

Simons Center for the Social Brain

Mission

The mission of the Simons Center for the Social Brain (SCSB) at MIT 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 celebrated its 10th year since inception in December 2021. Commencing January 2023, SCSB received funding for another 5-year period, January 2023 to December 2027, from SFARI International.

The Simons Center studies mechanisms of autism spectrum disorders in both humans and relevant model organisms and systems, as neural correlates of social cognition and behavior exist in diverse species. Our 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 2022-2023, SCSB supported faculty investigators working on three targeted projects, funded postdoctoral researchers conducting work in several labs, and continued to build the autism research community by hosting its long-running colloquium series and lunch seminars.

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. These projects are a vital part of the Simons Center's mission. SCSB supported three targeted projects in 2022–2023.

1. The 'Predictive Processes in Autistic and Neurotypical Individuals' targeted project completed its third and final year in June 2023. It involved three complementary teams: 'Behavioral and electrophysiological investigations of sensorimotor prediction' (Pawan Sinha), 'Investigations of adaptation to social and non-social stimuli' (John Gabrieli), and 'Developmental studies of prediction in autism' (Jesse Snedeker).
2. The targeted project 'Cognitive, Neural and Computational Foundations of Conversation' received its second year of funding in April 2023. It involves four teams of researchers that use a synergistic combination of behavioral, neural, and computational modeling approaches with neurotypical (NT) adults and children, and those with autism, to investigate human conversational ability – a key ingredient of social interaction. The four projects bring 7 PIs together and include: 'Large-scale behavioral investigations of conversational alignment in adults with and without autism' (Ted Gibson and Caroline Robertson), 'The functional organization of conversation in the adult brain' (Ev Fedorenko and Nancy Kanwisher), 'Understanding conversation in developing brains' (Rebecca Saxe) and 'Computational modeling of conversation' (Roger Levy and Joshua Tenenbaum).

3. A new, project, ‘Mitigating sensory overload with closed-loop stimulation’, was established in June 2023. It involves three teams of researchers: ‘Using closed-loop manipulation of alpha/beta rhythms to test hypotheses about the functional circuitry of predictive coding’ (Earl Miller), ‘Assessing rhythmic imbalance in Shank 3 transgenic marmosets and restoring balance using closed-loop stimulation’ (Robert Desimone), and ‘Conducting parallel studies in children with autism’ (Charles Nelson). Project 1 will test the hypothesis that turning down alpha/beta should reduce prediction signals, producing the altered predictive coding seen in autistic individuals. Turning up alpha/beta should mitigate this by improving predictive coding. Project 2 will test for the rhythmic imbalance in Shank 3 transgenic marmosets, their relation to oddball/predictive processing and whether normal processing can be restored via closed-loop stimulation. Project 3 will test for the rhythmic imbalance and their relationship to oddball/predictive processing in ASD and Phelan-McDermid Syndrome (PMS) children. The ultimate goal is non-invasive closed-loop stimulation for therapeutic use in humans.

Postdoctoral Fellowships

We updated our postdoctoral fellowship announcement to encourage applications from under-represented and under-served backgrounds. We established a collaboration with DEIJ officers across MIT, joined a working group, and were able to share our call for applications to a much wider distribution list. Announcements were advertised to various departments and centers at MIT as well as institutions throughout the Boston area.

In 2022, we continued with one round of applications, which we reviewed and of which we funded a subset. Applications were evaluated by a review committee, which included scientists from SFARI. In 2023, SCSB returned to the previous format of holding two rounds of funding competitions a year (Spring and Fall). In 2022–2023, SCSB awarded 7 postdoctoral fellowships. Mentoring our Simons Fellows is an important component of the Center’s mission.

Events

To strengthen its community, SCSB runs a colloquium series, held roughly on alternate weeks during the spring and fall terms, which brings major autism researchers to MIT and which has become the preeminent forum in the Boston area for research on autism and neurodevelopmental disorders. In addition, SCSB hosts a lunch talks series, held approximately once a month, featuring postdoctoral fellows and faculty PIs presenting their latest, ongoing research.

From July 2022 through June 2023, SCSB hosted 12 external colloquium speakers as part of its colloquium series and 10 internal lunch speakers as part of its lunch series. These events were conducted in hybrid mode, with both in-person and virtual options. By thus making our events more accessible we were able to consistently reach a much larger audience.

Additionally, we hosted the usual twice-yearly ‘visits’ by Jim and Marilyn Simons and Kelsey Martin, Director SFARI. The Spring 2023 visit took place in person at MIT, while the Fall 2022 visit was a virtual meeting. We expanded these ‘visits’ to enable the SFARI

scientific team to join remotely. During these visits, we were able to report on advances in research and provide an overview of the achievements made to date as well as future aims and projects.

Major Research Publications

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

Grand G.*, Blank I.*, Pereira F., Fedorenko, E. (2022). “Semantic projection recovers rich human knowledge of multiple object features from word embeddings.” *Nature Human Behavior* 6: 975-987. [<https://doi.org/10.1038/s41562-022-01316-8>] *Contributed equally

Bloem B., Huda R., Amemori K., Abate A., Krishna G., Wilson A., Carter C.W., Sur M., Graybiel A.M. (2022) “Multiplexed action-outcome encoding by striatal striosome-matrix compartments detected with a novel mouse cost-benefit foraging task.” *Nature Communications*, 13: 1541. [<https://doi.org/10.1038/s41467-022-28983-5>]

Tomasello D.L., Kim J., Khodour Y., McCammon J.M., Mitalipova M., Jaenisch R., Futerman A.H., Sive H. (2022) “16pdel lipid changes in iPSC-derived neurons and function of FAM57B in lipid metabolism and synaptogenesis.” *iScience* 25:10355. [<https://doi.org/10.1016/j.isci.2021.103551>]

Cory Shain, Alexander Paunov, Xuanyi Chen, Benjamin Lipkin, Evelina Fedorenko. (2023) “No evidence of theory of mind reasoning in the human language network.” *Cerebral Cortex*. [<https://doi.org/10.1093/cercor/bhac505>]

Impact

SCSB serves as a bridge connecting 15 Boston-area institutions; at MIT alone, it engages 16 departments, laboratories and centers. SCSB has supported 84 investigators who are engaged as present and former targeted project PIs, former seed grant investigators, or as postdoctoral mentors. SCSB has supported 51 postdoctoral researchers as Simons Fellows, including 8 current and 43 previous fellows. A significant number of Simons Fellows (n=19) have obtained faculty or independent research positions worldwide.

Administration and Governance

SCSB continues to be run by a small administrative core in which each individual performs a wide range of functions. In 2022-2023 the team included: Mriganka Sur (Director), Eleana MacPhail (Senior Administrative Manager, Fiscal Officer, and Facilities Officer), and Alexandra Sokhina (Program Coordinator).

Mriganka Sur

Director

Newton Professor of Neuroscience