BIOGRAPHICAL SKETCH

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NAME: Sjulson, Lucas

eRA COMMONS USER NAME (credential, e.g., agency login): SJULS01

POSITION TITLE: Associate Professor of Psychiatry and Neuroscience

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Johns Hopkins University, Baltimore, MD	BA	05/1999	Neuroscience
Weill Graduate School of Cornell University, New York, NY	PhD	05/2007	Neuroscience
Weill Medical College of Cornell University, New York, NY	MD	05/2008	Medicine
NYU School of Medicine, New York, NY	Residency	06/2012	Psychiatry
NYU School of Medicine, New York, NY	Postdoc	04/2013	Neural development
NYU Neuroscience Institute, New York, NY	Postdoc	02/2018	Systems neuroscience

A. Personal Statement

I am an Associate Professor in the departments of Psychiatry and Neuroscience at Albert Einstein College of Medicine. 90% of my time is devoted to research, and my lab studies the neural basis of **substance use disorders (SUDs) and neurodevelopmental disorders** in rodents using a broad range of approaches from systems, computational, molecular, and behavioral neuroscience. Themes of this work include reconciling neuronal ensembles in SUD models with low-dimensional neural manifolds, investigating neurophysiological endophenotypes in schizophrenia and ASDs, and developing novel translational technologies for gene therapies. My long-term goals are to develop novel gene-based therapeutic approaches and closed-loop neurostimulation devices for the treatment of SUDs and and neurodevelopmental disorders. 10% of my time is devoted to clinical work, and my main interest is therapeutic neuromodulation, including ECT and TMS, as well as the psychiatric evaluation and management of patients who receive deep brain stimulators and brain lesioning procedures. I collaborate closely with the Department of Neurosurgery in treating these patients, and we are building a clinical infrastructure that I hope to leverage in the future for clinical trials of novel procedure-based interventions for SUDs and neurodevelopmental disorders.

Since starting my lab at Einstein in 2018, it has grown to four postdocs, three PhD students, and three MD/PhD students. I have started to gain recognition in the field, recently giving 24 invited talks and serving on six NIH review panels. Einstein filed our first patent application in 2023 for a novel gene therapy for opioid use disorder and our second patent application in 2025 for a technology enabling fluorescence microscopy to image 128 colors simultaneously. I have been awarded DP1 Avenir, R21, and R01 grants from NIDA, as well as grants from the Keck, Whitehall, McManus, and Feldstein foundations.

Relevant publications

SUD ensembles and manifolds:

de Oliveira EF, Garg P, Batista-Brito R, **Sjulson L**. Identifying patterns differing between high-dimensional datasets with generalized contrastive PCA. *PLoS Comput Biol.* 2025 Feb 7;21(2):e1012747. doi: 10.1371/journal.pcbi.1012747.

de Oliveira EF, Kim S, Qiu TS, Peyrache A, Batista-Brito R, **Sjulson L.** Sleep reveals dynamics linking and separating movement and stimulus representations in V1**.** bioRxiv 2022, *Nature Neuroscience* (in revision)

Kim S, de Oliveira EF, Qiu TS, Batista-Brito R, **Sjulson L**. Brainwide movement encoding depends on arousal state. (in preparation for submission to *Neuron*)

Neurophysiological endophenotypes in schizophrenia and ASDs:

Kim S, Lechuga A, Batista-Brito R†, **Sjulson L†**. Visual mismatch negativity contains orthogonal contributions from local circuits and anterior cingulate cortex. (in preparation for submission to *Biological Psychiatry*)

Lechuga A, Kim S, **Sjulson L†**, Batista-Brito R†. Top-down cortical processing is selectively impaired in 22q11.2 animals. (in preparation for submission to *Molecular Psychiatry*)

Tran D, Ward C, Hyde R, Singh A, Rudolph S, **Sjulson L†**, Batista-Brito R†. Mef2c haploinsufficiency causes localized hypersynchronous discharges by disrupting parvalbumin interneuron maturation. (in preparation for submission to *Nature Neuroscience*)

†co-corresponding authors

Relevant funding:

DP1 DA051608 (NIDA Avenir Award) Sjulson (PI) 9/1/20 – 7/31/25
NIH/NIDA $300,000 direct cost per year
Title: **Uncovering links between neuronal transcriptomic and functional profiles in opioid addiction**
This project aims to determine the functional role that transcriptomically distinct medium spiny neuron populations in the nucleus accumbens play in opioid-related behaviors.
Role: PI

