

**The Faculty of Medicine of Harvard University  
Curriculum Vitae**

**Date Prepared:** June 11, 2026  
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**Education**

1997	B.A.	Liberal Arts Major: Molecular Biology	Bennington College
2004	Ph.D.	Neuroscience (Mentors: Alex L. Kolodkin, Ph.D. and David D. Ginty, Ph.D.)	Johns Hopkins University School of Medicine, Biochemistry, Cellular and Molecular Biology Program, Baltimore, MD
2023	Honorary Master's degree		Harvard University, MA

**Postdoctoral Training**

06/04 - 08/11	Postdoctoral Fellow	Neuroscience, Stem cells (Mentor: Rene Hen, Ph.D.)	Columbia University, New York, NY
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**Faculty Academic Appointments**

09/11 - 02/12	Lecturer	Psychiatry	Harvard Medical School
09/11 -	Principal Faculty	Harvard Stem Cell Institute	Harvard University
03/12 -10/17	Assistant Professor	Psychiatry	Harvard Medical School

10/17- 12/23	Associate Professor	Psychiatry	Harvard Medical School
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12/23-	Professor	Psychiatry	Harvard Medical School
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### **Appointments at Hospitals/Affiliated Institutions**

08/97 - 08/98	Research Fellow	Department of Biological Regulation (Mentor: Yosef Yarden, Ph.D.)	Weizmann Institute of Science, Israel
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09/11 - 11/14	Assistant in Research	Psychiatry	Massachusetts General Hospital
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04/12 -	Faculty Affiliate	Program in Neuroscience (PiN)	Harvard Medical School
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06/12 – 09/21	Member	Biological & Biomedical Science (BBS)	Harvard Medical School
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11/14 - present	Associate Researcher	Psychiatry	Massachusetts General Hospital
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09/15 -	Associate Member		BROAD Institute of Harvard and MIT
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07/18-	Faculty Steering Committee		Harvard Brain Science Initiative (HBI)
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### **Other Professional Positions**

05/16 -01/20	Co-Founder	LabMate Inc.	20 days per year
06/20-	Co-Founder	TAP Neuro Inc.	4 hours/week
03/25-	Co-Founder	LIPOS BIO Inc	4 hours/week

### **Major Administrative Leadership Positions**

#### **Local**

2013	Faculty Co-Chair, Harvard Stem Cell Institute Malkin Retreat	Harvard University
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2014 - 2018	Co-Director, Graduate Course BBS (CB226) -- Concepts in Development, Self Renewal and Repair	Harvard Medical School
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2013, 2017	Chair of Recruitment Committee Center for Regenerative Medicine	Massachusetts General Hospital
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## **National and International**

2014	Co-organizer, Adult Neurogenesis: From stem cells to therapies	Tata Institute of Fundamental Research, Mumbai, India
2015	Co-organizer, Watching the Brain Think, Israeli-American Kavli Frontiers of Science symposium, Jerusalem, Israel	Israel Academy of Science and Humanities; National Academy of Sciences
2017	Chair and Co-organizer, Kavli Frontiers of Science symposium, Irvine, CA	National Academy of Sciences

## **Committee Service**

### **Local**

2012 - 2013	Center for Regenerative Medicine Recruitment Committee	Massachusetts General Hospital Chair
2012 - 2021	Human Developmental and Regenerative Biology Senior Thesis Committee	Harvard University
2013 -	Home Base PTSD Research Scientific Committee	Massachusetts General Hospital
2013 -	Program in Neuroscience Admissions Interviews	Harvard Medical School
2014 -	MGH/McLean Research Concentration Program Working advisory group for psychiatry residents	Massachusetts General Hospital
2016-2019	Center for Regenerative Medicine Executive Committee on Research (ECOR) Representative	Massachusetts General Hospital
2016-2017	Chair, Center for Regenerative Medicine Recruitment Committee	Massachusetts General Hospital
2017-	Review Panel for Tosteson and Fund for Medical Discovery Postdoctoral Fellowship Awards	Massachusetts General Hospital
2018 - 2020	Committee on Fundamental Research (CFR) Executive Committee on Research (ECOR) Representative	Massachusetts General Hospital
2018 -	Harvard Stem Cell Institute Retreat Poster session Faculty Judge	Harvard University

2019-	Mass General Neuroscience Leadership Council	Massachusetts General Hospital
2019-	Review Panel for MGH Research Scholars Round 1	Massachusetts General Hospital
2021-	Co-founder and co-organizer MGH/MEE Neural Circuits seminars for trainees	Massachusetts General Hospital/ MEE

#### **Regional**

2014 - 2018	Dimensional Application Advisory Committee	Bennington College, Bennington, VT
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#### **National and International**

07/12 - 06/15	External Thesis Advisor, Candidate: Soyoung Rhee	SUNY, Stony Brook, NY
10/15	Faculty Opponent, Thesis Defense Candidate: Guilia Zanni	Goteburg University, Goteburg, Sweden
01/19	External Thesis Appraiser Candidate: Axel Guskjolen	University of Toronto, Ontario, Canada
2020-2022	Federation of European Neuroscience Societies (FENS)	SFN appointed Program Committee
2019-2024	Society For Neuroscience	Program Committee, Chair: Neurodegenerative disorders and Injury
2025-2027	American College of Neuropsychopharmacology	Program Committee

#### **Professional Societies**

2004 -	Society for Neuroscience	Member
2004 -	Molecular and Cellular Cognition Society	Member
2009 - 2022	Faculty of 1000	Associate Faculty Member
2011 -	Faculty of 1000 Animal Genetics section	Faculty Member
2012	International Society for Stem Cell Research	Reviewer

2014 - 2014 - 2019 2019-	American College of Neuropsychopharmacology	Associate Member Member
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### Grant Review Activities

2012	Investigator Initiated Research Grant	Alzheimer's Association, USA External Reviewer
2013	Internal CSR Catalyst Grant Competition	Heart and Stroke Foundation Center for Stroke Recovery Research, Canada Ad hoc Member, External Expert Reviewer
2013	Neurophysiology of Systems	Medical Research Council, UK Ad hoc Member
2015	Neuroscience	Agence Recherche, Neuroscience, French National Research Agency (ANR), France Ad hoc Member, External Reviewer
2016	Special Emphasis Panel/SRG PO1 2016/05 ZNS1 SRB-N (10)	National Institute of Neurological Disorders and Stroke (NINDS) Ad hoc Member
2017	Special Emphasis Panel/Scientific Review Group 2018/01 ZRG1 MDCN-B (02)	National Institutes of Health
2019	Special Emphasis Panel/SRG P01 2020/01 ZAG1 ZIJ-6 (J1)	National Institute of Aging
2019	Alzheimer's Association Research Grant New To Field Program	AARG
2020	INSERM Atip-Avenir 2020	INSERM
2020	Neurobiology of Learning and Memory LAM Study section	National Institutes of Health
2021	ZRG1 IFCN-E (02) Special Emphasis Panel	National Institutes of Health
2023	ZRG1 ICN (02) Special Emphasis Panel	National Institutes of Health

### Editorial Activities

#### Ad hoc Reviewer

Brain Plasticity  
Brain, Structure and Function  
Behavioral Brain Research

Biological Psychiatry  
 Cell Stem Cell  
 Cell Reports  
 eLife  
 Experimental Cell Research  
 Frontiers in Neural Circuits  
 Hippocampus  
 Nature  
 Nature Communications  
 Nature Methods  
 Nature Neuroscience  
 Nature Medicine  
 Nature Reviews Neuroscience  
 Neuron  
 Journal of Biological Chemistry  
 The Journal of Neuroscience  
 Neurogenesis  
 Neuropsychopharmacology  
 Molecular Psychiatry  
 Neuropharmacology  
 Molecular Brain  
 PLOS Computational Biology  
 Proceedings of the National Academy of Sciences (PNAS)  
 Science  
 Science Advances  
 Stem Cell Reports

### Honors and Prizes

1995	Career Center Grant for Research	Bennington College	Undergraduate Research
1995	Summer Undergraduate Research Fellowship	Rockefeller University	Undergraduate Research
1995	Summer Undergraduate Research Fellowship (declined)	Weizmann Institute of Science	Undergraduate Research
2002	First prize, Graduate Student Association, 4 <sup>th</sup> year Poster Competition	Johns Hopkins University School of Medicine	Doctoral Research
2006	Health Emotions Research Institute Award	University of Wisconsin, Madison	Travel Award
2009	3rd Annual Julius Axelrod Lecture Travel Award	Society for Neuroscience	Career Development Travel Award

2010	Early Career Travel Award	American College of Neuropsychopharmacology	Career Development Travel Award
2010	Translational Neuroscience Symposium Award (canceled)	Roche	Symposium Travel Award
2011	New Investigator Award	American Society of Clinical Psychopharmacology	Career Development Award
2011	Janett Rosenberg Trubatch Career Development Award	Society for Neuroscience	Career Development Award
2013	Kavli Fellow	National Academy of Sciences	Early Career scientist recognition
2019-2024	James and Audrey Foster MGH Research Scholar Award	MGH	

## **Report of Funded Projects**

### **Funding Information**

#### **Past**

- 2006 - 2008      Molecular mechanisms underlying the sensitive period for anxiety  
National Alliance for Research on Schizophrenia and Depression  
Young Investigator Award  
PI (\$60,000)  
The goal of this study was to determine the contributions of serotonin-dependent candidate circuit maturation genes on maturation of hippocampal circuits and anxiety-like behaviors.
- 2008 - 2010      Understanding how experience dependent plasticity mechanisms encode vulnerability to anxiety disorders: A role for Klf-9 dependent neural circuit maturation  
Sackler Institute for Developmental Psychobiology, Columbia University  
PI (\$100,000)  
The goal of this project was to determine if Klf-9 dependent neural circuit maturation when compromised during the early post-natal period confers vulnerability to early life stressors.
- 2008 - 2010      The role of a novel regulator of hippocampal circuit maturation in mediating the behavioral effects of antidepressants.  
National Alliance for Research on Schizophrenia and Depression  
Young Investigator Award  
PI (\$60,000)  
The goal of this study was to determine if Kruppel-like factor 9 dependent neural circuit maturation is necessary and sufficient for the behavioral effects of antidepressants.

