of techniques in biochemistry, cellular biology, molecular biology, bioanalytical chemistry and chemistry to provide precise biospecimen measurements. One of the clinic's marked successes this year was the development of a method to quantify plasmatic concentration of curcumin using mass spectrometry, further improving the optimization of fluorescent signals for beta-amyloid plaques detection in Alzheimer's disease, and facilitating correlations with brain imaging results. This ground-breaking project was presented at the annual International Mass Spectrometry Conference in August. As well,

the laboratory developed a method to quantify and separate vitamin D3 from ultraviolet radiation and vitamin D2 from diet (i.e. dairy products). The actual project is based on the effect of exercise on cognition and related to the measurement of blood concentrations for lactate and sugar to support brain imaging data. Members of the Clinical Analysis Suite team are also developing new biomarkers for cortisol (stress), melatonin (sleep), insulin (obesity), glutamate (memory and learning) and gamma-Aminobutyric acid (motor control, vision, anxiety) to help measure responses to therapeutic intervention.



ATHLETIC THERAPY CLINIC

The Athletic Therapy Clinic delivers prompt and professional care to staff and faculty, students as well as the general public. The clinic is a fully functional treatment centre with the latest in equipment and modalities, including Swim-Ex for aquatic therapy.

In addition to the over 2,800 regular appointments that were held this year, the athletic therapy internship clinic students and staff were involved in several community projects. Community participants enrolled in Quartier Loyola's Healthier Holistic Living for Seniors program, as well as those enrolled in the two sessions of the People Like Me – Arthritis project had complete musculo-skeletal evaluations and aquatic therapy sessions delivered by internship students. Forty young participants from the Paris Saint-Germain Academy had evaluations, sports specific testing and targeted exercises delivered through the Youth Injury Prevention program.



CARDIO-PULMONARY SUITE

The Cardio-Pulmonary Suite is purposely designed for exercise stress testing, critical for cardiovascular health research. These facilities provide research teams the flexibility to accommodate a broad range of cohorts from individuals who are mobility challenged to high-end athletes.

Cardio-pulmonary testing assesses the integrative response of the pulmonary, cardiovascular and musculoskeletal systems during an exercise intervention. PERFORM offers the gold standard in assessment for indirect calorimetry for measuring resting energy expenditure, which has direct clinical application to nutrition and exercise training. The centre's advanced capability in cardio-pulmonary testing was employed in a number of research projects this year both to assess changes in exercise capacity as well as to determine an exercise prescription.

One study looked at the possible determinants affecting walking speed through exercise training by assessing speed in relation to quality of life. In another research project, the suite's team used functional walking tests to measure exercise and electrocardiography levels to assess the electrical conductivity of the heart before and after exercise training and neuromodulation stimulation on individuals who have experienced traumatic brain injury. In a third case, a cold pressor test was administered to measure the response in heart rate and blood pressure changes to learn more about cardiovascular prognosis and the interaction between the nervous system and immune response in a sample of healthy individuals.

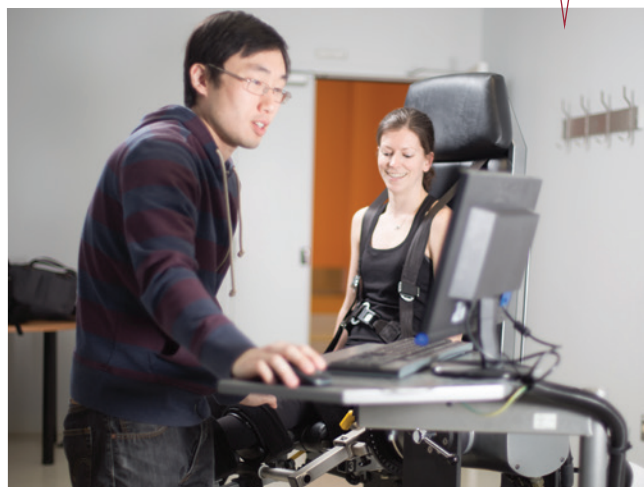
In addition to research, members of the platform also worked with faculty in Department of Exercise Science to offer clinical laboratories to train students in physical fitness assessments and prescriptions, as well as rehabilitation in special populations. They also collaborated with supervisors in the Athletic Therapy Clinic and Conditioning Floor to offer a rehabilitation program and group training classes for people living with arthritis.



CONDITIONING FLOOR

This winter, members of the PERFORM team had the opportunity to collaborate with and provide community programs to three new groups: the Montreal Association for the Blind, Giant Steps and the Walkley Centre. Through all three programs, five clinical exercise physiology interns, supervised by a certified exercise physiology staff member, had the opportunity to create and deliver exercise classes to these groups. This allowed students the opportunity to use the tools they acquired in class and to adapt their skills to work with participants with varying levels of visual impairment (including complete vision loss) and children challenged with Autism spectrum disorder.

To meet the needs of PERFORM's diverse and inclusive population, from varsity athletes to persons with mobility challenges, a multifunction space was adapted to accommodate group classes. Additionally, new equipment such as an Olympic half rack, a T-bar row, a prone leg curl, a cardio stepper, and a back extension machine were purchased to enhance the facility.



FUNCTIONAL ASSESSMENT LABORATORY

The Functional Assessment Laboratory is equipped to conduct tests that measure movement, flexibility, strength and balance. This state-of-the-art suite is used by researchers to advance the fields of biomechanics, ergonomics and cognition sciences to better understand how to keep the body moving.

This year, custom data processing algorithms were created to support research projects. The new algorithms provided objective insight into the neuromuscular patterns used by individuals to achieve tasks involving movement. This knowledge can further lead to the development of preventative measures and rehabilitation strategies that improve balance and locomotion and reduce the risk of injury in affected populations. Among the projects that were supported by the new processes were an investigation into the joint kinematics and muscle activity of amputees when the platform on which they are standing is destabilized and the validation of novel wearable sensors when assessing the gait of Parkinson's disease patients. The lab also supported several industry research projects such as one that examined the effects an on-body ergonomic aid designed to reduce low back activity during repetitive lifting tasks.

