

Precision Convergence Webinar Series

Modelling Trajectories of Brain Health & Aging

By Randy McIntosh

Simon Fraser University, Canada

With High-Level Panel of Leaders in Science, Technology, On-the-Ground Action, and Policy

Wednesday, April 26, 2023 | 11 AM to 1 PM EST (2 hours in duration)

For Remote Participation, please register [HERE](#)

ABSTRACT: The brain is a complex adaptive system which is constantly changing across our lives. Brain networks form and dissolve over time, which may impart differing degrees of cognitive resilience. We can measure these changes empirically but need computational modelling to construct generative models that help us understand the implications of different network architectures. My presentation will set the stage for such work from the perspective of Structured Flows on Manifolds and the potential for hidden repertoires that come because of network adaptations across the lifespan. I will show empirical work that measures such repertoires and suggest links to The Virtual Brain modelling platform to create population models. These models can then map trajectories of healthy aging and identify trajectories that indicate an elevated risk for dysfunction.



PRESENTER: Randy McIntosh's research program is geared to the development of a unified theory of brain operation that emphasizes the integrative capacity of the brain. One tenet of the theory is that cognitive operations emerge from the interactions between brain areas rather than being the sole responsibility of single regions. The program has two related arms: one to do with technical developments to explore brain integration, and the other with the collection of experimental evidence for this integration. This second arm uses modern brain imaging methods to explore the neural networks in human learning. One surprising outcome of this work has been the profound involvement of sensory processing regions of the brain in rather complex cognitive operations. This suggests that human cognition involves the active interaction among brain regions that processes specific sensory information (e.g., visual, auditory) and the mediating areas, such as prefrontal cortex and medial temporal lobes. In collaboration with Dr Cheryl Grady, we are undertaking a series of studies of the aged to explore whether age-related changes in cognition come about through physiological alterations in sensory systems, the mediating systems, or in the interaction between them.

About the series: The [precision convergence series](#) is launched to catalyze unique synergy between, on the one hand, novel partnerships across sciences, sectors and jurisdictions around targeted domains of real-world solutions, and on the other hand, a next generation convergence of AI with advanced research computing and other data and digital architectures such as [PSC's Bridges-2](#), and supporting data sharing frameworks such as [HuBMAP](#), informing in a real time as possible the design, deployment and monitoring of solutions for adaptive real-world behavior and context.

The McGill Centre for the Convergence of Health and Economics (MCCHE) is a virtual world network of scientist, action and policy leaders promoting the weaving of digital-powered interdisciplinary science into person-centered domain-specific solutions at scale to global challenges faced by traditional and modern economy and society worldwide. The MCCHE stimulates lasting collaborations that bridge the many divides in the market, economy, and society that are at the root of these most pressing modern challenges through collaborative of modular convergence innovation platforms.

The Pittsburgh Supercomputing Center is a joint computational research center between Carnegie Mellon University and the University of Pittsburgh. Established in 1986, PSC is supported by several federal agencies, the Commonwealth of Pennsylvania and private industry. PSC provides university, government, and industrial researchers with access to several of the most powerful systems for high-performance computing, communications, and data-handling available to scientists and engineers nationwide for unclassified research. PSC advances the state-of-the-art in high-performance computing, communications and informatics and offers a flexible environment for solving the largest and most challenging problems in computational science.

Co-Chairs:



Laurette Dubé, PhD is the founding Chair and Scientific Director of the McGill Centre for the Convergence of Health Economics. She holds the James McGill Chair of Consumer and Lifestyle Psychology and Marketing. Her work has been published in top disciplinary journals in Psychology, Management and Medicine as well as in multidisciplinary journals. She holds an MBA in finance, and a PhD in behavioural decision making and consumer psychology. During her 2020-2021 sabbatical, she is a visiting scholar at the National Research Council of Canada and at the Pittsburgh Supercomputing Center, Carnegie Mellon, USA. <https://thefutureeconomy.ca/interviews/laurette-dube>



Sergiu Sanielevici, Ph.D. is Director of Support for Scientific Applications at the Pittsburgh Supercomputing Center, a joint project of Carnegie Mellon University and the University of Pittsburgh. He has served as the Deputy Director of the Extended Collaborative Support Service of the US NSF XSEDE project and as the manager of its Novel and Innovative Projects program, fostering non-traditional and interdisciplinary applications of advanced computing and data resources since 2011. He is currently the Principal Investigator of the Bridges-2 project and co-Principal Investigator of the Neocortex project at PSC. Dr. Sanielevici is a proud alumnus of McGill University (Ph.D., Physics, 1986).

