

# **Exploring the Bidirectional Relationship Between Artificial Intelligence and Neuroscience: A Workshop**

## **Committee**

### **Magali Haas**

#### **Co-Chair**

Magali Haas, MD, PhD, MSE, is CEO and President of Cohen Veterans Bioscience, a non-profit brain research organization based in Cambridge, MA. Cohen Veterans Bioscience was established as a joint initiative between Orion Bionetworks, Inc. and Steve A. Cohen to advance the detection and treatment of post-traumatic stress (PTS) and traumatic brain injury (TBI) and related co-morbidities through cutting-edge research, so that the burden of these conditions may be lessened on service members, veterans, and their families. Orion Bionetworks was founded in 2012 by Dr. Haas to accelerate the development of next-generation diagnostics and treatments for brain disorders by harnessing the power of biotechnology (including neuroimaging, 'omics, and biosensors) in combination with high-performance computing and data analytics, to understand the underlying mechanisms of disease and discover new ways to improve brain health. Dr. Haas has over 15 years of pharmaceutical executive and clinical research experience, predominantly at Johnson & Johnson, where she assumed broad end-to-end development leadership roles in medical marketing, full clinical development, early development, and translational and biomarker sciences in psychiatry and neurology. She successfully filed NDAs in the US and Europe for risperidone indications in Autism, Adolescent Schizophrenia, Juvenile Bipolar Disorder and Conduct Disorders. She also led Development Teams evaluating compounds for Depression, Neuropathic Pain, Epilepsy, and Migraine Disorder. As an "intrapreneur" at J&J she established the first Neuroscience Translational Medicine & Integrative Solutions department, and co-founded the first Companion Diagnostics Center of Excellence as well as an R&D Innovation team. She serves on several advisory boards including the Alzheimer's Association National Plan Milestone Workgroup, Brain Canada, Pear Therapeutics and IMEC for nanoelectronics. Dr. Haas earned her bachelor of science degree in bioengineering from the University of Pennsylvania, a master of science degree in biomedical engineering from Rutgers University, New Jersey, and a medical degree and doctorate in neuroscience from Albert Einstein College of Medicine, New York.

# Terrence J. Sejnowski

## Co-Chair

Terrence Sejnowski, PhD, is the Francis Crick Professor at The Salk Institute for Biological Studies, where he directs the Computational Neurobiology Laboratory, and a Distinguished Professor of Biology and Neurosciences at the University of California, San Diego, where he is co-Director of the Institute for Neural Computation. He is the President of the Neural Information Processing Systems (NeurIPS) Foundation, which organizes the largest annual conference on machine learning and artificial intelligence. Dr. Sejnowski pioneered computational neuroscience and his long-range goal is to build linking principles from brain to behavior using computational models. This goal is being pursued with a combination of theoretical and experimental approaches at several levels of investigation ranging from the biophysical level to the systems level. His laboratory has developed new methods for analyzing the sources for electrical and magnetic signals recorded from the scalp and fMRI brain imaging by blind source separation using independent components analysis (ICA) and delay-differential analysis (DDA). Dr. Sejnowski has published over 500 scientific papers and 12 books, including "The Computational Brain" with Patricia Churchland and "The Deep Learning Revolution." His Massive Open Online Course (MOOC) with Barbara Oakley, "Learning How to Learn", is based on the principles of learning in brains and has been viewed by over 3 million learners in over 200 countries; their new three-MOOC specialization, "Uncommon Sense Teaching," is aimed at helping teachers navigate the complexities of two major learning systems in brains. He received the IEEE Neural Network Pioneer Award in 2002 and the Gruber Prize in Neuroscience in 2022 and has received honorary doctorates from the University of Zurich and Princeton University. He is a member of the National Academy of Sciences, the National Academy of Engineering, the National Academy of Medicine and the National Academy of Inventors.

# Jonathan Cohen

## Member

Jonathan Cohen, MD, PhD, is Robert Bendheim and Lynn Bendheim Thoman Professor in Neuroscience, Professor of Psychology, and Co-Director of the Princeton Neuroscience Institute at Princeton University. Dr. Cohen's laboratory focuses on the neurobiological mechanisms underlying cognitive control and their disturbance in brain and behavior disorders such as schizophrenia and depression. Cognitive control is the ability to guide attention, thought and action in accord with goals or intentions. Dr. Cohen and his colleagues are working to develop and test explicit hypotheses that will explain how these mechanisms of cognitive control work. The mechanisms of cognitive control influence attentional effects in sensory processing and goal-directed sequencing of motor output. Cognitive control's influence on the brain structures upon which these functions depend, such as the prefrontal cortex, anterior cingulate cortex, basal ganglia and brain-stem neuromodulatory dopamine and norepinephrine systems, are still poorly understood. Before joining Princeton University in 1998, Dr. Cohen worked at the University of Pittsburgh and Carnegie Mellon University.