In addition to research activity, the Functional Assessment Laboratory team worked closely with the Athletic Therapy Clinic and external community members, particularly those with a history of injury, to launch a program to safely test muscle strength using the isokinetic dynamometer. Participants in the study also had their balance tested in response to environmental stimuli and absent visual feedback using the computerized dynamic posturography technique. The assessments were used to design a therapy program to address any deficits that were identified.



NUTRITION SUITE

At PERFORM, the Nutrition Suite group helps people 'live their best life today' through research, community and education that explores the development of lifestyle habits that are enjoyable, sustainable, and beneficial. This means that dietitians are working on the application of the dietary components of research projects and community programs for different target populations.

This year, the Nutrition Suite team worked with young families at risk for Type 2 diabetes, young athletes, members of Concordia University's varsity teams, John Molson School of Business Executive MBA participants, people living with chronic conditions and those making lifestyle changes, and everyday active living enthusiasts. Additionally, learning opportunities were provided for nutrition and dietetic interns and volunteers through cooking classes, specialized seminars and more.



SLEEP LABORATORY

The Sleep Laboratory has been very busy since its refurbishment in 2015. This past year, over 300 individuals participated in significant studies that will improve how researchers detect chronic insomnia, clarify the role of sleep in the onset of Alzheimer's disease, and enhance overall understanding of the fundamental mechanisms by which exercise combined with sleep can impact brain function for improvement in health and cognitive function. Equipped with state-of-the-art wireless polysomnography, participants can move freely around the area without being encumbered by cables. The new sleep facility with its three bedrooms, examination room and set-up area has proven to be an efficient research space for both participants and research teams.

EXPANDING OUR RESEARCH

ADVANCING NEW APPROACHES IN THE DISCOVERY AND PROMOTION OF PREVENTIVE HEALTH MEASURES

Through a generous donation from the R. Howard Webster Foundation, Concordia University's PERFORM Centre has undertaken two new projects to advance the discovery and promotion of preventive health measures.



R. Howard Webster Foundation Healthy Living Program for Seniors

The PERFORM Centre's community engagement team is collaborating with representatives from nine community groups including the Centre de santé et de services sociaux Cavendish, to offer a healthy living program designed to engage disadvantaged seniors in healthier living and offer information that will empower individuals in their pursuit of healthier lifestyles. Through this novel initiative, new cohorts of 50 seniors will undertake journeys towards healthier lifestyles each year, for five years. Each participant will have a personalized nutrition and fitness program developed for their specific needs that includes group training sessions and group cooking classes.



R. Howard Webster Foundation Scientist in Nutrition Lifestyle Research and Bio-Imaging

PERFORM Centre is presently recruiting a leading scientist with expertise in nutrition, lifestyle research and bio-imaging to investigate the effects of daily routines on long-term health through innovative uses of imaging techniques. In alignment with the PERFORM Centre's mandate to provide an integrated and comprehensive environment to promote healthier lives through changes in behaviour and lifestyle by offering research opportunities; educational and hands-on learning opportunities; and services to the community, the scientist will be mandated to develop, plan and execute a research program that incorporates four key components: (1) use and development of advanced medical imaging techniques that are accessible and cost effective on clinical grade instruments - in support of primary health prevention and behaviour change; (2) training plan for future multimodal imaging experts (specialists who combine two or more imaging techniques to reveal new information and detail); (3) modalities to translate key findings into nutrition research science and bio-imaging into practical applications; and (4) a comprehensive dissemination strategy for equipping stakeholders with key findings.

PERFORM WELCOMES NEW MEMBERS TO ADVANCE INTERDISCIPLINARY RESEARCH THROUGH MULTIPLE PLATFORMS

This was the year our research members came together to discuss and implement ways to make full use of our multiple platforms to advance preventive health research in a manner that would effectively combine their unique sets of experience, knowledge and expertise. The combination proved fruitful with some 53 active research projects taking place at the PERFORM Centre.

Additionally, seven new members and a scientist were welcomed to our growing research team this year. From music therapy to learning development to the relationship between diet and cognition, each researcher brings a unique skill set to PERFORM's interdisciplinary spectrum of preventive health expertise.



Dr. Angela Alberga,
Department of Exercise Science
Examining how different factors influence our engagement in healthy behaviours

Angela Alberga's interdisciplinary research program at Concordia focuses on understanding how institutional, community and societal factors affect weight-related issues including obesity, eating disorders and physical inactivity. Alberga is particularly interested in policy

and public health efforts aimed at reducing weight stigma and discrimination. A recent newcomer to the university, she brings to PERFORM a wealth of experience working with children, youth and adults as an educator, mentor, personal trainer and clinical exercise physiologist in academic and community settings across Canada.



Dr. Sandi Curtis,
Department of Creative Arts Therapies

Understanding violence against women, its impact on health, and the role of music/music therapy in addressing issues at both the individual level and societal level

In her work, Sandi Curtis studies the impact of violence on women's health and explores how music can address issues at both the individual and societal levels.

Increasingly, she examines the role

of popular culture in perpetuating violence against women as well as in challenging sociopolitical underpinnings of the cycle of violence. She also looks at how survivors can be supported through music therapy. Her latest research project addresses sexual violence at universities. With her collaborators, she is developing evidence-based policies, practices and curricula to dismantle rape culture on campuses. This year in collaboration with others in Concordia's Department of Creative Arts Therapies, she contributed to the development of a new community program in music therapy at PERFORM.



Dr. Benjamin Eppinger,
Department of Psychology
Neuro-computational mechanisms underlying the development of learning and decision-making across the human lifespan

Benjamin Eppinger studies how complex learning and decision-making abilities change across the human lifespan, questioning specifically the role of technological devices used in daily life such as computers and smart phones. In his research at

PERFORM, he uses neuroimaging methods such as functional magnetic resonance imaging (fMRI) to study how individuals of different ages use latent – or not directly observable – information from the environment to make decisions. His collaborations with the centre's interdisciplinary research group allow him to establish ties to other fields such as physics, engineering or health sciences and to search for potential applications of insights from his research.