R01 DA051652 Sjulson (PI) 9/15/23 – 6/30/28
NIH/NIDA $282,211 direct cost per year
Title: **Hippocampal interactions with striatal subnetworks for reward prediction and evaluation**
The goal of this project is to test the hypothesis that two distinct subpopulations of accumbens medium spiny neurons defined by their functional coupling to the hippocampus play distinct roles in predicting future rewards and evaluating past rewards.
Role: PI

W. M. Keck Foundation Sjulson (contact PI) 1/1/24 – 12/31/26
$1,000,000 direct costs ($939,863 to PI Sjulson)
Title: **Hyperspectral FRET unmixing for massively multiplexed fluorescence microscopy of biological samples**
This project aims to develop a novel technology by which fluorescence microscopy can achieve 128 simultaneous colors, with a focus on spatial transcriptomics.
Role: contact PI (multi-PI with Mats Nilsson)

R21 DA057695 Sjulson (PI) 4/1/24 – 3/31/26
NIH/NIDA $275,000 directs over two years
Title: **Validating a novel chemogenetic strategy for opioid use disorder**
The goal of this project is to validate a novel therapeutic strategy for opioid use disorder based on a novel chemogenetic receptor called LAMuOR. LAMuOR provides a means by which a single treatment could confer a lifelong therapeutic effect.
Role: PI

R01 MH139635 (PI is Joseph Cheer) 5/1/2025 – 3/31/2030
NIH/NIMH $863,340 total directs to Sjulson
Title: **Endocannabinoid Control of Cholinergic Transmission and the Pursuit of Reward**
This project will explore the role of the endogenous cannabinoid system as a modulator of cholinergic tone for a broad spectrum of conditions involving compromised motivational drive and loss of memory.

Role: Consortium PI

Past funding:

Einstein/Montefiore ICTR Pilot Grant Sjulson (PI) 3/1/24 – 2/28/25
$40,000 direct costs
Title: **Developing a method to inactivate AAV-based gene therapies**
This pilot project aims to demonstrate a noninvasive method by which Adeno-Associated Viral vector (AAV) gene therapies in the brain can be permanently inactivated if adverse reactions occur, greatly improving their safety profile. This data will be used for the resubmission of an NCATS R21 grant application that received an impact score of 45 on the initial submission.

Whitehall Foundation Sjulson (PI) 9/1/20 – 8/31/21
$75,000 direct cost per year
Title: **Hippocampus-accumbens coordination in linking rewards to past and future actions.**
The goal of this project is to determine how the distinct functional roles of evaluating past rewards and predicting future rewards are subdivided among neuronal subpopulations in the nucleus accumbens defined by their functional coupling with the hippocampus.
Role: PI

Peter McManus Charitable Trust Sjulson (PI) 1/1/21 – 12/31/21
$75,000 direct cost per year
Title: **Hippocampal coupling with accumbens subcircuits for storage and retrieval of opioid-context associations**
This project aims to determine how different neuronal subcircuits within the nucleus accumbens store and retrieve associations between opioid use and specific environmental contexts, which are known to be triggers for relapse.
Role: PI

Feldstein Medical Foundation Sjulson (PI) 7/1/21 – 6/30/22
$72,000 direct cost per year
Title: **Preclinical validation of a novel gene-based therapeutic strategy for opioid use disorder**
The goal of this project is to use rodent models to test a new chemogenetic strategy for treating opioid use disorder.

B. Positions, Scientific Appointments, and Honors

Positions and Employment

2025-present Associate Professor, Department of Psychiatry and Behavioral Sciences, Dominick P. Purpura Department of Neuroscience, Albert Einstein College of Medicine.
2018-2025 Assistant Professor, Department of Psychiatry and Behavioral Sciences, Dominick P. Purpura Department of Neuroscience, Albert Einstein College of Medicine.
2013-2018 Research Assistant Professor, NYU Department of Psychiatry, NYU Department of Neuroscience and Physiology. Advisor: György Buzsáki.
2012-2013 Clinical Instructor, NYU Department of Psychiatry. Advisor: Gordon Fishell.
2008-2012 Resident Physician, NYU Department of Psychiatry.
2000-2008 Student, Cornell/Rockefeller/Sloan-Kettering Tri-Institutional MD/PhD Program. Thesis advisor: Gero Miesenböck. Thesis title: Two-Photon Imaging of a Genetically Encodable Voltage Sensor.

