

Precision Convergence Webinar Series

Distinctions Among Causation in Neuroscience and Biology: A Theoretical Framework to Support Smart Sciences for Real-World Transformation

By Dr. Lauren N. Ross

University of California, Irvine

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

Thursday, June 23, 2022 | 11 AM to 1 PM EST (2 hours in duration)

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

ABSTRACT: Are there different types of causation in neuroscience and biology? What does such a view entail and does scientific work in these fields support it? Answers to these questions should rely on rigorous definitions of causation, but they should also capture the diversity and complexity of causal systems in the world. This talk explores distinctions among causation in these sciences and it provides a theoretical framework for addressing these questions. In capturing distinctions among causation—sometimes referred to as causal diversity and causal pluralism—three types of claims should be distinguished. These concern whether there are different: (1) *definitions* of causation (2) *methods* used to establish causation, and (3) causal *structures* in the world, which are not tied to differences in defining causality. Separating these claims can help researchers examine (i) whether causality is defined in different ways in their field, (ii) if so, whether this is problematic or not, (iii) how methods for establishing causality relate to definitions of it, and (iv) how some types of causal diversity reflect different causal structures, as opposed to different definitions of causation. This framework is draws on mainstream philosophical accounts of causation and examples of causal reasoning in neuroscience and biology.

PRESENTER: 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.

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 [HuBMAT](#), 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>



Shawn Brown, PhD is the Vice Chancellor for Research Computing at the University of Pittsburgh and the Director of Pittsburgh Supercomputing Center at the Carnegie Mellon University & University of Pittsburgh. Prior to his appointment, Dr. Brown served as the Associate Director of Research Software Development at the McGill Centre of Integrative Neuroscience at the McGill Neurological Institute. Dr. Brown is an expert on high-performance computing and computational simulation. 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 also focused on how agent-based modeling and other computational techniques can be used to provide decision support in public health and chronic disease.

Panelists:



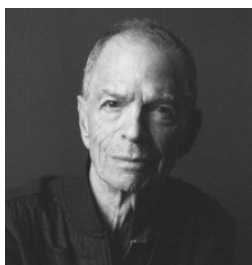
Ayelet Fishbach, PhD, is the Jeffrey Breakenridge Keller Professor of Behavioral Science and Marketing at the University of Chicago, Booth School of Business. She is the past president of the Society for the Study of Motivation and the International Social Cognition Network. She is an expert on motivation and decision making. Dr. Fishbach's groundbreaking research on human motivation has won the Society of Experimental Social Psychology's Best Dissertation Award and Career Trajectory Award, and the Fulbright Educational Foundation Award.



Prof. Dani Bassett is the J. Peter Skirkanich Professor at the University of Pennsylvania, Departments of Bioengineering, Electrical & Systems Engineering, Physics & Astronomy, Neurology, and Psychiatry, and external professor of the Santa Fe Institute. They received a B.S. in physics from Penn State University and a Ph.D. in physics from the University of Cambridge as a Churchill Scholar and NIH Health-Sciences Scholar. Following a postdoc at UC Santa Barbara, Bassett was a Junior Research Fellow at the Sage Center for the Study of the Mind. They have received multiple prestigious awards, including American Psychological Association's 'Rising Star' (2012), Alfred Sloan Fellow (2014), MacArthur Fellow (2014), IEEE EMBS Early Academic Achievement Award (2015), Office of Naval Research Young Investigator (2015), National Science Foundation CAREER (2016), Popular Science Brilliant 10 (2016), Lagrange Prize in Complex Systems Science (2017), Erdos-Renyi Prize in Network Science (2018), OHBM Young Investigator Award (2020), AIMBE College of Fellows (2020), American Physical Society Fellow (2021), and Web of Science's most Highly Cited Researchers (2019-2021). Bassett is the author of more than 380 peer-reviewed publications (36,000 citations), and an academic trade book co-authored with philosopher and twin Perry Zurn titled "Curious Minds: The Power of Connection" (MIT Press; 2022).