Dr. Tristan Glatard,
Department of Computer
Science and Software
Engineering
Building platforms for the efficient
and automated processing of
big data

In his research on big data infrastructures with a focus on neuroscience, Tristan Glatard designs new concepts and algorithms to automate data processing procedures. His research has led him to address

several important issues such ensuring that big data analyses are reproducible, and how the performance of key scientific applications can be improved. At PERFORM, the technologies he is developing will play an integral role in the merging and analysis of all information gathered by members from the various scientific platforms and facilities.



Dr. Marta Kersten-Oertel,
Department of Computer
Science and Software
Engineering
Developing novel visualization
methods, display devices and
interaction paradigms for
improving clinical workflows
and patient outcomes

Motivated by the potential of dramatically improving patient care, Marta Kersten-Oertel is interested in minimizing disruptions in image-guided neurosurgery through the

use of augmented reality and audio feedback techniques. She describes this work as something akin to how a driver navigates unfamiliar terrain using a GPS. At PERFORM, she will oversee a research investigation that will assess how wearable devices – earphones equipped with sensors similar to those of fitness trackers – can monitor and measure brain activity and temperature with the ultimate goal of encouraging improved, personalized lifestyle choices.



Dr. David Secko,
Department of Journalism
New models in health and science
journalism

A former journalist, David Secko works to develop new tools to communicate scientific knowledge. His current interdisciplinary research program is designed to clarify issues surrounding biotechnology and ethics to reporters, policy makers and the general public. His other interests include the designing

and moderating of research engagement events and the analysis of online commentary after science stories. At PERFORM, his expertise will be invaluable in the generation of research communications pieces geared to disseminate the centre's preventive health study results to a variety of audiences.



Dr. Laurel Young,
Department of Creative Arts
Therapies
Understanding how music can help
individuals and communities reach
their full potential for living well

Laurel Young's research is situated within a methodology where music therapy does not restrict itself to addressing symptoms or 'fixing' problems, but in implementing best practices into people's everyday lives in order to promote well-being. She

investigates various ways in which singing can promote health and resilience for various groups of people and communities including autistic adults, end-of-life care patients and bereaved persons. Her current work is focused on developing informed, sustainable and collaborative approaches to using music for persons living with dementia throughout all stages of their disease. She is also a certified practitioner in the Bonny Method of Guided Imagery and Music, a method of music therapy that people engage in for the purpose of self-development and to address various personal issues that may be impinging upon their lives. She hopes to collaborate with other PERFORM researchers to examine some of the neural mechanisms underlying this method.



Dr. Matthew Parrott, PERFORM Scientist

Understanding how nutrition influences the trajectory of age-related cognitive decline, and how individual differences in biology or lifestyle alter the diet-cognition relationship

Matthew Parrott, who comes to Concordia for a two-year term as a PERFORM scientist, is an expert on age-related cognitive decline as it relates to nutrition and other lifestyle factors.

He is currently working with members of the PERFORM research team to examine how healthy eating patterns might maximize the neurocognitive benefits of dance movement therapy in older adults. Most of his recent research involves analyzing the influence of dietary patterns on age-related cognitive decline in longitudinal cohorts that track the same people over time. Parrott will be able to make full use of the Centre's eight inter-related platforms to complement these types of investigations through direct measurement of biological mechanisms that underlie associations seen in large surveys. For example, the Imaging Suite will be used to better understand how an individual's baseline diet is associated with brain metabolism, brain structure, and patterns of brain activity. He will also employ the Conditioning

Floor to measure body composition, the Cardio Pulmonary Suite to test resting metabolic rate, and the Clinical Analysis Suite for blood-based biomarkers.



Dajana Vuckovic, New Chair in Clinical Metabolomics, Biomarkers and Preventative Health

Dajana Vuckovic, PERFORM research member and assistant professor in the Department of Chemistry and Biochemistry, was named the Concordia University Research Chair in Clinical Metabolomics, Biomarkers and Preventive Health in August.

In her research program, Vuckovic and her team of seven graduate students explore how mass spectrometry – a technique that determines the mass-to-charge ratio of molecules within a sample – can help improve the systematic measurement of metabolites in biological samples such as blood, urine or saliva. The power of this advanced technology lies in the capability to measure hundreds or thousands of metabolites simultaneously from a single drop of blood.

The resulting metabolite information can be used for many different applications: to help diagnose disease, to predict which medication or lifestyle change will work the best for a given individual, to discover new biomarkers or to monitor the health status of an individual. As such, her expertise is an asset at PERFORM in the development of metabolism-related and bioanalytical workflows. Her current

projects include monitoring metabolic changes associated with bipolar disorder; investigating the effects of diet, stress and/or cognitive activity on metabolic profiles in collaboration with other PERFORM members and characterization of metabolites of new potential drugs in collaboration with Dr. William Powell at McGill University.

Research Chairs

- Dr. Jean-Philippe Gouin, Tier II Canada Research Chair in Chronic Stress and Health
- Dr. Sylvia Santosa, Tier II Canada Research Chair in Clinical Nutrition
- Dr. Thien Thanh Dang-Vu, Concordia University Research Chair in Sleep, Neuroimaging and Cognitive Health
- Dr. Patrik Marier, Tier I Concordia University Research Chair in Aging and Public Policy
- Dr. Dajana Vuckovic, Concordia University Research Chair in Clinical Metabolomics, Biomarkers and Preventative Health
- Dr. Carsten Wrosch, Tier I Concordia University Research Chair in Aging and Health
- Dr. Ann English, Tier I Honorary Concordia University Research Chair in Bioinorganic Chemistry
- Dr. Peter Shizgal, Tier I Honorary Concordia University Research Chair in Psychology
- Dr. Louis Bherer, PERFORM Chair in Preventive Health Science Research
- Dr. Jennifer McGrath, PERFORM Chair in Childhood Preventive Health and Data Science



EDUCATION AND TRAINING

In addition to developing and offering educational programming through an extensive series of research lectures and an annual conference, PERFORM also offers a number of awards and internship opportunities designed to empower our future researchers and practitioners.

