

AZRIELI PROGRAM IN BRAIN, MIND & CONSCIOUSNESS

Seeks to examine the neural underpinnings of consciousness, leading to better treatments for mental health disorders and insights into the most profound questions about human nature.

This year the Azrieli Program in Brain, Mind & Consciousness added four new fellows and two new advisory committee members, and held two program meetings. The December 2016 meeting focused primarily on animal consciousness, discussing evidence that other species experience aspects of this seemingly human experience. The June 2017 meeting preceded the annual meeting of the Association for the Scientific Study of Consciousness, the leading scientific society dedicated to the study of consciousness. The program meeting's main theme was disorders of consciousness, brain dynamics and subjectivity, and individual differences.

The program also organized a satellite symposium in conjunction with the Annual Meeting of the Japanese Neuroscience Society in Tokyo in June 2016. Neuroscientists, philosophers and psychologists discussed "The Origin of Consciousness" and how the human brain gives rise to the human mind.

This year was notable for building research partnerships. CIFAR was an important partner in Western University's successful Canada First Research Excellence Fund (CFREF) application (BrainsCAN), the largest research grant in the university's history. Koerner Fellow **Adrian Owen** and Ivey Fellow **Mel Goodale** (both Western University) are principal investigators on this research. This initiative was partnered with McGill University's successful CFREF grant, a partnership encouraged by CIFAR and involving Senior Fellow **Robert Zatorre** (McGill University).

RESEARCH HIGHLIGHTS

Discussions with other fellows at her first program meeting inspired Senior Fellow **Sheena Josselyn** (The Hospital for Sick Children, Toronto) to revisit her work in a new light, testing a hypothesis on how engram interactions lead to memory formation. This new cross-disciplinary research showed that in mice, two memories become linked by recruiting overlapping neuronal populations. The work initiated a new line of research in her lab, inspired by a combination of cognitive psychology, philosophy and neuroscientific approaches.

- Rashid AS, Yan C, Mercaldo V, Hsiang HW, Park S, Cole CJ, De Cristofaro A, Yu J, Ramakrishnan C, Lee SY, Deisseroth K, Frankland PW, **Josselyn SA**. 2016. Competition between engrams influences fear memory formation and recall. *Science*. 353(6297): 383-387.

Senior Fellows **Anil Seth** (University of Sussex) and **Marcello Massimini** (University of Milan) examined the neural signatures of consciousness level changes during sleep. The study showed new evidence that neural dynamic complexity correlates with level of consciousness, a critical part of understanding the neuronal basis of consciousness.

- Schartner M, Pigorini A, Gibbs S, Sarasso S, Barnett LC, Nobili L, **Massimini M**, **Seth AK**, Barrett AB. 2017. Global and local complexity of intracranial EEG decreases during NREM sleep. *Neurosci Conscious*. 3(1): 22.

After attending CIFAR meetings and engaging in discussions with other fellows, Senior Fellow **Ani Patel** (Tufts University) reconsidered one of his recent studies. Using a new approach, he developed a hypothesis describing the evolution of human melody perception and how it differs from the way that non-human animals hear melodies. This hypothesis challenges existing views about sound processing in other species and generates testable predictions to advance the evolutionary perspective of the conscious experience of the auditory world.

- **Patel AD**. 2017. Why doesn't a songbird (the European starling) use pitch to recognize tone sequences? The Informational Independence hypothesis. *Comp Cogn Behav Rev*. 12: 19-32.

AT A GLANCE

FOUNDED: 2014

PROGRAM DIRECTORS: Melvyn Goodale, Western University, and Adrian Owen, Western University

FELLOWS, ADVISORS AND CIFAR AZRIELI GLOBAL SCHOLARS: 22

INSTITUTIONS REPRESENTED: 18, in 9 countries

FIELDS AND SUBFIELDS REPRESENTED: neuroscience, including cognitive neuroscience; biological and cognitive psychology; computer science, including artificial intelligence; genetics; anthropology; philosophy, including ethics; law

MEETINGS: 2; in Seattle, USA, and Beijing, China

RELEVANT KNOWLEDGE USERS: creative sector (artists, authors, musicians, filmmakers); medical community (psychiatrists, anaesthetists, neurologists); engineers working on human-machine interfaces; legal professionals; software developers; pharmaceutical industry

PARTNERS: Brain Canada Foundation through the Canada Brain Research Fund | Western University

SUPPORTERS: Azrieli Foundation | The Henry White Kinnear Foundation | The Larry and Judy Tanenbaum Family Foundation | Richard M. Ivey | Michael and Sonja Koerner

TO LEARN MORE: www.cifar.ca/research/brain-mind-consciousness/

Other Notable Publications and Outputs

- Podvalny E, Yeagle E, Megevand P, Sarid N, Harel M, Chechik G, Mehta AD, **Malach R**. 2017. Invariant temporal dynamics underlies perceptual stability in human visual cortex. *Curr Biol*. 27(2): 155-165.
- Abdalmalak A, Milej D, Diop M, Shokouhi M, Naci L, **Owen AM**, St. Lawrence K. 2017. Can time-resolved NIRS provide the sensitivity to detect brain activity during motor imagery consistently? *Biomed Opt Express*. 8(4): 2162-2172.



The work of Senior Fellow Ani Patel (right) on the European starling could help explain the conscious experience of the auditory world.

IDEAS EXCHANGE

The program continued to explore opportunities for targeted engagement with key knowledge user communities. Priority was given to how the program's research intersects with industry, specifically around new artificial intelligence technologies and the neuroethics of machine consciousness; and health care, including the psychology and neurology of consciousness.

GLOBAL ACADEMY

Two new CIFAR Azrieli Global Scholars joined the program for a two-year term, as part of the inaugural cohort appointed in 2016/2017. **Craig Chapman** (University of Alberta) and **Alona Fyshe** (University of Victoria) each presented their work at the December 2016 program meeting. Both scholars are the lead organizers for the program's first winter school planned for December 2017.

