

BIOGRAPHICAL SKETCH

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NAME: Swarup Mitra

eRA COMMONS USER NAME (credential, e.g., agency login): SMITRA3

POSITION TITLE: Assistant Professor

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Vidyasagar University	BS	06/2003	Microbiology (Hons)
Bangalore University	MS	05/2005	Biotechnology
University of Alaska Fairbanks	Ph.D.	08/2017	Biochemistry & Neuroscience (Neurobiology of compulsivity)
University of Nebraska Medical Center	Postdoc	04/2018	Neurobiology of schizophrenia
University at Buffalo	Postdoc	01/2022	Neurobiology of substance use disorder

A. Personal Statement

My newly established, independent research program at Marshall University School of Medicine is focused on leveraging cutting-edge cell-type specific, circuit, and epigenetic approaches to elucidate the neurobiology underlying opioid use disorder. I have substantial experience using a diverse set of molecular and biochemical techniques to study neural plasticity at the epigenetic, synaptic, and circuit levels that underlie behavioral maladaptation. The long-term research goals of my laboratory include building a comprehensive research program that facilitates translationally relevant research and training to engender impactful research studies of the highest ethical caliber.

The following 4 publications (* indicates co-first authorship) demonstrate the range of contributions I made to studying the role of epigenetic, synaptic, and circuit mechanisms implicated in drug relapse.

- 1) Engeln, M., **Mitra, S.**, Chandra, R., Gyawali, U., Fox, M. E., Dietz, D. M., & Lobo, M. K. (2020). Sex-specific role for Egr3 in nucleus accumbens D2-medium spiny neurons following long-term abstinence from cocaine self-administration. *Biological psychiatry*, 87(11), 992-1000. PMID: 31858986
- 2) Werner, C. T*, **Mitra, S***, Auerbach, B. D., Wang, Z.-J., Martin, J. A., Stewart, A. F., Gobira, P. H., Iida, M., An, C., Cobb, M. M., Caccamise, A., Salvi, R. J., Neve, R. L., Gancarz, A. M., & Dietz, D. M. (2020). Neuroadaptations in the dorsal hippocampus underlie cocaine seeking during prolonged abstinence. *Proceedings of the National Academy of Sciences*, 117(42), 26460-26469. PMID: 33020308
- 3) **Mitra, S***, Gobira, P. H*, Werner, C. T., Martin, J. A., Iida, M., Thomas, S. A., Erias, K., Miracle, S., Lafargue, C., An, C., & Dietz, D. M. (2021). A role for the endocannabinoid enzymes monoacylglycerol and diacylglycerol lipases in cue-induced cocaine craving following prolonged abstinence. *Addiction Biology*, n/a(n/a), e13007. PMID: 33496035

- 4) Fulton, S.L., **Mitra, S***, Lepack, A.E., Martin, J.A., Stewart, A.F., Converse, J., Hochstetler, M., Dietz, D.M., & Maze, I. (2022). Histone H3 dopaminylation in ventral tegmental area underlies heroin-induced transcriptional and behavioral plasticity in male rats. *Neuropsychopharmacol.* PMID: 35094023

B. Positions, Scientific Appointments, and Honors

- 2005 – 2006 Trainee scientist, Department of Bioinformatics, Jubilant Biosys Private limited.
- 2006 – 2007 Biomedical Research Associate, Department of Clinical Research, Accenture Health and Life.
- 2007 – 2008 Biomedical Specialist, Clinical Research, Novartis International Clinical Developmental Center.
- 2008 – 2008 Clinical Trial Analyst, Clinical Research, Cognizant/Sanofi Pasteur Research Institute, France.
- 2010 – 2012 Research Associate, Environmental Biology, Zhejiang University of Technology.
- 2012 – 2014 Graduate Teaching Assistant, Department of Chemistry & Biochemistry, University of Alaska Fairbanks, Alaska, USA, Doctoral Mentor: Dr. Abel Bult-Ito.
- 2014 – 2017 Graduate Research Assistant, IDeA Networks of Biomedical Research Excellence National Institute of Health, Doctoral Mentor: Dr. Abel Bult-Ito.
- 2017-2018 Postdoctoral Associate, University of Nebraska Medical Center
- 2018-2022 Postdoctoral Associate, University at Buffalo. Postdoc Mentor: Dr. David Dietz

Professional Memberships

- 2014 – Member, Society for Neuroscience
- 2015 – 2016 Member, Society for Behavioral Neuroendocrinology