TRAINING FUTURE GENERATIONS OF RESEARCHERS

This year our Special Events and Communications Committee merged with our Applied Bio-Imaging Committee to organize and host 23 research and didactic talks on a broad range of topics related to preventative health research:

LECTURES:

Automation of Big Data Analyses

Tristan Glatard, PhD, Assistant Professor, Department of Computer Science and Software Engineering, Concordia University

Prescribing Exercise to Enhance Mitochondrial Adaptations

Brian Irving, PhD, Louisiana State University and Pennington Biomedical Research Center

Imaging-based Pain Neurosignatures

Mathieu Roy, PhD, Assistant Professor, Department of Psychology, McGill University

Distinguishing Hippocampal Contributions to Memory and Mental Construction

Signy Sheldon, PhD, Assistant Professor, Department of Psychology, McGill University

Atlas-Guided Transcranial Ultrasound Examination with a Neuro-Navigation System

Xiao Yiming, PhD, Postdoctoral Fellow, PERFORM Centre, Concordia University

Magnetic Resonance Spectroscopy: Gaining Momentum as a Tool for Biomedical Research

Ian R. Lanza, PhD, Mayo Clinic

Optical Monitoring of Cerebral Blood Flow and Oxygen Metabolism in Neonates

Mathieu Dehaes, PhD, Assistant Professor, Department of Radiology and Institut de génie biomédical, Université de Montréal

Quantitative Ultrasound Imaging Technologies for Diagnosis of Cellular and Whole Organ Pathologies

Guy Cloutier, PhD, LBUM-CRCHUM

Neuroimaging-Based Subtyping in Epilepsy and Autism

Boris Bernhardt, Assistant Professor, Montreal Neurological Institute

Cooperative and Competitive Spreading Dynamics on the Human Connectome

Habib Benali, PhD, Professor, Department of Electrical and Computer Engineering, Interim Scientific Director, PERFORM Centre, Concordia University

White-Matter Connectional Anatomy of the Human Brain: Structure, Function, and Clinical Impact

Christopher Steele, PhD, Postdoctoral Fellow, Douglas Mental Health Hospital

Brain MRI Findings in Individuals Born with a Congenital Heart Disease: from the Fetus to the Young Adult

Marie Brossard-Racine, PhD, Assistant Professor, OT Program, McGill University

Cooperative and Competitive Spreading Dynamics on the Human Connectome

Bratislav Mistic, PhD, Assistant Professor of Neurology & Neurosurgery, McGill University

Contributions of Functional MRI and Event-Related Potentials to Mild Traumatic Brain Injury/Concussion Evaluation

Alain Ptito, PhD, McGill University

Alcohol, Nicotine, Amphetamine and Cocaine: A Potential Dopamine-Related Vulnerability Pathway to Addictions in Humans

Marco Leyton, PhD, McGill University



Imaging of Liver Fibrosis

An Tang, PhD, Université de Montréal

Neural Correlates of Anesthesia-Induced Unconsciousness

Stefanie Blain-Moraes, PhD, McGill University

Impact of Hyperventilation and Apnea on Myocardial Oxygenation and its Potential for Diagnosing Coronary Artery Disease

Matthias Friedrich, PhD, McGill University

Magnetization Transfer MRI, and Applications to Musculoskeletal Imaging

Ives Levesque, PhD, McGill University

Nutrition and Dementia Risk: Is there a recipe for success?

Matthew Parrott, PhD, PERFORM Centre, Concordia University

Locomotor-based Functional Markers to Improve Return to Function Decisions Post Concussion

Bradford J. McFadyen, CIRRI, CIUSSS-CN et Département de réadaptation, Faculté de médecine, Université Laval

Augmented Reality Visualization in Image-Guided Neurovascular Surgery

Marta Kersten-Oertel, PhD, Concordia University

Neuron-glia Metabolic Coupling: Relevance for Functional Imaging and Neuroprotection

Pierre Magistretti, PhD, Division of Biological and Environmental Sciences and Engineering, King Abdullah University of Science and Technology (KAUST) Thuwal, KSA and Brain Mind Institute, EPFL, Center for Psychiatric Neuroscience, Department of Psychiatry - CHUV/UNIL Lausanne, Switzerland



BIOIMAGING FOR PREVENTION AND HEALTH RESEARCH: AN IMAGE IS WORTH A THOUSAND WORDS

In light of recent important technological advancements in the bioimaging field, and the growing need to train future generations in this ever-expanding discipline, PERFORM invited six world-renowned speakers to this year's annual conference, titled Bioimaging for Prevention and Health Research.

Multimodal network modeling in neurodegeneration

Alan Evans, PhD McGill University

Multimodal quantitative neuroimaging databases and methods: the Cuban human brain mapping project

Pedro A. Valdes-Sosa, PhD, Cuban Neuroscience Centre

Body composition imaging method in obesity research

Wei Shen, PhD, Columbia University

Brown adipose tissue, a potential therapeutical target - what we have learned from imaging

Kirsi Virtanen, PhD, University of Turku

What do elite athletes, astronauts and LBP sufferers have in common

Julie Hides, PhD, Australian Catholic University

Quantitative imaging and image-based biomarkers in medicine

Timothy J. Hall, PhD, University of Wisconsin





METHODOLOGICAL WORKSHOP PROGRAM:

In breaking with tradition, the Applied Bioimaging Committee added a full day of sessions dedicated to the subject of longitudinal analysis to the annual conference. These sessions were added to present new tools to deal with data normalization, data mining, statistical modeling and inference testing in large-scale, multimodal and longitudinal neuroimaging studies to selected conference participants. Some 140 students and practitioners attended the methodological workshops.

Measuring progressive brain changes using structural MRI in health and illness

Mallar Chakravarty, PhD, Assistant Professor, Department of Psychiatry, McGill University

Statistical methods for brain imaging longitudinal studies: theory and practice

Felix Carbonell, PhD, Research Scientist, Biospective Inc.

Imaging amyloid proteins in aging and dementia

Sylvia Villeneuve, PhD, Assistant Professor, Department of Psychiatry, Faculty of Medicine, McGill University

Matrix-tensor network methods for brain connectivity

Pedro Valdes-Sosa, PhD, Cuban Neuroscience Centre

Mining the heterogeneity of brain connectivity networks in large population samples using fMRI

Pierre Bellec, PhD, Department of Computer Science and Operations Research, Université de Montréal



SUPPORTING THE NEXT GENERATION OF RESEARCHERS

PERFORM welcomed five exceptional individuals in 2016, all of whom played important roles in advancing the centre's research programs.