Dr. Amir Shmuel is the director of the Brain Imaging Signals Lab and a core faculty member of the McConnell Brain Imaging Centre of the Montreal Neurological Institute. He is a Professor of McGill University's Departments of Neurology, Neurosurgery, Physiology, and Biomedical Engineering. Dr. Shmuel served as the chair of the organizing committee and chair of the sixth conference of the International Society for Brain Connectivity in 2018. He is the PI of an \$18.7M grant funded by the Canada Foundation for Innovation to install the first large bore 7 Tesla MRI scanner in Quebec. His research program focuses on understanding the mechanisms of resting-state functional connectivity, understanding functional brain imaging signals and evaluating the degree to which they reflect the underlying neuronal activity, cortical lamina resolved neurophysiology and neuroimaging, and computational modeling of these themes. His lab employs an integrative approach, using a combination of imaging and electrical recording techniques. These include functional Magnetic Resonance Imaging (fMRI), optical imaging using intrinsic signals and voltage-sensitive dyes, multi-channel neurophysiological recordings, optogenetics, and tissue processing. Together, these techniques encompass multiple levels of spatial and temporal resolution. Dr. Shmuel's lab emphasizes the development of models in parallel to the acquisition of experimental data for each of the research questions, with the aim of fitting the models to the experimental data.



Dr. Peter Sterling studied at Cornell University and earned a PhD in neuroscience at Western Reserve University. Following postdoctoral study at Harvard Medical School, he established a laboratory at UPenn where he studied functional architecture of neural circuits, leading to a book with Simon Laughlin, *Principles of Neural Design* (2015). Sterling is also a lifelong social activist, having campaigned for civil rights as a "Freedom Rider" and against the brain-damaging attempts to treat mental disturbance by psycho-surgery, electroshock, and neuroleptic drugs. Sterling, noting poor health in socially stressed communities, formulated (with Joseph Eyer) the concept of allostasis, wherein the brain governs all the body's biochemistry and physiology. Allostasis employs a brain circuit that compels seeking and pauses briefly to a positive surprise. Modern life reduces opportunities for positive surprise, so we are compelled to seek it through consumption: bigger burgers, more opioids, and innumerable activities that drive climate change. Sterling's new book, *What is Health?* (2020), builds an understanding from molecules upward that society must abandon mere technical solutions and restore possibilities for daily small rewards for which we were wired by evolution. Sterling now winters on a small farm in western Panamá and summers in rural Massachusetts.



Dr. Luiz Pessoa received a BSc in Computer Science from the Federal University of Rio de Janeiro, Brazil in 1989 and an MSc in Computer Engineering in 1990 from the same university. He followed his MSc work on artificial neural networks by a PhD in computational neuroscience at Boston University (1996). After returning to Brazil for a few years and being on the faculty of Computer Science at the Federal University of Rio de Janeiro, he returned to the US to take a position as Visiting Fellow at the National Institute of Mental Health (1999 to 2003). He then joined the Department of Psychology at Brown University as an Assistant Professor (2003 to 2006), the Department of Psychological and Brain Sciences at Indiana University, Bloomington, as an Associate Professor (2006 to 2010), and since 2011 he has been Professor at the Department of Psychology and director of the Maryland Neuroimaging Center, University of Maryland, College Park. His research interests center around studying interactions in the brain between emotion, motivation, and cognition. He is also interested in the conceptual and philosophical foundations of neuroscience. He is the author of the *Entangled Brain: How Perception, Cognition, and Emotion Are Woven Together*, MIT Press (forthcoming).



Dr. Shan Siddiqi is an assistant professor of psychiatry at Harvard Medical School, a neuropsychiatrist at the Center for Brain/Mind Medicine at Brigham & Women's Hospital, and the director of psychiatric neuromodulation research at the Center for Brain Circuit Therapeutics. His work is focused on causal mapping of human brain function with the intent of identifying new treatment targets for neuropsychiatric disorders.