Conferences and Organizations

Medical Advisor, Lamarck Labs, 2024 – Present.
DEIA co-chair for COSYNE meeting, 2024 – 2025.
Symposium Chair, COSYNE meeting, DEIA panel, 2023.
Symposium Co-chair, American College of Neuropsychopharmacology, *Progress toward clinical applications of genetically-encoded neuromodulation*, 2022.
Member, Society for Neuroscience, 2000 – Present.

Grant Review Experience

Reviewer, BRAIN Initiative Special Emphasis Panel ZRG1 NV -E (53), 2025.

Reviewer, MCNP study section, 2024.
Reviewer, NIDA Special Review Panel ZDA1 BSW-N (A1), 2023.
Reviewer, NIDA Special Review Panel ZDA1 SKM-N (M2), 2023.
Reviewer, NIDA Special Review Panel ZDA1 SKP-D (05), 2021.
Reviewer, NIDA Special Review Panel ZDA1 SKP-D (02), 2021.
Reviewer, NIDA Special Review Panel ETTN-B (55), 2021.

Teaching Experience

Psychopharmacology supervisor for psychiatry residents at Einstein, 2023 –
Course co-director for neuroscience methods course at Einstein, 2019 –
Lecturer for psychiatry residents, addiction fellows, psychology interns, and PhD students, 2018 –
Neuroscience lecturer for Psychiatry Residents at NYU, 2012 – 2018.
Psychopharmacology Supervisor for Psychiatry Residents at NYU, 2012 – 2018
Journal Club Tutor for Medical School Neuroscience Course, 2002 – 2003.
Guest lecturer for graduate neuroscience course, University of Minho, Portugal, 2024 and 2025.

Honors

Student-invited graduation speaker, Albert Einstein College of Medicine, 2022.
Society of Biological Psychiatry Chair's Choice Award, 2019.
Leon Levy Neuroscience Fellowship, 2013.
NYU KL2 Translational Research Scholars Program, 2013.
NYU Physician Scientist Training Program, 2012.
NIMH Outstanding Resident Award, 2010.
Katherine Beineke Foundation Fellowship, 2003.
Phi Beta Kappa, 1999.
Johns Hopkins University Honor Society for Neuroscience, 1998 – 1999.
Elizabeth Glaser Pediatric AIDS Foundation Summer Fellowship, 1998.
National Merit Scholar, 1995.

Invited Presentations (selected from 25 total)

2025 New York Memory Hub meeting, New York, NY
2025 Mount Sinai Department of Psychiatry, New York NY
2024 Yale University, New Haven, CT
2024 Mount Sinai Department of Neuroscience, New York, NY
2024 Medical University of South Carolina, Charleston, SC
2024 University of Maryland, Baltimore, MD
2023 Swedish Basal Ganglia Society seminar series, Stockholm, Sweden
2023 Georgetown University, Washington, DC
2023 Cornell University, Ithaca, New York
2023 University of Washington, Seattle, Washington
2022 American College of Neuropsychopharmacology annual meeting, Phoenix, AZ
2022 University of California, Berkeley, Berkeley, California
2022 NeuroZoom seminar series, Stanford University, Stanford, California
2019 University of Oxford, Oxford, UK
2019 Winter Conference on Brain Research, Aspen, Colorado
2018 Rockefeller University, New York, New York
2018 National Institute on Drug Abuse, Baltimore, Maryland
2018 School of Engineering, Columbia University, New York, New York
2016 Nathan Kline Institute, Orangeburg, New York
2015 Leon Levy Foundation Symposium, New York, New York

C. Contributions to Science (h-index = 16)

1. Using sleep to reconcile the ensemble and manifold hypotheses of neuronal population activity. The addiction neuroscience field conceptualizes population activity as sparse “ensembles” of active neurons identifiable by Fos expression, but this is at odds with the dominant concept in systems/computational neuroscience of population activity as a trajectory on a low-dimensional “manifold.” Reconciling these

accounts is a major unsolved problem in the field. We discovered that, in visual cortex, movement- and stimulus-evoked activity interact on internally-generated neural manifolds that are preserved in slow-wave sleep. However, most stimulus coding occurs in an off-manifold subspace composed of sparse ensembles that are *less likely than chance* to occur during sleep. This work reveals an unexpected link between sparse ensemble coding and low-dimensional dynamics, providing a possible path to reconciling the ensemble and manifold hypotheses.