TRANSLATING MEDICAL IMAGES



Yiming Xiao
PERFORM Postdoctoral Fellowship

We have seen many advances in recent years in biomedical imaging. Advancing research in this field for further processing and interpretation are crucial if we are to make full use of imaging techniques and technologies.

Yiming Xiao, PERFORM's postdoctoral fellow, is working to advance research in this field. In his research, he employs image processing and machine learning

techniques to process and analyze medical images for computer-assisted diagnosis and image-guided medical procedures.

In the past year, Xiao has been diligent in his efforts to advance research that will impact both neurological and musculoskeletal conditions. For neurological disorders, his research involves improving point-of-care technology, devising computer algorithms for diagnosis and creating open-source medical imaging databases. As a highly valuable and cost-effective point-of-care imaging modality, he studies how transcranial ultrasound can noninvasively image the brain through the human skull and is often employed to diagnose and monitor neurovascular diseases, such as stroke. However, as he has discovered, difficulty in locating the target blood vessels from the 2D ultrasound scans can affect the efficiency and quality of diagnosis. To address this, Xiao has built a prototype of an interactive user interface that employs a population-averaged brain atlas to guide the examination in real time. In stroke treatment, prior assessment of the patient's neurovascular

circulation is important. To increase the accuracy and reliability of the assessment, he developed a method to automatically score the neurovascular circulation from the patient's CT angiographies, with an accuracy of 80%.

Xiao also strives to encourage research collaboration in the spirit of open science. He has led the creation of two publicly available data repositories: PD25 and RESECT. While PD25 offers brain atlases averaged from the MRI results of 25 Parkinson's disease patients, RESECT is composed of well annotated MRIs and ultrasound scans obtained during brain tumor surgeries. These data repositories provide the necessary materials for developing new medical image processing techniques, and simulating surgical models for medical training.

Xiao is also working to advance research that will impact diagnosis and treatment of musculoskeletal conditions. In this respect, he is collaborating with Maryse Fortin, PERFORM postdoctoral associate, to develop image processing methods to more efficiently and objectively quantify muscle atrophy among back pain patients for better rehabilitation programs.

THE FACTS ON FAT AFTER WEIGHT LOSS IN OBESE ADULTS: DOES WHEN THEY BECAME OBESE MATTER?



Jessica Murphy
PERFORM Doctoral Award

Despite strong efforts to optimize obesity treatment, not everyone succeeds at weight loss or responds in the same way. PERFORM research member Sylvia Santosa (Department of Exercise Science) suspects that the timing of obesity onset may offer some explanation for this heterogeneity. Her graduate student, Jessica Murphy, has set out to test this hypothesis

in the Clinical Analysis Suite. She has been comparing the fat characteristics of individuals who were obese since childhood to those who became obese only as adults. She has assessed how these two groups carry their body fat, and has analyzed fat samples from their abdominal and thigh regions to gain a cellular perspective on whether the fat is “sick” or dysfunctional. Moreover, she has examined muscle samples from the participants to determine just how equipped they are for burning fat. Her study participants are currently undergoing a diet and exercise program until they lose approximately 10 % of their body weight. Murphy will then investigate the changes in fat characteristics that occur after weight loss, and whether they differ between groups.

This study will provide an expanded understanding of the cellular and metabolic consequences of childhood- versus adult-onset obesity, and the extent to which they can be reversed with weight loss. The results will help identify specific defects that may be targeted in order to improve weight loss response and decrease disease risk in specific obesity phenotypes.

BRAIN OSCILLATIONS DURING SLEEP AS POTENTIAL MECHANISMS OF MEMORY CONSOLIDATION AND NEURODEGENERATION



Oren Weiner
PERFORM Doctoral Merit Award

Sleep is an important factor contributing to the formation of new memories. Recent evidence suggests that disturbed sleep might be an early symptom of Alzheimer’s disease that occurs before overt behavioural symptoms are detected. However, specific mechanisms underlying how sleep contributes to memory formation, and how disturbed sleep contributes to age-related

memory impairments, remain unclear. As such, the research program of Oren Weiner, a PhD student in clinical psychology supervised by PERFORM research member Thien Thanh Dang-Vu (Department of Exercise Science), examines the relationship between brain oscillation activity during sleep and cognitive health in older adults. More specifically, Weiner’s studies examine the interactions (or, “cross-frequency coupling”) between slower and faster brain oscillations, measured using EEG in the PERFORM Centre Sleep Lab, and investigates cross-frequency coupling (CFC) in relation to performance on cognitive – or memory – tasks presented before and after overnight sleep. Of primary interest is whether group-level increases or decreases in CFC during sleep and cognitive testing performance can be used to predict the extent of PET-measured beta-amyloid deposition in the brains of healthy and cognitively impaired seniors. In turn, Weiner addresses the question of whether measures of CFC obtained during sleep can be applied as a sensitive, non-invasive biomarker of age-related neurodegeneration.



