Michael C. Saul, Ph.D.

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Education, Training, and Positions

2022-Present: Computational Scientist, The Jackson Laboratory, Bar Harbor, ME.
Supervisor: Vivek Philip

2019-2022: Research Scientist, The Jackson Laboratory, Bar Harbor, ME.
Faculty Supervisor: Elissa Chesler.

2018-2019: Postdoctoral Associate, The Jackson Laboratory, Bar Harbor, ME.
Faculty Mentor: Elissa Chesler.

2014-2018: Postdoctoral Fellow, University of Illinois at Urbana-Champaign, Urbana, IL.
Faculty Mentor: Lisa Stubbs. Co-Advisors: Alison Bell, Justin Rhodes, Gene Robinson, and Saurabh Sinha.

2010-2014: Ph.D., Zoology (now Integrative Biology), University of Wisconsin-Madison, Madison, WI.
Faculty Mentor: Stephen Gammie.
Thesis: *A Complex Mania Model: The Behavior, Molecules, and Genotype of the Madison Mouse Strain.*

2003-2008: B.S., Biology (with honors), The University of Iowa, Iowa City, IA.
Faculty Mentor: Steven Green.
Thesis: *PKA and Activity-Dependent Synaptogenesis in the Mouse Auditory Cortex.*

Grants, Contracts, and Awards

Awarded

2021-Present: JAX Director's Innovation Fund: "Genetic Dissociation of 5-HT1B and 5-HT1D Effects on a Marketed Small Molecule for Addiction Treatment." $88,182 awarded for continued development of JAX IP on a novel potential addiction treatment (co-investigator)

2020-Present: JAX Director's Innovation Fund: "Validation of a Marketed Small Molecule for Addiction Treatment." $110,462 awarded for work developing JAX IP on a novel potential addiction treatment (co-investigator)

2019-2021: Jacobs Foundation Young Scholar (one of eleven), "Reconciling Genes and Contexts: Exploring the Genomic & Environmental Headwaters of Early Brain Development". 40,000 Swiss Francs (about $40,000) awarded for work on genome-by-environment interactions.

2014-2018: UIUC Institute for Genomic Biology Postdoctoral Fellowship. $205,000 awarded for stipend; $22,500 awarded for research expenses.

2015: IBANGS Travel Award. $650 awarded for travel to the annual IBANGS meeting in 2015.

2013: John Jefferson Davis Travel Award. $400 awarded for travel to Neuroscience 2013.

2013: John T. Emlen Award for Behavioral Research. $8,100 awarded for research on transcriptomic correlates of mania in the limbic brain of the Madison mouse strain.

2011: John Jefferson Davis Travel Award. $400 awarded for travel to Neuroscience 2011.

Scholarship

Patents

Application: "MOLECULAR TARGETS FOR ADDICTION." PCT/US2020/065941, filed 18 December 2020.

Publications

22 peer-reviewed publications, 9 as first/co-first author. Web of Science H-Index = 14.

ORCiD: 0000-0002-4916-8619, Web of Science Researcher ID: N-9303-2019
*equal contribution, †undergraduate co-author

Reviews and Position Papers

2019: **Saul MC**, Philip VM, Reinholdt LG, CSNA (consortium author), and Chesler EC. "High-diversity mouse populations for complex traits." *Trends in Genetics* 35(7): 501-514.
PubMed ID: 31133439

2018: Lightfoot JT, De Geus EJC, Booth FW, Bray MS, den Hoed M, Kaprio J, Kelly SA, Pomp D, **Saul MC**, Thomis MA, Garland T, and Bouchard C. "Biological/Genetic Regulation of Physical Activity Level: Consensus from GenBioPAC." *Medicine and Science in Sports and Exercise*, 50(4): 863-873.
PubMed ID: 29166322

2016: Gammie SC, Driessen TM, Zhao C, **Saul MC**, and Eisinger BE. "Genetic and Neuroendocrine Regulation of the Postpartum Brain." *Frontiers in Neuroendocrinology* 42: 1-17.
PubMed ID: 27184829

Original Research

2021: Seward CH*, **Saul MC***, Troy JM, Dibaeini P, Zhang H, Sinha S, and Stubbs LJ. "An epigenomic shift in amygdala marks the transition from pup-aversive to maternal-like behaviors in alloparenting virgin female mice." *PLoS One* 17(2): e0263632.
PubMed ID: 35192674

2020: Talluri B, Amar K, **Saul MC**, Shireen T, Konjufca V, Ma J, Ha T, 6 and Chowdhury F. "COL2A1 is a novel biomarker of melanoma tumor repopulating cells." *Biomedicines* (accepted).
PubMed ID: 32962144