- 2009 - 2011      Harnessing adult hippocampal neurogenesis to enhance learning and modulate mood.  
NIH/NIMH, 5K99MH086615 Pathway to Independence Award  
PI (\$166,440, Direct Costs)  
This proposal sought to determine the impact of stimulating adult hippocampal neurogenesis on learning and memory and regulation of mood.
- 2011 - 2014      Harnessing adult hippocampal neurogenesis to enhance learning and modulate mood  
NIH/NIMH, 4R00MH086615-03  
PI (\$581,760, Direct Costs)  
This proposal sought to determine the impact of stimulating adult hippocampal neurogenesis on learning and memory and regulation of mood.
- 2012 - 2015      Linking connectivity of adult-born neurons with encoding functions  
Whitehall Foundation  
PI (\$225,000, Direct costs)  
This project interrogated how a protocadherin dictates connectivity of adult-born neurons.
- 2012 - 2016      Reversing age related impairments in pattern separation to improve episodic memory formation.  
The Ellison Medical Foundation  
PI (\$400,000, Direct costs)  
This project investigated whether restoring synaptic connectivity in distinct regions within the medial temporal lobe of aged rodents will reverse age-related cognitive decline in pattern separation.
- 2015 - 2016      Generation of Human Hippocampal CA3 neurons  
HSCI Development Grant  
co-PI (\$100,000, Direct costs). Other Co-PI: Rakesh Karmacharya  
This project sought to develop protocols to generate hippocampal CA3 neurons from human induced pluripotent stem cells.
- 2015 – 2016      Re-engineering excitation-inhibition connectivity to rejuvenate memory circuits in aging  
ECOR Deliberative Interim Support Funding (ISF)  
PI (\$75,000, Direct costs)  
This project sought to address critiques of Ro1AG048908 for resubmission.
- 2015 - 2016      Maintaining Memory Fidelity in Aging and Alzheimer's Disease  
Ellison Family Funds (Philanthropic support)  
PI, (\$400,000, Direct costs)  
The proposed research aimed to generate insights into how hippocampal connectivity maintains precision of remote memories in aging and mouse models of Alzheimer's Disease.
- 2016 – 2017      Identification of novel pro-neurogenic factors to enhance memory processing during aging  
Massachusetts Alzheimer's Disease Research Center/Harvard Neurodiscovery Center  
Neurodegenerative Disease Pilot Study Grant

PI (\$40,000, Direct costs)

- 2014 – 2019 Molecular control of excitation-inhibition balance to encode ambiguous threats  
NIH/NIMH 1-R01MH104175  
PI (\$1.625 million, Direct costs)  
The proposed research aims to causally link feed-forward excitation-inhibition balance in dentate gyrus (DG)-CA3 circuit with discrimination of ambiguous threats and global remapping, identify hippocampal outputs that broadcast pattern separation dependent computations to extrahippocampal limbic circuits, and pharmacologically re-engineer DG-CA3 circuitry to improve global remapping.
- 2017 – 2019 Illuminating the neurobiology of human hippocampal pyramidal neurons in schizophrenia  
National Alliance for Research on Schizophrenia and Depression  
Independent Investigator Award  
PI, (\$100,000, Direct Costs)  
The goal of this study is to generate hippocampal pyramidal neurons from human fibroblasts.
- 2017-2019 Characterization of novel secreted pro-neurogenic enzyme  
Harvard Stem Cell Institute  
Seed Grant  
PI, (\$83,334, Direct costs)  
The proposal aims to characterize the pro-neurogenic potential of a secreted enzyme in adult and aged mice and using induced human neural stem cells.
- 2016 - 2021 Re-engineering excitation-inhibition connectivity to rejuvenate memory circuits in aging  
NIH/NIA 1R01AG048908-01A1  
PI, (\$1.25 million, Direct costs)  
This grant will determine how targeting excitation-inhibition balance in the aging hippocampus will improve memory processing.
- 2018-2021 Regulation of subcortical circuits by adult hippocampal neurogenesis  
Blue Guitar Fund, Harvard Stem Cell Institute  
PI, (\$250,000, Direct costs)  
This grant will determine how stimulation of adult-hippocampal neurogenesis modulates subcortical circuits.
- 2018-2021 Targeting feed-forward inhibition in DG-CA3 to improve memory in AD  
Alzheimer's Association International Research Grant - New to the Field Program  
PI, (\$136,365, Direct Costs)  
This project will investigate the role of feed-forward inhibition in DG-CA3 in AD
- 2020-2022 Transcription control of adult hippocampal neural stem cell homeostasis  
NIH/NINDS R56NS117529-01  
PI, (\$350,000, Direct costs)  
This project will investigate the role of the transcription factor Klf9 in regulation of neural stem homeostasis in the adult hippocampus

- 2021-2022 Alzheimer's Disease Supplement 3R01MH111729-04S1 (\$186, 637, Direct Costs)
- 2017-2023 Contributions of hippocampal oxytocin receptors to social recognition  
NIH/NIMH 1R01MH111729 - 01A1  
PI, (\$1.25 million, Direct Costs)  
This project will investigate the role of hippocampal oxytocin receptors in social memory
- 2019-2024 Interrogating plasticity and heterogeneity of inhibitory neurons as gatekeepers of memory processing  
James and Audrey Foster MGH Research Scholar  
PI, (\$500,000, Direct costs)  
This project will examine the molecular and physiological basis of inhibitory neuron plasticity and heterogeneity in hippocampal-septal circuits
- 2020-2025 Linking molecules, circuits and behavior to promote plasticity and memory in the aging Brain  
Glial mechanisms by which sleep preserves cognitive function and plasticity in aging  
Simons Collaboration on Plasticity and the Aging Brain  
PI, (\$1.875 million, Direct costs)  
This project will investigate the molecular regulation of inhibitory interneurons in aging hippocampus and regulation of neurogenesis and microglia
- 2023-2025 Targeting neurogenesis-inhibition coupling to improve memory in aging/ Diversity Supplement  
NIH/NIA 1R01AG076612-01S1  
PI, (\$123,032, Direct costs)  
This project will investigate how inhibitory circuits in the aging hippocampus influence social cognition
- 2024-2025 Inaugral Shenoy Undergraduate Research Fellowship in Neuroscience  
SIMONS Foundation  
\$11,500  
Support undergraduate research in autism and neuroscience

**Current**

- 2025-2030      Linking molecules, circuits and behavior to promote plasticity and memory in the aging Brain  
 Glial mechanisms by which sleep preserves cognitive function and plasticity in aging  
 Simons Collaboration on Plasticity and the Aging Brain  
 PI, (\$1.875 million, Direct costs)  
 This project will investigate the molecular regulation of inhibitory interneurons in aging hippocampus and regulation of neurogenesis and microglia
- 2021-            Harvard Brain Science Initiative (HBI) Community Building Grant  
 Co-Founder and co-Director (\$5000)  
 Goal is to bolster the career development of basic neuroscience trainees at MGH and MEE
- 2022-2027      Targeting neurogenesis-inhibition coupling to improve memory in aging  
 NIH/NIA 1R01AG076612-01  
 PI, (\$2.35 Million, Direct costs)  
 This project will investigate the role of neurogenesis-dependent GABAergic inhibition in memory in aging
- 2023-2028      Hippocampal synaptic and circuit mechanisms mediating Dyrk1a functions in social cognition  
 NIH/NIMH 1R01MH131652-01  
 PI, (\$1.935 Million, Direct costs)  
 This proposal will investigate whether we can target a molecular and circuit mechanism in adulthood to reverse impairments in social cognition circuitry and behavior resulting from developmental loss of one allele of Dyrk1a.
- 2025-2026      Shenoy Undergraduate Research Fellowship in Neuroscience  
 SIMONS Foundation  
 \$11,500  
 Support undergraduate research in autism and neuroscience

## **Report of Local Teaching and Training**

### **Teaching of Students in Courses**

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| 2003 | Neuroanatomy Laboratory course<br><br>1 <sup>st</sup> year medical students | Johns Hopkins University School of Medicine<br>Teaching Assistant; 5 hours per week for 8 weeks |
| 2012 | Lecture in BBS Nanocourse Stem Cells  | MGH and Harvard Medical School  |