NEURAL CORRELATES OF SLEEP DEPRIVATION USING SIMULTANEOUS EEG/FMRI



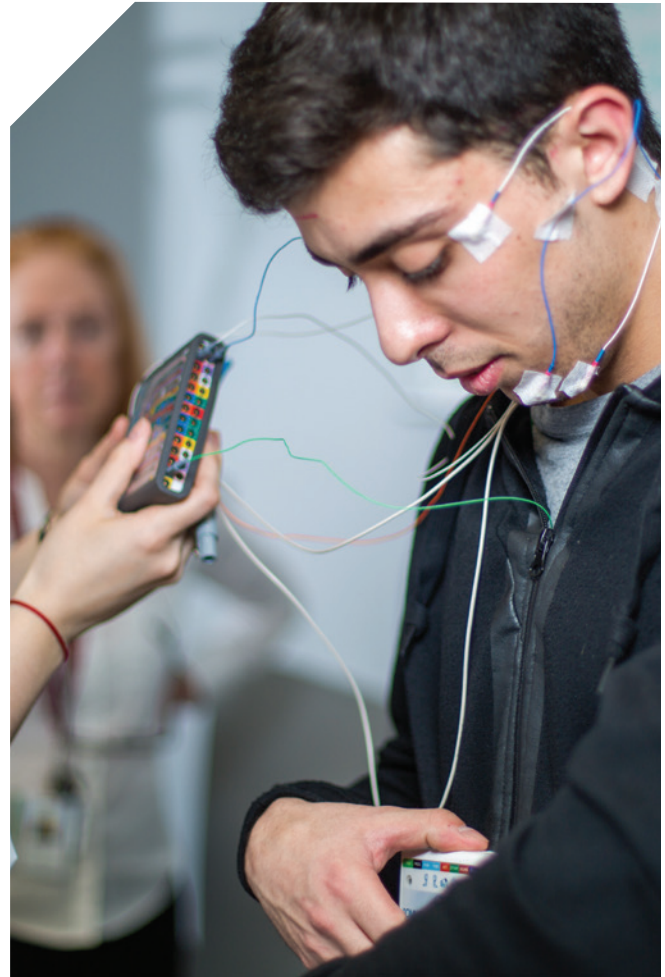
Aude Jegou

PERFORM Masters Award

Supervised by research members Christophe Grova (Department of Physics) and Thien Thanh Dang-Vu (Department of Exercise Science), Aude Jegou is studying the effect of sleep deprivation on brain function during sleep recovery by analyzing brain responses associated with sleep and resting-state oscillations. Studying sleep recovery will shed new light on the links

between sleep deprivation and cognitive performance. Moreover, studying resting state will allow Jegou to assess the overall architecture of brain activity, and compare functional connectivity after normal night and sleep deprivation night. To conduct this study, she acquired simultaneous EEG/fMRI data on healthy participants, after a good night's sleep and after a night of sleep deprivation. During the imaging session, participants were asked to perform some cognitive tasks, to do resting-state, and to take a nap. Methods developed in Grova's lab will be used to analyse functional connectivity whereas nap data will be analyzed by a procedure used during Jegou's internship in PERFORM.

This project is likely to shed light on some important mechanisms that will allow the team to demonstrate the importance of having good sleep hygiene in order to prevent the development of sleep disorders.



ED WHITLOCK PERFORM GRADUATE STUDENT SCHOLARSHIP AWARD

Vi Dam completed her BSc in nursing at the Université de Montréal and is a registered nurse in Quebec and Ontario. She graduated from Concordia with a MSc in 2015, and is currently enrolled in the individualized PhD program under the supervision of Sylvia Santosa. Her past nursing experience includes working in the cardiology unit at Ottawa's Hôpital Montfort. More recently, she worked as a research nurse for studies conducted at the McGill University Nutrition and Performance Laboratory. In her work, Dam has had the opportunity to train under experts in the areas of age and obesity-related dysfunction, chronic diseases and diabetes research at the Mayo Clinic in Minnesota. At PERFORM, she is now investigating how obesity-related immune function in fat tissue affects metabolism and future disease risk such as insulin resistance and cardiovascular disease.



Vi Dam and Ed Whitlock



REMEMBERING ED WHITLOCK (1931-2017)

The Concordia community was deeply saddened to learn of the passing of running legend Ed Whitlock. Whitlock passed away on March 13 after a battle with prostate cancer. He was 86 years old.

In 2013, the multiple world-record breaking octogenarian came to Concordia to discuss exercise and aging well with Louis Bherer, the inaugural scientific director of the PERFORM Centre, during Concordia's Thinking Out Loud conversation series.

Whitlock refused the honorarium offered to him for his participation, insisting the money be put toward a fellowship for students studying health and aging.

The Ed Whitlock Award, an annual \$5,000 scholarship, is given to a student enrolled in Concordia's MSc or PhD program whose research is related to improving the quality of life of seniors through physical activity. Whitlock made a yearly donation to the award.



EDUCATION AND TRAINING IN NUMBERS

110 internships and apprenticeships in a variety of disciplines including exercise physiology, athletic therapy, nutrition, music therapy, occupational therapy, dietetic, kinesiology and leisure studies



COMMUNITY EDUCATION PROGRAMS AND OUTREACH

The PERFORM Centre engages the community by offering health programs and services to the general population. Participants in our programs can also play an important role in advancing preventive health research through their participation in ground-breaking research.

In addition to our regular program offerings, this year the community engagement team developed specialized programs designed specifically to build groups of cohorts to advance research.

HIGHLIGHTS OF OUR 2016-2017 PROGRAMS:

People Like Me – Arthritis

The PERFORM Centre partnered with the Arthritis Society to develop and offer a tailor-made 12-week comprehensive wellness programs to individuals with osteoarthritis and rheumatoid arthritis. The programs, designed specifically to address the varied needs of the participants, brought together a team of experts in exercise training, nutrition, relaxation, music therapy, occupational therapy and psychosocial support to offer targeted overall wellness programs for improved quality of life.

This year, PERFORM's community engagement team reached out to Giant Steps – school that offers programs for families with autistic children in Montreal – and the Montreal Association for the Blind to offer programs that foster opportunities to socialize while being active. Both programs proved extremely successful, and offerings will be developed further for specialized future groups.

Quartier Loyola

The Quartier Loyola program was developed to engage seniors living in the Montreal borough of Notre-Dame-de-Grâce to work towards a healthier holistic lifestyle. Developed in collaboration with Concordia's Department of Recreation and Athletics, the Multi-Faith and Spiritual Centre and university libraries, Quartier Loyola welcomed 48 participants ranging in age from 55 to 87 years. In addition to providing participants with tools to adopt healthier lifestyles with respect to nutrition and exercise, the program also afforded opportunities for participants to socialize with Concordia's varsity athletes for a cooking challenge.

Group Classes:

The Conditioning Floor team also offered a variety of classes this year, among them: Yoga, Spinning, Zumba, Judo, Cardio-Karate, Muay Thai, Pilates, and Dance for Mobility.