Honors

- 2003 University gold medalist for securing first position during under-graduation (Vidyasagar University)
- 2005 Recipient of Indian government scholarship for pursuing MS.
- 2008 Recipient of best performer award in Japanese encephalitis vaccine trial project under Sanofi Pasteur Vaccine Institute, Lyon France
- 2010 Recipient of Chinese government scholarship to pursue research.
- 2013 Recipient of 2013 summer RAHI chemistry adjunct teaching position.
- 2014 Recipient of CNSM travel award to present poster at NISBRE conference 2014 in Washington, DC
- 2014 Recipient of 2014 INBRE travel grant for poster presentation at Society for Neuroscience, Washington DC, 2014.
- 2014 Recipient of 2014 summer Research assistant position from CNSM, UAF.
- 2014 Recipient of 2014-2015 (academic year) NIH INBRE research assistantship.
- 2015 Recipient of 2015-2016 (academic year) NIH INBRE research assistantship.
- 2015 Recipient of 2015 NIH INBRE travel award for poster presentation at Society for Neuroscience Conference, Chicago, Illinois, USA.
- 2015 ASRA (Alaska Summer Research Academy) Instructor for behavioral Neuroscience module.
- 2015 Recipient of 2015-2016 (academic year) BLaST Graduate mentoring research assistantship.
- 2016 Recipient of 2016-2017 (academic year) NIH INBRE research assistantship.
- 2016 Recipient of best mentoring award for mentoring high School student Kate Bates on her Alaska Statewide High School Science Symposium (AHSSS) project that won the first prize.
- 2016 Recipient of 2016 INBRE travel grant for poster presentation at Society for Neuroscience, San Diego, California, 2016.
- 2016 Recipient of 2016 BLaST travel grant for poster presentation at Society for Behavioral Neuroendocrinology, Montreal Quebec, Canada, 2016.
- 2016 Recipient of Vice Chancellor Research Award for publishing impactful research.
- 2017 Recipient of 2017-2018 (academic year) NIH INBRE research assistantship (Turned down due To summer 2017 graduation).
- 2019 Recipient of Beverly Petterson Bishop and Charles W. Bishop Neuroscience Travel Awards
- 2021 Recipient of Trainee Professional Development Award. Society for Neuroscience

C. Contributions to Science

1. Generated a novel compulsive-like mouse model that recapitulates clinical heterogeneity based on strain and sex.

I have contributed towards a greater understanding of molecular mechanisms underlying compulsivity. My Ph.D. research involved determining the interplay of strain and sex and female sex hormones (estrogen and progesterone) in influencing compulsive-, anxiety-, cognitive- and depression-like behaviors in a spontaneous mouse model of compulsive-like phenotype. I investigated the role of serotonin signaling and its subsequent impact on affective functions triggered by post-partum lactation. I have demonstrated how differential regulation of lactation by dopamine and oxytocin influences serotonin signaling and SSRI (Selective Serotonin Reuptake Inhibitors) effectiveness leading to behavioral changes in a compulsive-like mouse model. This research is crucial in understanding post-partum depression and anxiety leading to therapeutic measures. One of my thesis chapters has resulted in a patent filing to the Federal Drug Administration (FDA) for identifying a novel treatment strategy to attenuate compulsivity.

Mitra, S., Bastos, C. P., Bates, K., Pereira, G. S. & Bult-Ito, A. Ovarian Sex Hormones Modulate Compulsive, Affective and Cognitive Functions in A Non-Induced Mouse Model of Obsessive-Compulsive Disorder. *Front Behav Neurosci* 10, 215, doi:10.3389/fnbeh.2016.00215 (2016). PMID: 27881956

Mitra, S., Mucha, M., Khatri, S. N., Glenon, R., Schulte, M. K. & Bult-Ito, A. Attenuation of Compulsive-Like Behavior Through Positive Allosteric Modulation of $\alpha 4\beta 2$ Nicotinic Acetylcholine Receptors in Non-Induced Compulsive-Like Mice. *Front Behav Neurosci* 10, 244, doi:10.3389/fnbeh.2016.00244 (2016). PMID: 28105008 (Provisional patent number: 62/308,560 Title: Composition and Methods for Treating Compulsive-Like Behavior in a Subject.)

Mitra, S., Mucha, M., Owen, S. & Bult-Ito, A. Postpartum Lactation-Mediated Behavioral Outcomes and Drug Responses in a Spontaneous Mouse Model of Obsessive-Compulsive Disorder. *ACS Chem Neurosci* 8, 2683-2697, doi:10.1021/acschemneuro.7b00231 (2017). PMID: 28945961

Mitra, S., Bastos, C. P., Chesworth, S., Frye, C. & Bult-Ito, A. Strain and sex based characterization of behavioral expressions in non-induced compulsive-like mice. *Physiol Behav* 168, 103-111, doi:10.1016/j.physbeh.2016.11.002 (2017). PMID: 27838311

(2) Identified novel epigenetic and circuit adaptations underlying cocaine and heroin-induced plasticity.