	Graduate students	1 hour lecture
2013, 2015	Lecture in DRB Boot Camp Graduate students	MGH and Harvard Medical School 1 hour lecture and 3 hour practicals
2013, 2015, 2018, 2019 2022	Lecture in MCB graduate level course: Interesting Questions in Physical Biology Graduate students	Harvard University 1 hour lecture
2014	Graduate Course Stem Cell and Regenerative Biology SCRB 200 Graduate students	Harvard University 3 hour lecture and discussion
2019-	Lecture in SCRB 140 Development and Molecular basis of Regeneration Undergraduates and Graduates	Harvard University 1 hour lecture
2014 - 2018	Course Co-director Graduate Course BBS Program CB 226: Concepts in Development, Self-renewal and Repair Graduate students	Harvard Medical School 3 hours per week for 13-14 weeks, Fall Semester
2021-	Co-founder and Director of Neural Circuits Trainee Seminars	MGH and MEE 1.5 hours/month
2022-	Neuroscience section, HBTM 235 Leder Human Biology and Translational Medicine Program Graduate students of Harvard and MIT	Harvard Medical School 3 hours lecture & discussion session, Fall semester, 3 classes, 80 hours initial prep

### **Formal Teaching of Residents, Clinical Fellows and Research Fellows (post-docs)**

2011 - 2013	Lecture in PGY2 Neuroscience Course Psychiatry residents	MGH 1 hour lecture
2020-	Clinical and Translational Research Academy Mentor	Harvard Medical School 3 hours/week

### **Laboratory and Other Research Supervisory and Training Responsibilities**

2001	Supervision of undergraduate student	Johns Hopkins University School of Medicine 160 hours
2005 - 2010	Co-supervision of graduate students with PI	Columbia University 3 hours per day

2011 -	Supervision of laboratory technicians / MGH Center for Regenerative Medicine, Sahay lab	MGH Daily mentorship, 5 hours per week
2012 -	Supervision of postdoctoral research fellows / MGH Center for Regenerative Medicine, Sahay lab	MGH Daily mentorship, 2-3 hours per week
2012 -	Supervision of graduate student research / MGH Center for Regenerative Medicine, Sahay lab	MGH Daily mentorship, 3-5 hours per week
2013 -	Supervision of undergraduate student research / MGH Center for Regenerative Medicine, Sahay lab	MGH Daily mentorship, 1-2 hours per week
2020-2023	Scientific Latino's minority graduate student mentorship initiative (GSMI)	2 hour/month

### **Formally Mentored Medical, Dental and Graduate Students**

2012 - 2014	Melissa Boldridge, A.B. Department of Stem Cell and Regenerative Biology, Harvard University Class of 2014. PhD Program in Nutritional Sciences and Toxicology, Univ. California at Berkeley (2019-) Senior Honors Thesis
2013 - 2015	Shannen Kim, A.B. Neurobiology, Harvard University Class of 2015 Senior Honors Thesis in Mind, Brain and Behavior. Co-author on publication in <i>Hippocampus</i> . Recipient of 2013 Harvard College Research Fellowship, 2014 Harvard Stem Cell Institute Undergraduate Research Program (HIP), Phi Beta Kappa Honor Society, <i>summa cum laude</i> in Neurobiology. Medical Student, UCSF Medical School (2017-)
2013 - 2016	Alexia Zagouras, A.B. Department of Stem Cell and Regenerative Biology and Anthropology, Harvard University Class of 2016 Recipient of 2015 Harvard Stem Cell Institute Undergraduate Research Program (HIP) award and 2016 Thomas Hoopes Prize for outstanding scholarly work or research (Amar Sahay and Arthur Kleinman, co-mentors), co-author <i>eLife</i> 2022. Medical student, Cleveland Clinic Lerner College of Medicine of Case Western Reserve University (2018-)
2012	Amelia Chang, Member, BBS Program, Preliminary Qualifying Exam
2012	HuiXin Xu, Member, BBS Program, Preliminary Qualifying Exam
2013	Fongching Chau, Member, BBS Program
2012 -2018	Tara Raam, Graduate Ph.D. Program in Neuroscience, Harvard University

Raam et al, *Nature Communications* 2017, 2017 Wisconsin Emotion Symposium Travel Awardee. 2018-Postdoctoral Fellow at UCLA. 2022 NARSAD Young Investigator Awardee.

- 2012 - 2019 Hugo-Vega Ramirez, graduate student, Program in Neuroscience, Harvard University, Howard Hughes Medical Institute Gilliam Fellow  
Co-authored publication in *Neuron*.
- 2016-2018 Alec Reed, Department of Stem Cell and Regenerative Biology, Harvard University, Class of 2018, Recipient of 2015 Harvard Stem Cell Institute Undergraduate Research Program (HIP) award, Senior honors Thesis, Medical student, Harvard Medical School (2018-).
- 2017- 2020 James Coleman, Department of Stem Cell and Regenerative Biology, Harvard University, Class of 2021, Recipient of 2018 Harvard Stem Cell Institute Undergraduate Research Program (HIP) award, co-author *eLife* 2022
- 2017-2020 Debolina Ghosh, Department of Stem Cell and Regenerative Biology, Harvard University, Class of 2021, Concentration in Neurobiology, Recipient of 2019 Harvard Stem Cell Institute Undergraduate Research Program (HIP) award, Summa Cum Laude Neuroscience Thesis, Highest honors in Neuroscience, co-author *eLife* 2022, Case Western Reserve Medical School (2020-)
- 2018-2019 Victor Steininger, Masters Thesis (Bioengineering), recipient 2018 Harvard-EPFL Bertarelli Fellowship, Ecole Polytechnique Fédérale de Lausanne
- 2018 Peter Angelli, Member, Program in Neuroscience, Preliminary Qualifying Exam
- 2018 Blake Chancellor, Member, BBS program, Preliminary Qualifying Exam  
Dissertation Defense External examiner
- 2018-2023 Michael Florea, Member, BBS program, Preliminary Qualifying Exam  
Dissertation Advisory Committee
- 2018-2022 Rebecca Senft, Member, Program in Neuroscience, Dissertation Advisory Committee
- 2023 Peter Angelli, Member, Program in Neuroscience, Thesis Defense Committee
- 2023 Chris Reid, Member, Program in Neuroscience, Thesis Defense Committee

#### **Other Mentored Trainees and Faculty**

- 2005 - 2010 Kimberly N. Scobie, Ph.D. /Assistant Director, Princeton Neuroscience Institute  
Career stage: Graduate trainee of Dr. Rene Hen (PI) at Columbia University. Mentoring role: Postdoctoral Co-research advisor. Accomplishments: First author on publication in *The Journal of Neuroscience* and second author on publication in *Nature*.

- 2009 - 2011 Alexis S. Hill / Assistant Professor, Department of Biology, College of Wooster, MA  
Career stage: Graduate trainee of Dr. Rene Hen (PI) at Columbia University. Mentoring role: Postdoctoral Co-research advisor. Accomplishments: Third author on publication in *Nature* and first author on publication in *Neuropsychopharmacology*.
- 2011 - 2013 Sally Levinson, B.S./PhD Program in Neuroscience, New York University  
Career stage: Technician in my lab. Mentoring role: Research advisor. Accomplishments: Co-author on publication in *Frontiers in Neural Circuits*. Abstract submitted to 2016 Society For Neuroscience Meeting, San Diego, CA.
- 2012 - 2013 Sreyan Chowdhury, B.S./PhD Program in Biomedical Sciences, Columbia University  
Career stage: Summer intern 2012, 2013. Mentoring role: Research advisor.  
Accomplishments: 2012 Harvard Stem Cell Institute Undergraduate Research Program.
- 2013 - 2015 Tomer Langberg, B.S./ Ph.D. Program in Molecular cellular Biology, UC Berkeley  
Career stage: Technician in my lab. Mentoring role: Research advisor. Accomplishments: Co-author on Besnard et al, *Cell Reports* (2018)
- 2013 - 2014 Genelle Rankin, B.A./Ph.D. Program in Neuroscience, Harvard Medical School  
Career stage: Winter intern 2013, 2014. Mentoring role: Research advisor.  
Accomplishments: Co-author on publication in *Hippocampus*.
- 2013 - 2014 Craig Russo, B.S / Associate, Venture capital  
Career stage: Summer intern 2012, 2013. Mentoring role: Research advisor.  
Accomplishments: 2013 Harvard Stem Cell Institute Undergraduate Research Program (HIP). Co-author on publication in *Neuron* and *Hippocampus*.
- 2014 - 2015 Soyoung Rhee, Ph.D. / SUNY Stony Brook Class of 2015  
Career stage: Graduate student. Mentoring role: External Thesis Advisor.
- 2015 Guilia Zanni, Ph.D. / Gothenburg University Class of 2015  
Career stage: Graduate student. Mentoring role: External Thesis Advisor “Opponent”, Gothenburg University, Sweden.
- 2015 - 2016 Duong Chu, B.S. / Medical Student, Queens University School of Medicine, Ontario, CN  
Career stage: Technician in my lab. Mentoring role: Research advisor. Accomplishments: Co-author on abstract submitted to 2016 Society For Neuroscience Meeting, San Diego, CA. Medical student, Queen’s University Medical School, Ontario, Canada (2017-)
- 2016-2017 Dylan O’Hara, B.A/Bennington College Class of 2018  
Career stage: Winter term intern. Mentoring role: Research advisor. Accomplishments: Admitted SURF program Vollum Institute 2017. Ph.D Program in Neuroscience, SUNY Stony Brook (2018-)
- 2016-2018 Michael Taeho Kim, B.S/ Ph.D program, BBS, Harvard Medical School

Career stage: Technician in my lab. Mentoring role: Research advisor. Accomplishments: Co-author on Guo et al, *Nature Medicine* 2018 and Besnard et al, *Nature Neuroscience* 2019.