Community Education and Outreach in Numbers

2817

VISITS TO THE ATHLETIC
THERAPY CLINIC

5398

INDIVIDUALS ON THE
CONDITIONING FLOOR

3219

INDIVIDUAL FITNESS OR
NUTRITION APPOINTMENTS,
GROUP TRAINING PROGRAMS
AND CARDIOPULMONARY TESTS

50

RESEARCH MEMBERS

10

PERFORM RESEARCH MEMBERS
HOLD RESEARCH CHAIRS

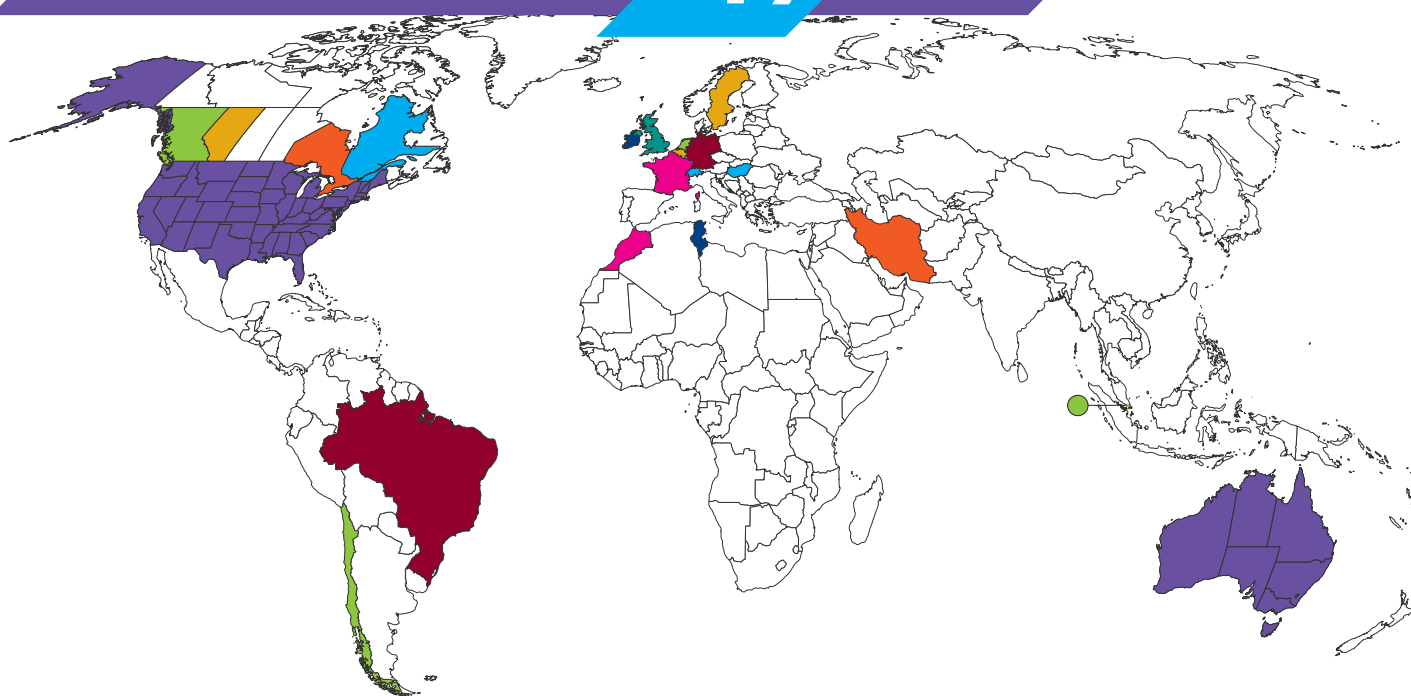
354

PUBLICATIONS

INTERNATIONAL COLLABORATIONS WITH

19

COUNTRIES



NATIONAL

1. Alberta, Canada
2. British Columbia, Canada
3. Kingston, Canada
4. London, Ontario, Canada
5. Montreal, Canada
6. Ottawa, Canada
7. Quebec City, Canada
8. Sherbrooke, Canada
9. Toronto, Canada

INTERNATIONAL:

1. Berlin, Germany
2. Boston, USA
3. Santiago, Chile
4. Fez, Morocco
5. Florida, USA
6. Geneva, Switzerland
7. Humburg, Germany
8. Illinois, USA
9. Dublin, Ireland
10. Groningen, Netherlands
11. Irvine, California, USA
12. Leipzig, Germany
13. Liege, Belgium
14. London, UK
15. Manhattan, USA
16. Mashad, Iran
17. Melbourne, Australia
18. Oxford, UK
19. Paris, France
20. Pittsburgh, USA
21. Porto Alegre, Brazil
22. Rotterdam, Netherlands
23. Santo André, Brazil
24. Semmelweis, Budapest
25. Sfax, Tunisia
26. Singapore
27. Stanford, USA
28. Stockholm, Sweden
29. Texas, USA
30. Warwick, England
31. Washington DC, USA
32. York, England

PERFORM RESEARCH MEMBERS

Habib Benali – Interim Scientific Director

Modelling of normal and pathological dynamics of the brain's anatomo-functional circuits observed by neuroimaging tools to better understand brain activity in healthy aging and disease

Louis Bherer – Associate Scientific Director

Effect of cognitive stimulation and physical activity on cognitive decline associated with aging and chronic disease

Jean-Paul Soucy - Associate Director, Bioimaging

Understanding the pathophysiology of neurodegenerative conditions using nuclear medicine techniques and developing new approaches for diagnosis and for follow-up tests to assess response to therapy

Angela Alberga

Examining how institutional, community and societal factors influence our engagement in healthy behaviours

Tracie Barnett

Understanding the natural history of obesity in youth, focusing on the physical and social environments that influence overweight/obesity and their behavioural precursors

Linda Booij

The impact of early trauma on human brain development and underlying molecular mechanisms

Richard Courtemanche

Brain synchrony and behavior

Sandra Curtis

Understanding violence against women, its impact on health, and the role of music/music therapy in addressing issues at both the individual level and societal level

Thien Thanh Dang Vu

Understanding the causes of sleep disorders to better inform treatment

Peter Darlington

Our immunology laboratory studies environmental factors that contribute to the risk of developing autoimmunity

Kaberi Dasgupta

Developing and testing strategies and programs to reduce vascular disease and its risk factors by addressing physical activity, eating habits, and social determinants of health