a) de Oliveira EF*, Kim S*, Qiu TS, Peyrache A, Batista-Brito R, **Sjulson L.** Sleep reveals dynamics linking and separating movement and stimulus representations in V1**.** bioRxiv 2022, *Nature Neuroscience* (in revision).
b) de Oliveira EF, Garg P, Batista-Brito R, **Sjulson L**. Identifying patterns differing between high-dimensional datasets with generalized contrastive PCA. *PLoS Comput Biol.* 2025 Feb 7;21(2):e1012747. doi: 10.1371/journal.pcbi.1012747.

2. Identifying cocaine-induced changes in inter-region functional coupling between the hippocampus and nucleus accumbens as a neurophysiological substrate storing drug-context associations. As a postdoc in György Buzsáki's lab, I led a study that used dual-site silicon probe recordings with optotagging to show that cocaine place conditioning selectively strengthened inputs to D2-positive medium spiny neurons in the nucleus accumbens that arise from hippocampal place cells encoding the cocaine-paired context. This provided the first evidence suggesting that selective plasticity of specific subsets of connections may be a mechanism by which the brain stores drug-context associations, which are thought to drive relapse.
   a) **Sjulson L**, Peyrache A, Cumpelik A, Cassataro D, Buzsáki G. Cocaine place conditioning strengthens location-specific hippocampal coupling to the nucleus accumbens. *Neuron*. 2018 Jun 6;98(5):926-934. PMID: 29754750

3. Developing novel chemogenetic approaches to treat substance use disorders. My work has long focused on the development of novel translational strategies for treating drug addiction based on protein engineering. This started when I was a psychiatry resident working in the Fishell lab. In 2014, this led to the first study showing that chemogenetic neuromodulation can be used to reduce consumption of an addictive drug. This line of work has continued in my lab at Einstein, and in 2023, Einstein filed a patent application for a novel mu opioid receptor mutant we have developed that is activated selectively by exogenous opioids, as a potential gene therapy-based chemogenetic approach for opioid use disorder.
   a) Cassataro D, Bergfeldt D, Malekian C, Van Snellenberg JX, Thanos PK, Fishell G, **Sjulson L**. Reverse pharmacogenetic modulation of the nucleus accumbens reduces ethanol consumption in a limited access paradigm. *Neuropsychopharmacology*. 2014 Jan;39(2):283-90. PMCID: PMC3870771.
   b) Cassataro, D., & **Sjulson, L**. (2015). The Use of DREADDs (Designer Receptors Exclusively Activated by Designer Receptors) in Transgenic Mouse Behavioral Models. In *Neuromethods: Designer Receptors Exclusively Activated by Designer Drugs* (Vol. 108, pp. 95–108). New York, NY: Springer New York.

4. Developing genetically-encoded tools for high-speed *in vivo* two-photon imaging and manipulation of neural activity. My main PhD work focused on the development and high-speed two-photon imaging of genetically encoded voltage indicators based on Fluorescence Resonance Energy Transfer. I developed a FRET-based voltage indicator that gave the largest fluorescence signal of any indicator at that time and modified a two-photon microscope to increase imaging speed, leading to the first in vivo optical voltage recordings with a genetically encoded indicator. I also developed the first rigorous biophysical framework for quantifying the theoretical and practical limits of voltage indicator performance with high-speed two-photon microscopy.
   a) **Sjulson L**, Miesenböck G. Rational optimization and in vivo imaging of a genetically encoded optical voltage reporter. *J Neurosci*. 2008 May 21;28(21):5582-93. PMCID: PMC2714581.
   b) **Sjulson L**, Miesenböck G. Optical recording of action potentials and other discrete physiological events: a perspective from signal detection theory. *Physiology*. 2007 Feb;22:47-55. PMID: 17289930.
   c) **Sjulson L**, Miesenböck G. Photocontrol of Neural Activity. *Chemical Reviews*. 2008 May;108(5):1588-602. PMID: 18447399.
   d) **Sjulson L**, Cassataro D, DasGupta S, Miesenböck G. Cell-Specific Targeting of Genetically Encoded Tools for Neuroscience. *Annu Rev Genet.* 2016 Nov 23;50:571-594. PMCID: PMC5630135.

Complete List of Publications: https://www.ncbi.nlm.nih.gov/pubmed/?term=sjulson