Panelists:



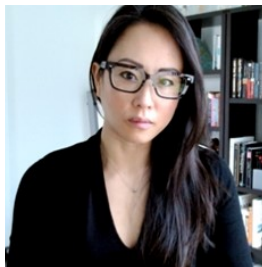
Michael J. Frank is Edgar L Marston Professor of Cognitive, Linguistic & Psychological Sciences at Brown University. He directs the Center for Computational Brain Science within the Carney Institute for Brain Science. He received his PhD in Neuroscience and Psychology in 2004 at the University of Colorado, following undergraduate and master's degrees in electrical engineering. Frank's work focuses primarily on theoretical models of frontostriatal circuits and their modulation by dopamine, especially their cognitive functions and implications for neurological and psychiatric disorders. The models are tested and refined with experiments across species, neural recording methods, and neuromodulation. Honors include the Troland Research Award from the National Academy of Sciences (2021), Kavli Fellow (2016), the Cognitive Neuroscience Society Young Investigator Award (2011), and the Janet T Spence Award for early career transformative contributions (Association for Psychological Science, 2010). Dr Frank is a senior editor for eLife.



Georg Northoff, MD, PhD is EJLB-CIHR Michael Smith Chair in Neurosciences and Mental Health and holds a Canada Research Chair for Mind, Brain Imaging and Neuroethics at the University of Ottawa Institute of Mental Health Research (IMHR). With over 100 scientific publications, his current focus is predominantly on the self - having developed the concept of cortical midline structures. Experimental research within his unit focuses on the functional and biochemical mechanisms underlying our sense of self in both healthy subjects and psychiatric patients. In addition to neuroimaging, he also focuses on neuroethical issues. Early on, he investigated issues related to personal identity in patients with deep brain stimulation and brain tissue transplantation. Another neuroethical focus is on the impact of emotions and empathy in the decision making involved in informed consent, which is of particular relevance regarding psychiatric patients. Finally, these issues converge nicely with his deep standing interest in the discipline of neurophilosophy. He is considered one of the main founders from the European-continental side, as is illustrated by several papers and books including "Philosophy of the Brain" (2004).



Lauren N. Ross, MD, PhD is an Associate Professor in Logic and Philosophy of Science at UC Irvine. Her research concerns causal reasoning and explanation in neuroscience and biology. A significant amount of her research explores causal diversity—different types of causes, causal relationships, and causal systems present in scientific contexts. This research has focused on causal systems such as mechanisms, pathways, and cascades, and causal relationships that differ with respect to their stability, specificity, and reversibility. Her work identifies the features characteristic of these causal systems and their implications for how these systems are studied and how they behave. Ross’s research has received a National Science Foundation (NSF) CAREER award, a Humboldt Experienced Researcher Fellowship, and an Editor’s Choice Award at The British Journal for the Philosophy of Science.



Jennie Z. Young, PhD is the Executive Director of the Canadian Brain Research Strategy (CBRS). Dr. Young holds a PhD in Neuroscience from the University of Alberta, Canada. She then spent 14 years at the Massachusetts Institute of Technology (MIT), and served as scientific chief-of-staff to Nobel Laureate Susumu Tonegawa and to Picower Institute Director Li-Huei Tsai. Her work has spanned the fields of learning and memory and Alzheimer’s disease and has led to publications in leading peer-reviewed journals, including *Nature*, *Science*, *Cell*, *Nature Neuroscience*, *Nature Biomedical Engineering*, and *Neuron*. Dr. Young joined CBRS in March, 2021. As Executive Director, she leads a pan-Canadian effort to develop a national research strategy for brain and mental health. The mission of CBRS unites a broad, diverse coalition of government, academic, private, non-profit, research funding, patient, and Indigenous stakeholders. Together, they envision a future where Canada pioneers a powerful paradigm shift towards collaborative, transdisciplinary, and open brain research worldwide.



Philip Blood is the As PSC’s Scientific Director, Phil directs PSC’s research and research support teams, including Biomedical Applications, AI & Big Data, and User Support for Scientific Applications. In his work, Phil is focused on architecting, building, and supporting cutting-edge research resources that provide the means to overcome difficult scientific problems. Current projects include building and supporting the flexible hybrid cloud microservices architecture supporting the NIH Human Biomolecular Atlas Program (HuBMAP) and Cellular Senescence Network (SenNet) Program and integrating these resources with the NIH Common Fund Data Ecosystem (CFDE). Phil also leads the NIH Anton project at PSC, in collaboration with D. E. Shaw Research, and serves as co-PI of the NSF XSEDE project. In these roles, Phil works closely with PSC’s leadership team to accomplish our mission to apply advanced computing to enable discoveries that benefit the world.



Shawn Brown is currently the Senior Director of the HPE Cray Programming Environment at Hewlett-Packard Enterprise (HPE) where he leads the team that is developing the software platform for exascale high-performance computing and data science. Previously, Dr. Brown was the Director of the Pittsburgh Supercomputing Center in 2019. He has over 25 years of experience in developing software to support the use of high-performance computing for research in areas such as chemistry, bioinformatics, and public health. His research interests are: (1) How agent-based modeling and other computational techniques can be used to provide decision support in public health and chronic disease; (2) Building of highly convergent collaborative neuroinformatics platforms for open data sharing and computation; (3) Synthetic Ecosystems for representing cohort and cross-sectional data for modeling and open data sharing