Richard DeMont

Understanding the neuromuscular system as it relates to prevention and rehabilitation of orthopaedic injury

Geoff Dover

Correlating psychological factors to tissue pathology in chronic pain patients and athletes

Ann English

Redox processes, metals and oxidative stress

Benjamin Eppinger

Neuro-computational mechanisms underlying the development of learning and decision-making across the human lifespan

Tiago H. Falk

Developing signal processing methods that enable innovative automated medical diagnostic and human performance monitoring tools

Caroline Fitzpatrick

Identifying modifiable risk factors, such as cognitive control, that can be targeted in early childhood to positively shape later well-being and health-related behavior

Claudine Gauthier

Looking at the impact of lifestyle on the brain in healthy aging

Tristan Glatard

Building platforms for the efficient and automated processing of big data

Jean-Philippe Gouin

How depression, worry, rumination, and sleep disturbances can amplify stress-induced immune dysregulation

Christophe Grova

Investigating normal and pathological brain functions combining several modalities (electrophysiology and imaging)

Lisa Kakinami

Understanding how our behaviours, lifestyles, and life circumstances relate to obesity and heart disease

Marta Kersten-Oertel

Developing novel visualization methods, display devices and interaction paradigms for improving clinical workflows and patient outcomes

**Najmeh Khalili-Mahani**

Cyberwellness: rethinking health research in the age of new media and biosensor technologies

Robert Kilgour

Assessing and evaluating rehabilitation and supportive care programs for advanced cancer patients with cachexia

Jordan LeBel

Factors influence consumer food choices at home and away

Gabriel Leonard

Complex bimanual coordination as a marker for cognitive and motor rehabilitation in neurological patients

Karen Li

Understanding the cognitive and motor processes involved in multiple-task performance in adulthood and healthy aging

Patrik Marier

Policy implications of changing demographic structures in comparative contexts

Paul Martineau

Research program oriented on sport medicine and musculoskeletal trauma focused towards the development of novel treatment and diagnostic strategies

Jennifer McGrath

Untangling how greater stress and poorer sleep may get under the skin to adversely impact children's health

Anil Nigam

Understanding how diet and exercise impact on cardiovascular and brain function in high-risk patients

Matthew Parrott

Understanding how nutrition influences the trajectory of age-related cognitive decline, and how individual differences in biology or lifestyle alter the diet-cognition relationship

David J. Pearsall

Understanding the biomechanics of human locomotion and injury prevention

Virginia Penhune

Understanding the plastic changes that occur in the human brain during motor learning and performance

Veronique Pépin

Optimizing exercise testing and training approaches in individuals with chronic cardiopulmonary diseases

Alain Ptito

Neuroimaging and cognitive markers for the diagnosis, prognosis and rehabilitation of mTBI/concussion

Natalie Phillips

How cognitive abilities (language, attention) change and interact as we age

Tiberiu Popa

Research includes geometric modeling, animation, 2D to 3D reconstruction, etc. One important focus spatio-temporal geometry acquisition (or 4D geometry acquisition) with vast applications in many disciplines ranging from games, engineering, e-commerce to medical

Hassan Rivaz

Developing novel image processing algorithms to improve detection and diagnosis capabilities of medical imaging

Shawn Robbins

Utilizing biomechanical and clinical measures to assess orthopaedic health conditions in both clinical and laboratory settings

Mathieu Roy

Understanding how psychological factors can effect pain

Sylvia Santosa

Studying the skinny on fat in disease development and progression

David Secko

New models in health and science journalism

Peter Shizgal

Neural basis of decision-making, reward, and motivation

Nancy St-Onge

Posture, balance, and movement control in healthy and impaired populations

Jason Steffener

Understanding the healthy aging process and identifying lifetime exposures and behaviors that provide protection from the onset of cognitive decline by bringing together multiple types of brain imaging techniques, cognitive performance and behavioral measures

Truong Vo Van

Study of thin films and nanostructures and their applications, and the prototyping of optical metrology instruments

Dajana Vuckovic

Developing mass spectrometry methods for targeted and untargeted metabolomics and biomarker quantitation in biofluids and tissues

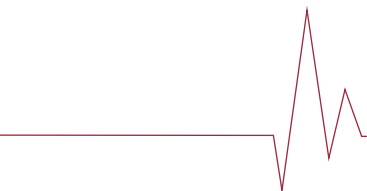
Carsten Wrosch

Psycho-social pathways to well-being and health

Laurel Young

Understanding how music can help individuals and communities reach their full potential for living well





YEAR AT A GLANCE

MAY 1, 2016 – APRIL 31, 2017

RESEARCHERS

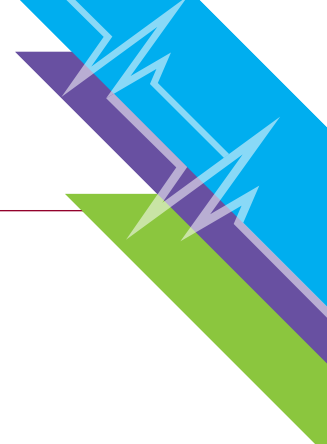
354 PUBLICATIONS in academic journals

205 PRESENTATIONS at a various conferences and events

EDUCATION

110 INTERNSHIPS AND APPRENTICESHIPS in a variety of disciplines including exercise physiology, athletic therapy, nutrition, music therapy, occupational therapy, dietetic, kinesiology and leisure studies

**SERVING THE
COMMUNITY THROUGH
EXPERIENTIAL LEARNING**



294 **STUDENTS SUPERVISED** (91 undergraduate; 77 Master's; 72 PhD, and 54 post-doctoral and other)

115 **INTERVIEWS** (broadcast and print) and articles on studies led by our researchers

**SHARING OUR
KNOWLEDGE**

23 **RESEARCH AND DIDACTIC TALKS**

1 **ANNUAL CONFERENCE:** Bio Imaging for Prevention and Health Research: An image is worth a thousand words

2817 **VISITS** to the Athletic Therapy Clinic

5398 **INDIVIDUALS** on the Conditioning Floor

3219 Individual fitness or nutrition appointments, group training programs and cardiopulmonary tests



Centre **PERFORM** Centre

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