- 2016-2018 Charlotte Herber, B.S/ Yale University, Class of 2018  
Career stage: Junior and Senior. Mentoring role: Research advisor.  
Accomplishments: Co-author on Guo et al, *Nature Medicine* 2018, Guo et al *eLife* 2022.  
MSTP Program Stanford University (2018-)
- 2016 Alvar Paris, B.S.  
Career stage: Senior, Cambridge University. Mentoring role: Research advisor.  
Accomplishments: 2016 Harvard Stem Cell Institute Undergraduate Research Program.
- 2017- Cinzia Vicidomini, Ph.D./Postdoctoral Fellow  
Career stage: Postdoctoral Fellow. Mentoring role: Research advisor.  
Accomplishments: 2018 NARSAD Young Investigator Award, co-author *Cell Reports* 2018, First author Review in *Neuron* 2020, 2021MGH ECOR Fund for Medical Discovery (FMD) Fundamental Research Fellowship Award
- 2017- Hannah Twarkowski, Ph.D./ DFG Return Fellow, Data Architect, Germany  
Career stage: Postdoctoral Fellow. Mentoring role: Research advisor.  
Accomplishments: 2018 German Ministry of Science DFG Postdoctoral Fellowship, co-author *Nature Neuroscience* 2019, First author *eLife* 2022
- 2017- Yu-Tzu Shih, Ph.D./Postdoctoral Fellow  
Career stage: Postdoctoral Fellow. Mentoring role: Research advisor.  
Accomplishments: 2018 Taiwan Ministry of Science Postdoctoral Fellowship, 2021MGH ECOR Fund for Medical Discovery (FMD) Fundamental Research Fellowship Award, co-author *eLife* 2022, lead author *Neuron* 2023, lead co-first author, manuscript under revision at *Nature*
- 2017 Chay Graham, B.S.  
Career stage: Senior, Cambridge University. Mentoring role: Research advisor.  
Accomplishments: 2017 Harvard Stem Cell Institute Undergraduate Research Program.
- 2018-2020 Haley Zanga, B.S./Loyola University School of Medicine, Chicago Class of 2026  
Career stage: Technician in my lab, co-author *eLife* 2022
- 2018 Travis Goode, Ph.D./Postdoctoral Fellow  
Career stage: Postdoctoral Fellow, 2020 NARSAD Young Investigator Award, Lead Author on Perspective in *Neuron* 2020, SOBP 2023 Travel Awardee, 2023 NIMH K99/R00 Awardee, Interviewing Faculty positions
- 2018-2021 Samara Miller, Ph.D./Postdoctoral Fellow (UCLA)  
Career stage: Postdoctoral Fellow  
Accomplishments: Miller and Sahay, *Nature Neuroscience* 2019, second author on *Cell Reports* 2020.

- 2019 Michael Kritzker-Cohen M.D, Ph.D.  
Career stage: Postdoctoral Fellow, T32 MGH Psychiatry
- 2020-2022 Robert William Meara, B.S/Tevard Biosciences  
Career stage: Lab technician  
Accomplishments: co-author *eLife* 2022
- 2022- Jason Alipio, Ph.D  
Career stage: Postdoctoral Fellow  
Accomplishments: NIA Diversity Supplement, co-author *Neuron* 2023

### Graduated to Faculty

- 2012 -2017 Kathleen McAvoy, PhD/ Senior Research Scientist, Arvinas Pharma.  
Career stage: Postdoctoral Fellow. Mentoring role: Research advisor. Accomplishments: First author publications in *Neuron*, *Hippocampus*, *Frontiers in Systems Neuroscience*, *Neurotherapeutics*, co-author *Nature Communications*. Recipient of 2015 Health Emotions Institute Travel Award.
- 2012 – 2020 Antoine Besnard, Ph.D./ Tenure track, Assistant Professor, INSERM, France. Career stage: Instructor. Mentoring role: Research advisor. Accomplishments: Recipient of 2012 Fondation Bettencourt Fellow, 2014 NARSAD Young Investigator Award, 2014 Health Emotions Institute Travel Award, 2016 MGH ECOR Fund for Medical Discovery (FMD) Postdoctoral Fellowship Award. Besnard and Sahay, *Neuropsychopharmacology* 2016, Besnard et al, *Cell Reports* 2018, Besnard et al *Nature Neuroscience* 2019, Besnard and Sahay, *Cell Reports* 2020, Besnard and Sahay *Brain Behavior Research* 2020, *Frontiers in Systems Neuroscience* (co-first author) and *Frontiers in Neural Circuits* (co-author).
- 2012 -2020 Nannan Guo, Ph.D. / Tenure track, Assistant Professor, Department of Neurobiology, Southern Medical University, China) Career stage: Instructor. Mentoring role: Research advisor. Accomplishments: Guo et al, *Nature Medicine* (2018), Guo et al, *eLife* 2022, First author on Book Chapter (2015), co-first author Review in *Neuron* 2020. Invited Speaker at 2019 Japan Neuroscience Society Meeting.
- 2019 -2022 Ain Chung, Ph.D. /Tenure track, Assistant Professor, Department of Bioengineering, Korea Advanced Institute of Science and Technology (KAIST), Seoul, Korea. Also received offer from Department of Psychological Sciences, Purdue University, IN) Career stage: Postdoctoral Fellow. Mentoring role: Research advisor.

2018 -2026 Travis D. Goode, Ph.D. /Interviewing for faculty positions (January 2026)  
Career stage: Postdoctoral Fellow. Mentoring role: Research advisor.

### **Local Invited Presentations**

*No presentations below were sponsored by outside entities.*

- 2011 Adult neurogenesis, Anxiety and Depression / Invited Talk  
MGH Leadership Council in Psychiatry
- 2012 Harnessing adult hippocampal neurogenesis to enhance cognition and modulate mood /  
Translational Neuroscience Lecture  
Psychiatric Neurogenetics Unit, MGH
- 2012 Harnessing adult hippocampal neurogenesis to enhance cognition and modulate mood /  
Grand Rounds  
Center for Addiction Medicine, MGH
- 2012 Harnessing adult hippocampal neurogenesis to enhance cognition and modulate mood /  
PTSD seminar; Invited talk  
Home Base Program, MGH
- 2013 Adult hippocampal neurogenesis, pattern separation-completion balance and  
overgeneralization of fear / MGH Inaugural Grand Rounds: Translating basic  
neuroscience insights into PTSD mechanisms & circuits  
Department of Psychiatry, MGH
- 2013 Harnessing adult hippocampal neurogenesis to enhance cognition and modulate mood /  
Seminar series; Invited talk  
Department of Psychiatry, McLean Hospital
- 2014 Harnessing adult hippocampal neurogenesis to enhance cognition and modulate mood /  
Invited talk  
Depression Clinical & Research Program, MGH
- 2014 Rejuvenating memory circuits with new neurons in adulthood and aging / Invited talk  
Stem Cells 2.0, Harvard Stem Cell Institute, MGH
- 2015 Molecular mechanisms, neural circuits and pathways underlying fear generalization /  
PTSD seminar  
Home Base Program, MGH
- 2015 Re-engineering and rejuvenating memory and mood circuits with new brain cells / Invited  
talk  
Seminar to MGH Chiefs Council, MGH

- 2015 Rejuvenating and re-engineering memory circuits in adulthood and aging / Invited seminar; host: Brad Hyman  
Department of Neurology, MGH
- 2016 Enhancing memory precision to combat PTSD / Medical Grand Rounds  
Department of Medicine, MGH
- 2018 Hippocampal circuit mechanisms underlying social memory processing / Harvard Interdisciplinary Oxytocin research initiative, MGH
- 2018 Rejuvenating and re-engineering hippocampal circuits to modulate memory interference/  
Boston Children's Hospital NeuroBehavioral Core Symposium
- 2018 Adult hippocampal neurogenesis: Neural stem cells, circuits and memory  
BBS sponsored seminar, MGH
- 2020 Rejuvenating and re-engineering memory and emotion circuits  
ECOR sponsored research Scholars Update, MGH
- 2022 A transcriptional regulator of neural stem cell expansion and anticipatory neurogenesis in  
the adult brain  
DRB sponsored seminar, HMS
- 2022 Improving cognition in the aging brain  
BIDMC Division of Gerontology Grand Rounds, HMS

## **Report of Regional, National and International Invited Teaching and Presentations**

### **Invited Presentations and Courses**

*No presentations below were sponsored by outside entities.*

#### **Regional**

- 2013 Genetic modulation of neuronal competition homeostasis in the adult dentate gyrus to  
enhance hippocampal functions (selected oral abstract)  
Abcam Brain Repair and Reprogramming, Cambridge, MA
- 2016 Rejuvenating and re-engineering memory circuits in adulthood and aging / Invited talk  
Department of Biology, Boston University, Boston, MA
- 2016 Rejuvenating memory circuits to constrain fear generalization and age-related cognitive  
decline / Invited talk  
Neuron to Synapse and Optogenetics, Burlington, MA
- 2016 Optimizing aging memory circuits: Insights from rejuvenating, re-engineering and  
reprogramming approaches/Invited Talk