A major emphasis of my postdoctoral research has been to decipher the epigenetic and circuit adaptations underlying drugs of abuse. I was one of the earliest to demonstrate early growth response (Egr)-mediated epigenetic programming in the mesolimbic system underlying cocaine-induced long-term behavioral plasticity. I along with others were the first to demonstrate a novel epigenetic modification whereby covalent attachment of the neurotransmitter dopamine to histone H3 glutamine 5 drives both cocaine and heroin-induced epigenetic adaptations. I have also uncovered a non-canonical activin signaling pathway in the dorsal hippocampus (DH) that alters synaptic connections between DH and the lateral septum (LS) underlying cocaine-induced behavioral plasticity. Additionally, I have co-authored some important studies that were the first to show ubiquitin proteasomal regulated epigenetic modifications in the mesolimbic dopamine system at protracted abstinence from volitional cocaine intake. Overall, these studies have elucidated previously unknown epigenetic and synaptic mechanisms and have expanded our understanding of the neurobiology of SUD.

Mitra, S*, Gobira, P. H*, Werner, C. T., Martin, J. A., Iida, M., Thomas, S. A., Erias, K., Miracle, S., Lafargue, C., An, C., & Dietz, D. M. (2021). A role for the endocannabinoid enzymes monoacylglycerol and diacylglycerol lipases in cue-induced cocaine craving following prolonged abstinence. *Addiction Biology*, n/a(n/a), e13007. PMID: 33496035 (*Co-first)

Lepack, A. E., Werner, C. T., Stewart, A. F., Fulton, S. L., Zhong, P., Farrelly, L. A., Smith, A. C. W., Ramakrishnan, A., Lyu, Y., Bastle, R. M., Martin, J. A., **Mitra, S.**, O'Connor, R. M., Wang, Z.-J., Molina, H., Turecki, G., Shen, L., Yan, Z., Calipari, E. S., Dietz, D. M., Kenny, P. J., & Maze, I. (2020). Dopaminylation of

histone H3 in ventral tegmental area regulates cocaine seeking. *Science*, 368(6487), 197-201. PMID: 32273471

Fulton, S*, **Mitra, S***, Lepack A. E., Stewart, A.F., Converse, J., Hochstetler, M., Dietz, D. M., & Maze, I. Histone H3 Dopaminylation in ventral tegmental area underlies heroin-induced transcriptional and behavioral plasticity in male rats. In press: *Neuropsychopharmacology*. PMID: 35094023 (* Co-first)

Werner, C. T*, **Mitra, S***, Auerbach, B. D., Wang, Z.-J., Martin, J. A., Stewart, A. F., Gobira, P. H., Iida, M., An, C., Cobb, M. M., Caccamise, A., Salvi, R. J., Neve, R. L., Gancarz, A. M., & Dietz, D. M. (2020). Neuroadaptations in the dorsal hippocampus underlie cocaine seeking during prolonged abstinence. *Proceedings of the National Academy of Sciences*, 117(42), 26460-26469. PMID: 33020308 (*Co-first)

(3) Examined how dietary modulation influence epigenetics and glial immunoreactivity in neurodegeneration

Apart from projects during my Ph.D. and postdoctoral training, I have performed an additional line of research. This research entails examining the impact of dietary intervention on neurodegenerative pathophysiology. I have elucidated critical neuroinflammatory, epigenetic, and cellular mechanisms underlying behavioral anomalies. Recently, I was also one of the first to introduce the term neuroimmunometabolism in relationship to degenerative disorders. This review article detailing the disruption of cellular mediators and cascades that lies at the intersection of metabolism and inflammation is expected to open avenues for future research in degenerative and psychiatric diseases including substance use disorder.

Mitra, S., Banik, A., Saurabh, S., Maulik, M. & Khatri, S. N. Neuroimmunometabolism: A new pathological nexus underlying neurodegenerative disorders. *J Neurosci*, doi:10.1523/jneurosci.0998-21.2022 (2022). PMID: 35027409

Maulik, M*, **Mitra, S***, Sweeney, M., Lu, B., Taylor, B. E. & Bult-Ito, A. Complex interaction of dietary fat and Alaskan bog blueberry supplementation influences manganese mediated neurotoxicity and behavioral impairments. *J Funct Foods* 53, 306-317, doi:10.1016/j.jff.2018.12.028 (2019). PMID: 31558914 (*Co-first)

Maulik, M*, **Mitra, S***, Basmayor, A. M., Lu, B., Taylor, B. E. & Bult-Ito, A. Genetic Silencing of Fatty Acid Desaturases Modulates α -Synuclein Toxicity and Neuronal Loss in Parkinson-Like Models of *C. elegans*. *Front Aging Neurosci* 11, 207, doi:10.3389/fnagi.2019.00207 (2019). PMID: 31447665 (*Co-first)

Maulik, M*, **Mitra, S***, Bult-Ito, A., Taylor, B. E. & Vayndorf, E. M. Behavioral Phenotyping and Pathological Indicators of Parkinson's Disease in *C. elegans* Models. *Front Genet* 8, 77, doi:10.3389/fgene.2017.00077 (2017). PMID: 28659967 (*Co-first)

Total N of publications: 22 articles in PubMed (16 first and co-first author, 2 corresponding authors), 1 article in review (first author). Current h-index: 10, i10-index: 12, 341 total citations) based on Google Scholar database as of 2/16/22. Link to complete Bibliography: [My Bibliography - NCBI \(nih.gov\)](#)