Simons Center for the Social Brain

The mission of the Simons Center for the Social Brain (SCSB) at MIT, now in its eighth year, is to understand the neural mechanisms underlying social cognition and behavior, and to translate this knowledge into better diagnosis and treatment of autism spectrum disorders (ASD). SCSB was founded in January 2012 with support from the Simons Foundation Autism Research Initiative (SFARI), and completed its first five-year phase of funding in December 2016. SCSB funding was renewed for a second phase in January 2017, and for a third phase beginning January 2020.

SCSB studies the underlying mechanisms of ASD in both humans and relevant model organisms and systems, as neural correlates of social cognition and behavior exist in diverse species. Its approaches take advantage of MIT's strengths in genetics and genomics, molecular and cell biology, analyses of neural circuits and systems, cognitive psychology, computation, and engineering.

During 2018–2019, SCSB continued its support for postdoctoral fellows and collaborative targeted projects that involve three to four researchers bridging multiple levels of analysis. In addition, SCSB continued to host events that reach a wide audience, including a colloquium series and a lunchtime talks series.

Symposia and Events

To strengthen its community, SCSB runs a colloquium series, which brings major autism researchers to MIT, and has become the preeminent forum in the Boston area for research on autism and neurodevelopmental disorders. In addition, SCSB hosts a lunch talks series featuring postdoctoral fellows and faculty principal investigators presenting their latest, ongoing research.

As in previous years, the colloquium was held roughly on alternate Wednesdays during the spring and fall terms. The lunch talks were held approximately once a month. In 2018–2019, SCSB hosted 13 external colloquium speakers and 12 internal lunch speakers as part of its lunch series. Additionally, SCSB co-hosted two special seminars that were relevant to autism and developmental brain disorders.

Research

Postdoctoral Fellowships

SCSB continued its outreach efforts for announcing, receiving, reviewing, and awarding postdoctoral fellowships. Announcements were widely advertised to various departments and centers at MIT, as well as to institutions throughout the Boston area. As in the past, the grant application and funding cycle occurred in two rounds (February and September).

From July 2018 to June 2019, SCSB awarded seven postdoctoral fellowships (including four renewals for a second year of funding). Applications were reviewed by peer review committees that were set up for each round of applications, and overseen by the SCSB steering committee which met after each round of review.

Targeted Projects

SCSB supports uniquely collaborative, focused projects undertaken by multiple laboratories to explore in depth specific aspects of autism. These targeted projects are structured to require collaboration among researchers in order to quickly and flexibly address pressing questions in autism research. SCSB supported three targeted projects in 2018–2019. Two of these continued from previous years, while one was newly initiated.

The first project addresses the role of the thalamic reticular nucleus (TRN) in thalamocortical coordination, cognitive processing, and sleep in ASD. The TRN targeted project received its third year of funding in November 2018. This project has four components:

- Role of TRN in spindle generation and hippocampal-neocortical coordination during wake/sleep (Matthew Wilson)
- Spindle activity and thalamocortical interactions (Dara Manoach)
- Molecular diversity and role of ASD risk genes in the TRN (Guoping Feng)
- Role of TRN in prefrontal representations underlying cognitive control and flexibility (Michael Halassa)

The second project focuses on circuit mechanisms of ASD-relevant behaviors in marmosets. The marmoset-targeted project received its second year of funding in 2019. It also has four components:

- Neural circuits for social attention and social reward (Robert Desimone)
- Investigation of striatal circuits in marmoset brain underlying repetitive, perseverative behaviors (Ann Graybiel)
- Mechanisms of switching and prediction in marmoset cortex (Mriganka Sur)
- Molecular measurement and perturbation of marmoset brain networks (Alan Jasanoff)

The third project studies predictive processes in autistic and neurotypical individuals: A behavioral, neural, and developmental investigation. We initiated this new targeted project, with its first year of funding, in July 2019. This project has three components:

- Behavioral and electrophysiological investigations of sensorimotor prediction during metronomic and probabilistic auditory sequences (Pawan Sinha)
- Investigations of adaptation to social and non-social stimuli (John Gabrieli)
- Developmental studies of prediction in autism: sequence learning, neural adaptation, and lexical prediction (Jesse Snedeker)

Each of the project teams met regularly to discuss ongoing findings, provide feedback, and share results and ideas between labs.

Major Research Publications

A wide range of publications resulted from SCSB funding. A sample of these is as follows:

- Neuronal deletion of Gtf2i, associated with Williams syndrome, causes behavioral and myelin alterations rescuable by a remyelinating drug—Boaz Barak and Guoping Feng, *Nature Neuroscience*
- Deep phenotyping of speech and language skills in individuals with 16p11.2 deletion—Ev Fedorenko and Angela Morgan, *European Journal of Human Genetics*
- Striatal Microstimulation Induces Persistent and Repetitive Negative Decision-Making Predicted by Striatal Beta-Band Oscillation—Ann Graybiel, *Neuron*
- Thalamic Reticular Dysfunction as a Circuit Endophenotype in Neurodevelopmental Disorders—Alexandra Krol, Michael Halassa, and Guoping Feng, *Neuron*
- Probing Mechanical Properties of Brain in a Tuberous Sclerosis Model of Autism—Mustafa Sahin and Krystyn Van Vliet, *Journal of Biomechanical Engineering*
- Pharmacological enhancement of KCC2 gene expression exerts therapeutic effects on human Rett syndrome neurons and Mecp2 mutant mice—Xin Tang, Mriganka Sur, and Rudolf Jaenisch, *Science Translational Medicine*

Impact

The impact of SCSB on the community manifested in many ways. More than 77 investigators—across 16 departments, labs, and centers at MIT and 13 Boston-area institutions—are engaged with SCSB as investigators or as postdoctoral mentors. SCSB has supported 39 postdoctoral researchers as Simons Fellows.

Until now, SCSB researchers have published nearly 250 original research papers (some publications in 2018–2019 are highlighted above) and obtained over $50 million in external funding from SCSB-supported early-stage research or targeted project research. A significant number of Simons Postdoctoral Fellows have obtained faculty or independent research positions.

Administration and Governance

SCSB continues to be run by a small administrative core in which each individual performs a wide range of functions. In 2018–2019 the team included: Mriganka Sur (director), Eleana Ricci (administrative manager), and Alexandra Sokhina (administrative assistant II and events coordinator).

Postdoctoral fellowship applications were evaluated by review committees comprising six to eight reviewers across MIT, based on their expertise, and with representation from SFARI. The committees met twice a year, for each round of funding. Targeted projects were reviewed by SFARI and by external reviewers commissioned by SFARI.

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