Stem Cell 2.0, Boston, MA

- 2017 Rejuvenating and re-engineering memory circuits in adulthood and aging / Invited talk  
Department of Molecular and Cellular Biology, Brown University, Providence, RI
- 2024 Neotenic expansion of adult-born neurons reconfigures inhibition to enhance social  
cognition/Graduate student invited seminar  
WPI, Worcester, MA
- 2025 Rejuvenation, Re-wiring and Restoration of memory circuits to preserve cognition.  
cognition/Invited talk  
Harvard Stem Cell Institute at 20, HMS, Boston, MA
- 2025 On Synapses, Memory and Neural Networks  
Diamond Middle School lecture, Lexington, MA
- 2026 Pro-cognitive restoration of PV interneuron plasticity in neurodevelopmental disorders  
/Invited Talk  
Rosamund Stone Zander and Hansjoerg Wyss Translational Neuroscience Center (TNC),  
Children's Hospital, Harvard Medical School

**National**

- 2009 Increasing adult hippocampal neurogenesis is sufficient to improve pattern separation but  
not Mood (selected oral abstract)  
Molecular Cellular Cognition Society Meeting, Chicago, IL
- 2009 Increasing adult hippocampal neurogenesis is sufficient to enhance pattern separation but  
not Mood (selected oral abstract)  
Synapses: From Molecules to Circuits & Behavior, Cold Spring Harbor Laboratory  
Meetings, New York
- 2010 Impact of increasing adult hippocampal neurogenesis on cognition and mood (selected  
oral abstract)  
Basic Neuroscience of Mood Disorders and Their Treatment, American College of  
Neuropsychopharmacology Meeting, Miami, FL
- 2011 Targeting adult neurogenesis to modulate hippocampal functions in cognition and mood /  
Faculty Candidate Interview; Invited seminar  
MGH Center for Regenerative Medicine, Harvard Medical School, MA; University of  
Pittsburgh, PA; University of Southern California, CA; Northwestern University, IL;  
University of Utah, UT; Scripps Institute, FL; University of Virginia, VA; University of  
Michigan, MI; University of California, Irvine, CA, Rutgers University, NJ (declined),  
University of Rochester, NY (declined), Medical University of South Carolina, SC  
(declined), Duke University-NUS, Singapore, (declined).

- 2011 Impact of increasing adult hippocampal neurogenesis on cognition and mood (selected oral abstract)  
Keystone Symposia, Adult Neurogenesis, Taos, NM
- 2013 Harnessing adult hippocampal neurogenesis to enhance cognition and modulate mood / Invited talk  
New Scholars Series, Reed College, Portland, OR
- 2013 Harnessing adult hippocampal neurogenesis to enhance cognition and modulate mood / Invited talk  
Kavli-National Academy of Science "Frontiers of Science" symposium, Irvine, CA
- 2013 Harnessing adult hippocampal neurogenesis to enhance cognition and regulate mood / Invited talk  
Penn State Neuroscience 2013 Graduate student invited speaker, Hershey, PA
- 2014 Re-engineering memory circuits with new neurons / Invited talk  
American Psychological Association Annual Meeting, Washington, DC
- 2014 Rejuvenating and re-engineering memory circuits in adulthood and aging / Invited talk  
Vollum Institute of Neuroscience, Portland, OR
- 2015 Rejuvenating and re-engineering memory circuits in adulthood and aging / Invited talk  
State University of New York, Stony Brook, NY
- 2015 Tuning adult hippocampal neurogenesis to constrain fear generalization in adulthood and aging / Invited talk  
ACNP Meeting, Hollywood, FL
- 2015 Local circuits and neural pathways linking adult hippocampal neurogenesis with fear generalization / Invited talk  
ACNP Meeting, Plenary Session, Hollywood, FL
- 2016 Rejuvenating and re-engineering memory circuits in adulthood and aging / Invited talk  
Department of Molecular Biology, UT Southwestern, Dallas, TX
- 2016 Hippocampal circuit mechanisms underlying fear generalization / Invited talk  
Society of Biological Psychiatry, Atlanta, GA
- 2016 Rejuvenating and re-engineering memory circuits in adulthood and aging /Invited Talk  
Eli and Edythe Broad Center for Regenerative Medicine and Stem Cells, UCSF, CA.
- 2017 Rejuvenating and re-engineering memory circuits in adulthood and aging /Invited Talk  
Keystone Meeting, Lake Tahoe, CA
- 2017 Rejuvenating and re-engineering aging memory circuits/Invited Talk

Neuroplasticity, Neuroregeneration and Brain Repair, New York Academy of Sciences, NY

- 2017 Rejuvenating memory circuits in adulthood and aging /Invited Talk  
University of Virginia, VA
- 2017 Rejuvenating memory circuits in aging /Invited Talk  
Cognitive Aging Summit III, NIH, Bethesda, MD
- 2018 Hippocampal circuit mechanisms underlying memory discrimination and generalization /Invited Talk  
Department of Pharmacology, University of Washington, Seattle
- 2018 Dentate granule cell recruitment of feedforward inhibition governs engram maintenance and remote memory generalization /Invited Talk  
Learning and Memory 2018, Huntington Beach, CA
- 2018 Molecular re-engineering of aging memory circuits/Invited Speaker  
Samsung Global Research Symposium on Molecular Neuroscience, Mountain View, CA
- 2018 Hippocampal circuit mechanisms underlying memory discrimination and generalization /Invited Talk  
Department of Neuroscience, Johns Hopkins University, Baltimore, MD
- 2018 Stem cells and disease modeling: Neuropsychiatric and neurodegenerative Disease/Chair, Nanosymposium, Society for Neuroscience Annual Meeting, San Diego, CA
- 2019 Inhibitory interneurons: Gatekeepers of indexing, discrimination and generalization/Invited Speaker  
University of California, Irvine, Center for the Neurobiology of Learning and Memory Colloquium series
- 2019 Inhibition, Memory Interference and Indexing/Invited Speaker  
Gordon Research Conference, Inhibition in the CNS, Newry, Maine
- 2019 Dentate granule cells, memory discrimination and generalization/Selected Speaker  
Annual Molecular Psychiatry Meeting, San Francisco, CA
- 2019 Neurogenesis, memory interference and memory indexing/Invited Speaker  
Neuroscience Seminar series, University of Wisconsin, Madison
- 2019 Contribution of new neurons to hippocampal functions/Invited Speaker  
Minisymposium, Adult Hippocampal neurogenesis in humans and rodents: New evidence and New perspectives. Society for Neuroscience Annual Meeting, Chicago, Illinois
- 2019 Rejuvenating and re-engineering aging memory circuits/Invited Speaker  
Plasticity in the aging brain, Simons Foundation, New York City, NY

- 2020 Rejuvenating, re-engineering and restoring aging memory circuits/Invited Speaker  
NIA Summit on Neurogenesis and Aging, NIH, Washington DC (Virtual)
- 2020 Decoding Hippocampal-lateral septal projection logic governing contextual calibration of  
defensive behaviors/Invited Speaker (Virtual)  
Inscopix World wide Webinars in Neuroscience, Palo Alto California
- 2021 A transcriptional regulator of neural stem cell expansion and anticipatory neurogenesis in  
the adult brain/Invited Speaker (Virtual)  
MDI Biological Laboratory, Bar Harbor, Maine, USA
- 2021 Adult hippocampal neurogenesis, memory and aging/Invited Speaker (Virtual)  
Stem cells and Aging Workshop, sponsored by NIA, MDI Biological Laboratory, Bar  
Harbor, Maine, USA
- 2021 Rejuvenating and Re-engineering aging memory circuits /Invited Speaker  
GSA 2021 Annual Scientific Meeting, Phoenix, Arizona, USA
- 2021 Lateral Septum: From ontogeny to Function in Motivated Behaviors /Selected symposium  
ACNP Meeting, San Juan, Puerto Rico, USA
- 2022 Improving Cognition in the Aging Brain /Plenary lecture ASNR 60th Annual Meeting and  
Symposium Neuroradiologicum XXII, New York, USA
- 2022 A dentate gyrus inhibitory microcircuit governs memory consolidation/Invited Talk  
Neuroscience Seminar Series, University of Alabama, Birmingham, AL
- 2023 Re-engineering memory circuits to improve cognition /Invited Talk  
Neuroscience Seminar Series, University of North Carolina, Chapel Hill, NC, USA
- 2023 An inhibitory circuit-based enhancer of Dyrk1a function reverses Dyrk1a-associated  
impairment in social cognition/Symposium  
International Learning and Memory Meeting, Huntington Beach, CA, USA
- 2023 Re-engineering memory circuits to improve cognition/Invited Talk  
Neuroscience Seminar Series, O'Donnell Brain Institute, UT Southwestern, Dallas, TX
- 2023 Re-engineering inhibitory microcircuits to improve cognition/Invited Talk  
Center for Neural Science and Medicine Neuroscience seminar series, Cedars-Sinai  
Medical Center, Los Angeles, CA
- 2024 Rejuvenating memory circuits /Invited Talk  
Distinguished Speaker Seminar Series, Department of Stem Cell Biology and  
Regenerative Medicine, USC, Los Angeles, CA

- 2025 Pro-cognitive restoration of PV interneuron plasticity in neurodevelopmental disorders /Invited Talk  
Gordon Research Conference, Inhibition in the CNS, Newry, Maine
- 2025 Neotenic expansion of new neurons reconfigures inhibition to enhance social cognition /Invited Talk  
University of Illinois at Chicago, Chicago, IL
- 2025 Pro-cognitive restoration of PV interneuron plasticity in neurodevelopmental disorders /Invited Talk  
Experience-driven dynamics in cortical inhibition for learning and memory, Society for Neuroscience Mini Symposium, San Diego, CA
- 2026 Pro-cognitive restoration of PV interneuron plasticity in neurodevelopmental disorders /Invited Talk  
University of Michigan, Ann Arbor, MI, USA