## **Nita Farahany**

### **Member**

Nita Farahany, JD, PhD, is the Robinson O. Everett Professor of Law & Philosophy, Director of Duke Science & Society, and Chair of the Duke MA in Bioethics and Science Policy. From 2010-2017, she served on the U.S. Presidential Commission for the Study of Bioethical Issues. She is a widely published scholar on the ethical, legal, and social implications of the biosciences and emerging technologies, and a frequent commentator for national media and radio shows, and keynote speaker at major events and conferences including the Aspen Ideas Festival, TED, the World Economic Forum, corporate events, academic and judicial conferences. Farahany is an elected member of the American Law Institute, an elected Fellow of the American Association for the Advancement of Science, a member of the World Economic Forum Global Council, Board member and past President of the International Neuroethics Society, serves on scientific advisory boards, the Neuroethics Division of the BRAIN Initiative for NIH, the National Advisory Council of NINDS, Neuroscience Forum at the National Academies of Science, and is a co-editor-in-chief and a founding editor of the Journal of Law and the Biosciences. Farahany holds an AB (Genetics) from Dartmouth College, an ALM (Biology) from Harvard University, and a JD, MA, and PhD (Philosophy) from Duke University.

## **M. Ehsan Hoque**

### **Member**

Ehsan Hoque, PhD, is an Associate Professor of Computer Science at the University of Rochester where he co-leads the Rochester Human-Computer Interaction (ROC HCI) Lab. Dr. Hoque's research program aims to use techniques from artificial intelligence to amplify human ability. He models and captures the dynamics of human behavior and their relationships using machine learning, and design interactive systems to promote equity and access in health care and education. His work has positively impacted the lives of disadvantaged, ill, disabled, and other individuals who struggle with socio-emotional communication, such as those with autism, severe anxiety, neurodegenerative disease, PTSD, aging, and terminal illness. Dr. Hoque earned his Ph.D. from the Massachusetts Institute of Technology in 2013, where his dissertation of 'using computers to help with conversations' was highlighted by the MIT Museum as one of MIT's most unconventional inventions. Microsoft is currently using his patent to introduce "presenter coach" in Microsoft PowerPoint. His ideas and impact of developing health interventions have been recognized through MIT Technology Review Top Innovators Under 35 Award in 2016. In 2017, Science News named him one of the one of ten early- to mid-career scientists to watch, and in 2018, he received the Early Career Award for Scientists and Engineers (ECASE)—the highest honor bestowed by the US Army Research Office for young scientists and engineers. Dr. Hoque is a Distinguished Member of the Association of Computing Machinery (ACM)—the world's largest computing society, and a senior member of the Association for the Advancement of Artificial Intelligence (AAAI)—the largest scientific society for AI.

## **Frances E. Jensen**

### **Member**

Frances Jensen, MD, is Professor of Neurology and Chairman of Neurology at the Perelman School of Medicine, University of Pennsylvania, and Co-Director of Penn Translational Neuroscience Center. She was formerly Professor of Neurology, Harvard Medical School, Director of Translational Neuroscience and senior neurologist at the Brigham and Women's Hospital and Boston Children's Hospital. After receiving her AB from Smith College and MD from Cornell Medical College, she obtained her neurology residency training at the Harvard Longwood Neurology Residency Program. Her research focuses on mechanisms of epilepsy, and the interaction of epilepsy with other disorders such as autism and dementia, to elucidate new therapies for clinical trials development. She has authored over 150 manuscripts on subjects related to her research and has been continuously funded by NIH since 1987 and was the recipient of a NIH Director's Pioneer Award in 2007 and a NIH-NINDS Javits Award in 2020. Dr. Jensen was elected as a member of the National Academy of Medicine in 2015 and the recipient of the Smith College Medal in 2020. Dr. Jensen has trained numerous clinical and basic research fellows who now hold independent faculty positions nationally and internationally. Dr. Jensen is currently President of the American Neurological Association (2020-2022) and was President of the American Epilepsy Society in 2012. She has served on multiple leadership boards including Society for Neuroscience and NIH. Dr. Jensen is a Trustee of the Franklin Institute in Philadelphia and is involved in community outreach for brain research and education. In addition, Dr. Jensen is an advocate for awareness of the adolescent brain development, its unique strengths and vulnerabilities, as well as their impact on medical, social, and educational issues unique to teenagers and young adults, and author of the book "The Teenage Brain", released by Harper Collins in 2015/16, translated and published in over 25 languages worldwide.

## **Michael L. Littman**

### **Member**

Michael L. Littman, PhD, is currently serving as Division Director for Information and Intelligent Systems at the National Science Foundation. The division is home to the programs and program officers that support researchers in artificial intelligence, human-centered computing, data management, computational neuroscience, and assistive technologies, as well as those exploring the impact of intelligent information systems on society. Littman is also University Professor of Computer Science at Brown University, where he studies machine learning and decision-making under uncertainty. He has earned multiple university-level awards for teaching, and his research has been recognized with three best-paper awards and three influential paper awards. Littman is a Fellow of the Association for the Advancement of Artificial Intelligence and the Association for Computing Machinery.