#### **International**

- 2009 Harnessing adult hippocampal neurogenesis to enhance cognition and regulate mood / Invited talk  
8th Dutch Endo-Neuro-Psycho Meeting, Hippocampal Neuroplasticity in Health and Disease, Doorwerth, The Netherlands
- 2010 Harnessing adult hippocampal neurogenesis to enhance cognition and regulate mood / (selected oral abstract)  
Adult Neurogenesis: Structure and Function, Frauenchiemsee, Germany
- 2013 Genetic modulation of neuronal competition homeostasis in the adult dentate gyrus to enhance hippocampal functions / Invited talk  
Abcam Neurogenesis, Matsushima, Miyagi, Japan
- 2014 Re-engineering the adult dentate gyrus through neuronal competition to enhance memory precision  
Adult Neurogenesis: From stem cells to therapies, Mumbai, India
- 2014 Rejuvenating the dentate gyrus with stage-specific expansion of adult-born neurons to enhance memory precision in adulthood and aging / (selected oral abstract)  
Keystone Symposia, Adult Neurogenesis, Stockholm, Sweden
- 2014 Rejuvenating and re-engineering memory circuits in adulthood and aging / Invited talk  
Johannes Gutenberg University of Mainz & Program Translational Neuroscience, Germany.

- 2015 Rejuvenating and re-engineering memory circuits in adulthood and aging / Invited talk  
Weizmann Institute of Science, Rehovot, Israel
- 2015 Local circuits and neural pathways linking adult hippocampal neurogenesis with fear generalization / Invited talk  
Harvard- Ludwig-Maximilians-Universität in Munich (LMU) Young Scientist Forum, Munich, Germany
- 2015 Rejuvenating and re-engineering memory circuits in adulthood and aging / Seminar  
Gothenburg University, Sweden
- 2016 Rejuvenating and re-engineering memory circuits in adulthood and aging / Invited talk  
1<sup>st</sup> Neurogenesis Fusion Conference, Cancun, Mexico
- 2016 How adult-born neurons link encoding with emotional responses / Invited talk  
3<sup>rd</sup> Eurogenesis Meeting, Adult Neurogenesis in Physiology and Disease, Bordeaux, France.
- 2017 Rejuvenating and re-engineering memory circuits in adulthood and aging / Invited talk  
Center for Regenerative Therapies, Dresden, Germany
- 2019 Hippocampal circuit mechanisms underlying discrimination and generalization/Invited Talk  
Campbell Family Mental Health Research Institute, Toronto, Ontario, Canada
- 2019 Inhibitory interneurons: Gatekeepers of indexing, discrimination and generalization/Invited Talk  
Neuroscience Distinguished Lectureship series, Collaborative Program in Neuroscience, University of Toronto, Ontario, Canada.
- 2019 Hippocampal circuit mechanisms underlying discrimination and generalization/Invited Speaker  
EMBO Workshop, Molecular neuroscience: From genes to circuits in health and disease, Bangalore, India
- 2019 Dentate granule cells and memory precision/Invited Speaker  
2<sup>nd</sup> Neurogenesis Fusion Conference, Nassau, Bahamas
- 2019 Dentate granule cells, memory discrimination and generalization/Invited Talk  
4<sup>th</sup> Eurogenesis Meeting, Adult Neurogenesis in Physiology and Disease, Bordeaux, France
- 2019 Hippocampal Inhibition, Memory Interference and Indexing/ Invited talk  
Hebb 70: Synapses, Engrams, and Disease/  
Symposium to celebrate 70<sup>th</sup> Anniversary of Donald Hebb's "The Organization of Behavior, Toronto
- 2020 XIV. International Magdeburg Learning & Memory Meeting 2020/Invited Talk

Learning And Memory: Cellular and Systemic Views, Magdeburg, Germany  
(Postponed due to Covid 19)

- 2021 Hippocampal Inhibition, Memory Interference and Indexing/ Invited talk  
Neurosur 2021 Symposium (Harvard/ University of Chile, the University of Santiago de Chile, the University of Valparaiso Joint Meeting)
- 2021 Understanding how a hippocampal inhibitory microcircuit contributes to memory consolidation and generalization/invited speaker  
<https://www.crowdcast.io/e/amarsahays-wwndev-forum>
- 2022 A dentate gyrus inhibitory microcircuit governs memory consolidation/Invited Talk  
Neuronal representation - From Synapses and microcircuits to behavior, July 1-2, Freiburg, Germany
- 2022 Lateral septal inhibitory neurons govern calibrate defensive and appetitive behaviors/Plenary Speaker  
Brain mapping & Psychiatric disorders, Korea Brain Research Institute, Daegu, Korea
- 2024 Neotenic expansion of adult-born neurons reconfigures inhibition to enhance social Cognition/Invited Speaker  
Institute of Neuroscience, CEBSIT, Chinese Academy of Sciences, Shanghai, China
- 2024 Neotenic expansion of adult-born neurons reconfigures inhibition to enhance social Cognition/Invited Speaker  
SMU, Guongzhou, China
- 2026 Re-engineering inhibition to enhance cognition /Invited Talk  
Aging and Adult Neurogenesis International Symposium, Academia Sinica, Taiwan
- 2026 Pro-cognitive restoration of PV interneuron plasticity in neurodevelopmental disorders /Invited Talk  
Symposium: Inhibitory neurons-From synapses and microcircuits to behavior  
University of Freiburg, Freiburg, Germany

## **Report of Technological and Other Scientific Innovations**

Strategies that stimulate adult neurogenesis and improve cognition (2010)	Provisional US Patent Application; April 13, 2010 (expired) We demonstrated in proof of concept study that stimulating neurogenesis by targeting the Bax gene improved memory.
Agents and Methods for diagnosing and treating	Provisional US Patent Application; March 13, 2014 (Application 61/952, 485)

behavioral disorders (2014)	We identified a gene important for memory in adulthood and aging and demonstrated a strategy targeting this gene to improve memory.
Memory-regulating agents and methods (2019)	US Patent 10, 287, 580 (Issued May 14, 2019) Methods for inhibition of Ablim3 to improve memory in aging, Alzheimer's disease and PTSD.
Vectors and Methods for treatment of neurodegeneration, delaying cognitive decline and improving memory	PCT/US2023/016901 Gene Therapy for reducing neuroinflammation and preserving memory in aging and Alzheimer's disease.

## **Report of Education of Patients and Service to the Community**

### **Activities**

*No activities below were sponsored by outside entities.*

- 1995                      Genetics Course, Mount Anthony Union High School, VT / Co-instructor.  
Developed practical component of course to study genetics using yeast model system.

## **Report of Scholarship**

### **Peer-Reviewed Scholarship in print or other media**

#### **Research Investigations**

1. Giger RJ, Cloutier JF\*, **Sahay A\***, Prinjha RK\*, Levengood DV, Moore SE, Pickering S, Simmons D, Rastan S, Walsh FS, Kolodkin AL, Ginty DD, Geppert M. Neuropilin-2 is required in vivo for selective axon guidance responses to secreted semaphorins. *Neuron*. 2000 Jan;25(1):29-41. PMID:10707970. (\* equal contribution)
2. **Sahay A**, Molliver ME, Ginty DD, Kolodkin AL. Semaphorin 3F is critical for development of limbic system circuitry and is required in neurons for selective CNS axon guidance events. *The Journal of Neuroscience*. 2003; 23(17): 6671-6680. PMID: 12890759.
3. Cloutier JF\*, **Sahay A\***, Chang EC, Tessier-Lavigne M, Dulac C, Kolodkin AL, Ginty DD. Distinct requirements for Semaphorin 3F and Slit-1 in axonal targeting, fasciculation and segregation of olfactory receptor sensory neuron projections. *The Journal of Neuroscience*. 2004; 24(41): 9087-9096. PMID: 15483127. (\* equal contribution)
4. **Sahay A\***, Kim CH\*, Sepkuty JP, Cho E, Hujanir RL, Ginty DD, Kolodkin AL. Secreted semaphorins modulate synaptic transmission in the adult hippocampus. *The Journal of Neuroscience*. 2005; 25(14): 3613-3620. PMID:15814792. (\* equal contribution)

5. Scobie KN, Hall BJ, Wilke SA, Klemenhausen KC, Fujii-Kuriyama Y, Ghosh A, Hen R, **Sahay A**. Krüppel-like factor 9 (Klf-9) is necessary for late-phase neuronal maturation in the developing dentate gyrus and during adult hippocampal neurogenesis. *The Journal of Neuroscience*. 2009; 29(31): 9875-9887. PMC2753873.
6. Weber T, Baier V, Pauly R, **Sahay A**, Baur M, Herrmann E, Ciccolini F, Hen R, Kronenberg G, Bartsch D. Inducible gene expression in GFAP+ progenitor cells of the SGZ and the dorsal wall of the SVZ— a novel tool to manipulate and trace adult neurogenesis. *Glia*. 2011; 59(4):615-626. PMID: 21294160.
7. **Sahay A\***, Scobie KN, Hill AS, O'Carroll CM, Kheirbek MA, Burghardt NS, Fenton AA, Dranovsky A, Hen R\*. Increasing adult hippocampal neurogenesis is sufficient to improve pattern separation. *Nature*. 2011; 472 (7344): 466-470. PMC3084370. \*Co-corresponding author.
  - “New Neurons, New Opportunities”, Leading Edge, Learning & Memory, *Cell* 145, May 13, 2011
  - Research Highlights, *Nature Reviews Neuroscience*, Volume 12, June 2011
  - “New strategy for stimulating neurogenesis may lead to drugs to improve cognition and mood”, Eurekalert, April 3, 2011
  - “More Young Neurons Equals Better Brain Function”, Massachusetts Alzheimer's Disease Research Center (<http://madrc.mgh.harvard.edu>), April 4, 2011
  - “Engineered Mice Make Better Choices”, *MIT Technology Review*, April 6, 2011
  - “Nurturing newborn neurons sharpens minds in mice Also lifts mood when combined with exercise- NIH-funded study”, NIH Press Release, April 3, 2011
  - Cited > 1700 times
8. Tata PR, Mou H, Pardo-Saganta A, Zhao R, Prabhu M, Law BM, Vinarsky V, Cho JL, Breton S, **Sahay A**, Medoff BD, Rajagopal J. Dedifferentiation of committed luminal epithelial cells into functional stem cells *in vivo*. *Nature*. 2013; 503(7475):218-223. PMC4035230.
9. Ikrar T, Guo N, He K, Besnard A, Levinson S, Hill A, Lee HK, Hen R, Xu X, **Sahay A**. Adult neurogenesis modifies excitability of the dentate gyrus. *Frontiers in Neural Circuits*. 2013;7:204. PMC3872742.
10. Hill AS, **Sahay A\***, Hen R\*. Increasing adult hippocampal neurogenesis is sufficient to reduce anxiety and depression-like behaviors. *Neuropsychopharmacology*. 2015; 40(10):2368-2378. PMC4538351. \* Co-corresponding author.
11. McAvoy K, Russo C, Kim S, Rankin G, **Sahay A**. Fluoxetine induces input-specific dendritic spine remodeling in adulthood and middle age. *Hippocampus*. 2015; 25(11):1429-1446. PMC4596739.
12. McAvoy K, Scobie KN, Berger S, Russo C, Guo N, Decharatanachart P, Miake-LyeS , Whalen M, Nelson M, Bergami M, Bartsch D, Hen R, Berninger B, **Sahay A**. Modulating neuronal competition dynamics in the dentate gyrus to rejuvenate aging memory circuits. *Neuron*. 2016; 91(6):1356-1373.
  - “Encouraging Integration”. Research Highlights in *Nature Reviews Neuroscience*, Volume 17, number 11, November, 2016.
  - Previewed in “Re-engineering the Hippocampus” in *Neuron*, 2016; 91(6): 1190-1191.

- “Making memories stronger and more precise during aging”. EurekAlert, 1 September 2016.
  - “Identifying mechanisms that may keep memories sharp in the aging brain”. Featured in Newsroom, National Institute on Aging.
13. Kaluski S, Portillo M, Besnard, A, Stein D, Einav M, Zhong L, Ueberham U, Arendt T, Mostoslavsky R, **Sahay A**, Toiber D. Neuroprotective functions for the histone deacetylase SIRT6. *Cell Reports*. 2017; 18(13):3052-3062.
  14. Raam T, McAvoy K, Besnard A, Veenema A, **Sahay A**. Hippocampal oxytocin receptors are necessary for discrimination of social stimuli *Nature Communications*. 2017. 8(1):2001.
    - HMS News and research. Study reveals an oxytocin-fueled brain circuit that regulates social recognition <https://hms.harvard.edu/news/social-memory>
    - Boston Globe Dec 14, 2017. How the brain distinguishes friends from strangers
  15. Culig L, Surget A, Bourdey M, Khemissi W, Le Guisquet AM, Vogel E, **Sahay A**, Hen R, Belzung C. Increasing adult hippocampal neurogenesis in mice after exposure to unpredictable chronic mild stress may counteract some of the effects of stress. *Neuropharmacology* 2017; 126:179-189
  16. Dietrich J, Baryawno N, Nayyar N, Valtis YK, Yang B, Ly I, Besnard A, Severe N, Gustafsson KU, Andronesi OC, Batchelor TT, **Sahay A**, Scadden DT. Bone marrow drives central nervous system regeneration after radiation injury. *Journal of Clinical Investigation* 2018; 128(1) 281-293.
  17. Guo N, Soden ME, Herber C, Kim MT, Besnard A, Lin P, Ma X, Cepko CL, Zweifel LS, **Sahay A**. Dentate granule cell recruitment of feedforward inhibition governs engram maintenance and remote memory generalization *Nature Medicine*. 2018; 24(4):438-449.
    - News and Views in *Nature Medicine*
    - “Switch” that could improve memory identified, The Harvard Gazette
    - Investigators identify neural circuit genetic “switch” that maintains memory precision, EurekAlert 12 March 2018.
    - NIH Director discussed this paper in his monthly blog on advances in sciences and medicine <https://directorsblog.nih.gov/2018/05/24/unlocking-the-brains-memory-retrieval-system/>
  18. Besnard A, Langberg T, Levinson S, Chu D, Vicidomini C, Scobie KN, Dwork AJ, Arango V, Rosoklija GB, Mann JJ, Hen R, Leonardo ED, Boldrini M, **Sahay A**. Targeting Kruppel-like factor 9 in excitatory forebrain neurons protects against chronic stress-induced impairments in dendritic spines and fear responses *Cell Reports* 2018 23 (11): 3183-3196.
    - HMS News and research. Blocking key protein prevents impact of stress on neurons and alters fear response in mice. <https://hms.harvard.edu/news/silencing-stress>
  19. Besnard A, Gao Y, Kim MT, Twarkowski H, Langberg T, Feng W, Xu X, Saur D, Zweifel L, Davison I and **Sahay A**. Dorsolateral septum somatostatin interneurons gate mobility to calibrate context specific behavioral fear responses *Nature Neuroscience* 2019 22 (3): 436-446
    - Massachusetts General study identifies brain cells that modulate behavioral response to threats [https://www.eurekalert.org/pub\\_releases/2019-02/mgh-mgs021119.php](https://www.eurekalert.org/pub_releases/2019-02/mgh-mgs021119.php)

- Threat sensors: the neurons that regulate fear response  
<https://hsci.harvard.edu/news/threat-sensors>

20. Besnard A, Miller S and **Sahay A**. Distinct dorsal and ventral hippocampal CA3 outputs govern contextual fear discrimination. *Cell Reports* 2020; 30(7):2360-2373.

21. Centonze A, Lin S, Tika E, Sifrim A, Fioramonti M, Malfait M, Song Y, Wuidart A, Van Herck J, Dannau A, Bouvencourt G, Dubois C, Dedoncker N, **Sahay A**, de Maertelaer V, Siebel CW, Van Keymeulen A, Voet T, Blanpain C. Heterotypic cell-cell communication regulates glandular stem cell multipotency. *Nature* 2020; 584, 608–613

22. Besnard A, and **Sahay A**. Enhancing adult neurogenesis promotes contextual fear memory discrimination and activation of hippocampal-dorsolateral septal circuits *Beh Brain Research* 2020; Sep 16;112917. doi: 10.1016/j.bbr.2020.112917.

23. Choi S, Zhang B, Ma S, Gonzalez-Celeiro M, Stein D, Jin X, Kim ST, Kang Y, Besnard A, Rezza A, Grisanti L, Buenrostro J, Rendl M, Nahrendorf M, **Sahay A**, Hsu Y. Corticosterone inhibits GAS6 to govern hair follicle stem-cell quiescence. *Nature* 2021;592, 428-432

24. Guo N, McDermott KD, Shih YS, Zanga H, Ghosh D, Herber C, Meara WR, Coleman J, Zagouras A, Wong LP, Sadreyev R, Gonçalves JT and **Sahay A**. Transcriptional regulation of neural stem cell expansion in the adult hippocampus. *eLife* 2022;11:e72195

25. Twarkowski H, Steininger V, Kim MJ, and **Sahay A**. A dentate gyrus-CA3 inhibitory circuit promotes evolution of hippocampal-cortical ensembles during memory consolidation. *eLife* 2022 11:e70586

26. Shih Y-T, Alipio JB and **Sahay, A**. An inhibitory circuit-based enhancer of DYRK1A function reverses *Dyrk1a*-associated impairment in social recognition. *Neuron* 2023;111(19): 3084-3101

- Some social issues in DYRK1A model mice stem from faulty inhibitory circuits  
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### Reviews, chapters, monographs and editorials

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## Thesis

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## Narrative Report

### Area of Excellence-Investigation

Adaptively responding to the environment is critical to optimal navigation of our world. The hippocampus plays a critical role in this process by generating memories of our experiences, transferring these memories for storage or consolidation to the prefrontal cortex and recalling and routing memories to subcortical circuits to calibrate defensive and motivated behaviors (e.g., approach, cadence, avoidance, reward seeking). It is intuitive to think how aberrations in hippocampal circuit mechanisms underlying memory processing or storage or linkage of mnemonic information with subcortical circuits are the basis for cognitive impairments in brain disorders. Using a bottom-up gene->synapse->circuit->network->systems level approach, my lab has generated fundamental insights into molecular, circuit and network

plasticity mechanisms supporting cognition. Since psychiatric and neurological disease risk genes converge upon these same mechanisms, our science may ultimately guide therapeutic strategies to alleviate cognitive impairments associated with aging, neurodevelopmental disorders, Alzheimer's Disease and PTSD.