## **Bill Martin**

### **Member**

Bill Martin, PhD, is the Global Therapeutic Area Head of Neuroscience for Janssen Research & Development. Dr. Martin brings a diverse background and more than 20 years of demonstrated success in neuroscience R&D leadership to the scientific community. His experience spans drug discovery and development, scientific and business strategy, as well as company formation and growth. At Janssen, Bill has end-to-end responsibility for the neuroscience R&D portfolio from discovery, translational medicine, biomarkers and to clinical development. Prior to Janssen, Bill co-founded Blackthorn Therapeutics where he held positions of increasing responsibility, from Chief Scientific Officer and Head of R&D to President and CEO. He began his career at Merck and later joined Theravance Biopharma where he held multiple leadership positions across all aspects of Neuroscience R&D. Bill has served on numerous Boards of Directors and Advisory Councils, including those of BlackThorn Therapeutics, the Alliance for Artificial Intelligence in Healthcare, the Coalition for the Life Sciences and Brown University's Carney Institute for Brain Science. He has held leadership positions in the Society for Neuroscience, the American Physiological Society and the International Brain Research Organization and has published extensively, with more than 75 publications in scientific journals. He graduated from Swarthmore College, earned a Ph.D. from Brown University, and conducted postdoctoral research at the Keck Center for Integrative Neuroscience at the University of California, San Francisco.

## **Kevin Miller**

### **Member**

Kevin Miller, PhD, is a research scientist on the Neuroscience Team at DeepMind and a postdoc at University College London with Kenneth Harris and Matteo Carandini. Dr. Miller's work asks questions like "Can we understand what the brain is doing well enough to reproduce it in software?" Dr. Miller's work involves training rodents to play structured games, then carefully studying both the choices that they make and the neural signals that underlie those choices. It also involves designing software agents that play the same games as the rodents and using these agents as tools for understanding the brain. He is excited about both reinforcement learning and neural networks as tools for building software agents, and about multi-level modeling as a tool for understanding experimental data. Before moving to London, Dr. Miller did a PhD at the Princeton Neuroscience Institute with Carlos Brody and Matt Botvinick. His PhD work focused on understanding how the brain makes plans, with a focus on the orbitofrontal cortex and the hippocampus. When not in the lab, Dr. Miller can often be found hiking up a mountain, canoeing down a river, exploring a canyon, cross-country skiing, or otherwise enjoying the outdoors.

## **Kathryn Richmond**

### **Member**

Kathryn Richmond, PhD, MBA, is an Executive Vice President at the Allen Institute, leading the Office of Science and Innovation and The Paul G. Allen Frontiers Group. In this role, she leads initiatives across the Institute and oversees scientific strategy, government relations, and business development. With a focus on emerging bioscience and technology areas, she has dramatically grown the Frontiers Group portfolio, overseeing >\$275M in award funding to date. Through identification of high-risk, high reward opportunities, she has also formed >\$50M in strategic philanthropic partnerships. Dr. Richmond frequently serves as an invited panel member, speaker and advisor on topics ranging from open science to technology development. She has convened the inaugural Bioscience and Philanthropy Summit, engaging thought pioneers, technologists, venture capital leaders and philanthropic funders from around the world. Previously, Dr. Richmond has served as a member of the executive team at the DOE Great Lakes Bioenergy Research Center. Along with a doctorate in Cell and Molecular Biology and an MBA from the University of Wisconsin, Madison, she also attended Stanford University as an American Cancer Society fellow and was funded by DARPA for breakthrough research efforts.

## **Katie Sale**

### **Member**

Katie Sale, BA, is the Executive Director of the American Brain Coalition (ABC), a nonprofit organization comprised of the United States' leading professional neurological, psychological, and psychiatric associations and patient organizations. The ABC seeks to advance the understanding of the functions of the brain, and to reduce the burden of brain disorders through education, public advocacy, and outreach. Ms. Sale has been the American Brain Coalition Executive Director since the ABC was incorporated in 2004. In her position as Executive Director, Ms. Sale provides executive leadership over the administration and daily operations to ensure strong integration among all programs and advocacy activities. She provides broad guidance on operations and policy implementation. Ms. Sale participates with the board in planning and establishing program policies, objectives, and priorities as well as directing the development and implementation of the ABC's strategic action plans. Ms. Sale services the needs of the ABC's membership comprised of patients, families, neuroscientists, clinicians, industry, and government agencies. Ms. Sale serves as an Executive Committee member on the Friends of the National Institute of Mental Health (NIMH), a member of the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative Alliance, as well as a Community Liaison Board member on the National Institutes of Health (NIH) Adolescent Brain & Cognitive Development (ABCD) Study. Prior to joining the American Brain Coalition, Ms. Sale served as the Senior Director for Planning and Membership at the Society for Neuroscience. Ms. Sale coordinated the governance activities of the Society, supervised the Membership and Chapters & Special Programs Departments, and all functions related to the Society's corporate sponsorship, diversity programs and grants, international affairs, travel awards programs, as well as the Society's History and Women's Careers Committees.