In the field of adult hippocampal neurogenesis, we were the first to demonstrate that increasing adult hippocampal neurogenesis is sufficient to improve memory discrimination in adulthood and aging (*Nature* 2011, *Neuron* 2016). In a manuscript under revision (Chung, Alipio et al, Accepted, *Nature Neuroscience*), we identified a parvalbumin inhibitory neuron-dependent circuit mechanism by which a small number of immature neurons exert a disproportionate effect on hippocampal network activity and cognition. This discovery may explain how neoteny of a small number of adult-born hippocampal neurons functionally compensates for decline in adult hippocampal neurogenesis in humans. Thinking about other approaches to boost neurogenesis in the aging brain or following injury led us to ask if we could replenish the cognitive reserve embodied in the pool of neural stem cells in the hippocampus. Our efforts led to discovery of the first transcriptional regulator of neural stem expansion in the adult hippocampus (*eLife* 2022). In a functional genetic screen for synapse-loss induced dentate granule neuron secreted factors we identified a secreted phospholipase whose expression is increased in dentate granule neurons during aging. Our functional analysis demonstrated that this secreted phospholipase confers cognitive resilience during aging and in mouse models of Alzheimer's disease by reducing neuroinflammation and preserving synapses and memory (Global Patent filed 2022, Vicidomini et al, *Nature Neuroscience* 2026).

Complementing these efforts to *rejuvenate* and *replenish* cognitive reserve in the hippocampus during aging, we investigated how we can molecularly *re-engineer* inhibitory circuit connectivity to improve memory precision. We identified a learning-dependent molecular specifier of parvalbumin inhibitory neuron microcircuitry in the hippocampus. We demonstrated how this molecular factor can be harnessed to re-engineer hippocampal circuitry to enhance memory consolidation and precision in adulthood and aging (*Nature Medicine* 2018, US Patent awarded 2019). We built on this work to demonstrate how selectively increasing feed-forward inhibition promotes hippocampal-cortical communication underlying memory consolidation (*eLife* 2022). Only in the last few years has the role for the hippocampus in social cognition come into prominence. Our group was the first to uncover a physiological role for hippocampal Oxytocin receptors in behavior, specifically social cognition (*Nature Communications* 2017). Building on these studies, we have begun investigating how inhibitory neuron microcircuits in the hippocampus contribute to social cognition. We identified a synaptic and an inhibitory circuit mechanism by which *Dyrk1a*, a gene implicated in autism spectrum disorder, contributes to social recognition (*Neuron* 2023). Taken together, these studies highlighted the persistence of experience-dependent parvalbumin inhibitory neuron plasticity in the adult hippocampus. In a study under revision at *Nature*, we instantiate a previously unrecognized genetic and epigenetic program that enables parvalbumin inhibitory neurons to reorganize and reconfigure their intrinsic properties input output connectivity and synaptic plasticity in response to experience. We demonstrate that parvalbumin inhibitory neuron plasticity is a convergent mechanism for neurodevelopmental disorders and that restoring this form of inhibitory neuron plasticity in adulthood is sufficient to suppress seizures and reverse cognitive impairment in a widely used neurodevelopmental disorder risk mouse model (Shih and Alipio et al, Accepted, *Nature*).

To begin to understand how alterations in hippocampal functions contribute to irregularities in affective behaviors, we began to investigate the neural pathways that link hippocampally computed mnemonic or contextual information with cortical and subcortical circuits that mediate defensive and motivated behaviors (approach, avoidance, cadence, reward seeking etc.). Although the lateral septum is one of the major targets of the hippocampus, the functional significance of this hippocampal target has remained poorly understood. In two studies published in *Nature Neuroscience* and *Cell Reports*, our lab illuminated how hippocampal projections to the lateral septum recruit distinct classes of inhibitory

neurons to calibrate motion during expression of defensive behaviors. In a manuscript under revision (Goode et al, Accepted, *Neuron*), we identify a distinct neuropeptidergic population of lateral septal neurons that links the dorsal hippocampus with lateral hypothalamus to regulate food consumption.

Stress is a major risk factor for psychopathologies such as depression and anxiety disorders. Understanding how brain mechanisms support coping behaviors and confer resilience is key to devising novel therapeutic strategies to moderate the effects of stress on the brain and behavior. Our group was the first to demonstrate how selectively enhancing adult hippocampal neurogenesis was sufficient to prevent chronic stress-induced anxiety-like behavior and promote stress associated coping behavior (*Neuropsychopharmacology* 2015). In thinking about how stress affects neural circuitry to mediate overgeneralization of fear in PTSD, we identified a transcriptional regulator of resilience to chronic stress-induced overgeneralization of fear. In a study in *Cell Reports*, we showed how changes in levels of a transcription regulator in the hippocampus in response to chronic stress engenders distinct synaptic and behavioral adaptations in a sex specific way.

Many of our findings have been independently replicated and our papers have garnered over 10,000 citations. My study demonstrating that increasing neurogenesis is sufficient to improve memory has been cited over 2000 times. Our discoveries have led to formulation of several influential review articles and perspectives (*Neuropsychopharmacology* 2016, *Nature Neuroscience* (2007, 2011, 2019, 2026-in review) and *Neuron* (January 2020 and *Neuron* August 2020) that continue to shape the leading edge of science on hippocampal and inhibitory circuit plasticity and cognition. Notably, we have reached across the aisle to clinicians to relate fundamental neural circuit mechanisms underlying hippocampal memory processing (memory interference, discrimination, and generalization) with psychiatric disease endophenotypes, age-related cognitive decline and Mild Cognitive Impairment. My research program has secured funding amounting to approximately \$15.5 million in direct costs from NIH and private foundations (5 lead PI R01s and two successive SIMONS Foundation SCPAB \$1.875 million 5-year awards). I have co-founded or am involved in two biotech/AI startups aimed at restoring cognition in AD.

## Teaching

I have mentored numerous undergraduates who have performed senior honors thesis research (including a recipient of the Hoopes Prize for outstanding senior thesis at Harvard), co-authored high-impact publications and gone onto attend prominent medical, graduate and MSTP programs. My laboratory's mentoring style has been profiled by the Harvard Stem Cell Institute and is routinely recognized in thesis critiques. I mentored minority undergraduates through Cientific Latino's graduate student mentorship initiative (GSMI) program. I currently participate in the Shenoy Undergraduate Research Fellowship in Neuroscience (SURFiN) Program funded by the SIMONS foundation to mentor undergraduates whose backgrounds and experiences are underrepresented in science. Postdoctoral trainees have won numerous postdoctoral fellowships including K99/R00 and 3 NARSAD young Investigator Awards. Several graduate and postdoctoral trainees have transitioned into postdoctoral and independent faculty or industry positions, respectively.

I serve on local committees to foster basic neuroscience research including Mass General Neuroscience Leadership Council, scientific council of Homebase which is a Red Sox Foundation and Massachusetts General Hospital Program for treatment of veterans and PTSD, and the newly founded Center for Neuroscience of Psychedelics at MGH. I co-founded a monthly seminar series for trainees in basic neural circuit neuroscience at MGH and Massachusetts Eye and Ear Institute and secured a Harvard Brain Science Initiative (HBI) Community Building Grant for it. In 2017, I co-launched a startup to create sustainable paths for postdoctoral fellows to biotech and pharmaceutical jobs. Although the startup failed 3 years later, I published a white paper documenting my experience in *Cell Mentor* so that other innovators would benefit from my insights and experience.

I co-directed the Harvard BBS Program graduate level stem cell course, Concepts in Development, Self-renewal and Repair CB226, for five consecutive years (2014-2018) at MGH. I give lectures to undergraduates and medical residents as part of courses on Regeneration, Neuroscience and Psychiatry at Harvard University, Harvard Medical School and MGH. I teach the neuroscience section of the Leder Human Biology and Translational Medicine Program to Harvard and MIT graduate students at Harvard Medical School (2022-). I participate in the MGH/McLean research track residency program and HMS Clinical and Translational Research Academy that recruit and train psychiatry residents. I provide R01 level grant writing mentorship to Assistant professors at MGH and co-chaired the Harvard Stem cell Institute Annual Retreat that brings together trainees from across the Harvard ecosystem. On a national and international level, I co-organized the first international meeting of adult neurogenesis in mainland Asia and led national and international Kavli Frontiers of Science symposia. I am a member of the American College of Neuropsychopharmacology and served on the Program Committee for the Society for Neuroscience, SFN, Annual Meeting (2019-2023). Additionally, I served as the SFN appointed member for the Program Committee of the Federation of European Neuroscience Societies (FENS) from 2020-2022. I currently serve on Program Committee of the American College of Neuropsychopharmacology and the leadership and faculty steering committee of the Harvard Brain Science Initiative (HBI).

### **Summary**

I have established a multifaceted research program and have fostered collaborations within MGH, HMS and BROAD communities. Through my research, publications, mentoring, lecturing, and involvement with professional societies, I continue to promote a culture of inclusion and diversity, generate fundamental insights into hippocampal functions in memory and emotion, and edify new ways to think about alleviating memory and mood impairments that characterize psychiatric and neurological disorders.