2019: Bukhari SA, **Saul MC**, James N, Bensky M, Stein L, Trapp R, and Bell AM. "Neurogenomic insights into paternal care and its relation to territorial aggression." *Nature Communications* 10(1):4437.
PubMed ID: 31570726

2019: Shpigler HY, **Saul MC**, Murdoch EE, Corona F†, Cash-Ahmed AC, Seward CH, Chandrasekaran S, Stubbs LJ, and Robinson GE. "Honey bee neurogenomic responses to affiliative and agonistic social interactions." *G2B*: e12509.
PubMed ID: 30094933

2019: **Saul MC**, Blatti C, Yang W, Bukhari SA, Shpigler HY, Troy JM, Seward C, Sloofman L, Chandrasekaran S, Bell AM, Stubbs LJ, Robinson GE, Zhao SD*, and Sinha S*. "Cross-species systems analyses reveal a shared brain transcriptional response to social challenge." *G2B*: e12502.
PubMed ID: 29968347

2018: Sorokina AM†, **Saul MC**, Goncalves TM, Gogola JV†, Majdak P, Rodriguez-Zas SL, and Rhodes JS. "Striatal transcriptome of a mouse model of ADHD reveals a pattern of synaptic remodeling." *PLoS ONE* 13(8): e0201553.
PubMed ID: 30110355

2018: **Saul MC**, Stevenson SA, Zhao C, Driessen TM, Eisinger BE, and Gammie SC. "Genomic variants in an inbred mouse model predict mania-like behaviors." *PLoS ONE* 13(5): e0197624.
PubMed ID: 29768498

2017: Shpigler HY*, **Saul MC***, Corona F†, Block L†, Cash-Ahmed A, Zhao SD, and Robinson GE. "Deep evolutionary conservation of autism-related genes." *PNAS* 114(36): 9653-9658 (Featured on the UIUC Home Page and reported in *Science*, *The Times* of London, and *The New York Post*).
PubMed ID: 28760967

2017: Bukhari SA, **Saul MC**, Seward C, Zhang H, Bensky M, James N, Zhao SD, Chandrasekaran S, Stubbs LS, and Bell AM. "Temporal Dynamics of Neurogenomic Plasticity in Response to Social Interactions in Male Threespined Sticklebacks." *PLoS Genetics* 13(7): e1006840 (Reported in

EurekAlert!).
PubMed ID: 28704398

2017: Shpigler HY, **Saul MC**, Murdoch EE†, Cash-Ahmed A, Seward C, Sloofman LG, Chandrasekaran S, Sinha S, Stubbs L, and Robinson GE. "Behavioral, transcriptomic and epigenetic responses to social challenge in honey bees." *G2B* 16(6): 579-591.
PubMed ID: 28328153

2017: **Saul MC***, Seward C*, Troy J, Zhang H, Sloofman LG, Lu X, Weisner PA, Caetano-Anolles D, Sun H†, Zhao SD, Chandrasekaran S, Sinha S, and Stubbs L. "Transcriptional regulatory dynamics drive coordinated metabolic and neural response to social challenge in mice." *Genome Research* 27: 959-972 (Reported in EurekAlert!).
PubMed ID: 28356321

2017: **Saul MC**, Majdak P, Perez S, Reilly M, Garland T, and Rhodes JS. "High motivation for exercise is associated with altered chromatin regulators of monoamine receptor gene expression in the striatum of mice from selectively bred lines." *G2B* 16(3): 328-341 (Reported in the UIUC's *Storied*).
PubMed ID: 27749013

2016: **Saul MC***, Zhao C*, Driessen TM, Eisinger BE, and Gammie SC. "MicroRNA expression is altered in lateral septum across reproductive stages." *Neuroscience* 312: 130-140.
PubMed ID: 26592715

2014: Mitchell CL, **Saul MC**, Lei L, Wei H, and Werner T. "The Mechanisms Underlying Alpha-Amanitin Resistance in *Drosophila melanogaster*: A Microarray Analysis." *PLoS ONE* 9(4): e93489.
PubMed ID: 24695618

2014: Driessen TM, Eisinger BE, Zhao C, Stevenson SA, **Saul MC**, and Gammie SC. "Genes Showing Altered Expression in the Medial Preoptic Area in the Highly Social Maternal Phenotype are Related to Autism and Other Disorders with Social Deficits." *BMC Neuroscience* 15: 11.
PubMed ID: 24423034

2013: Eisinger BE, **Saul MC**, Driessen TM, and Gammie SC. "Development of a Versatile Enrichment Analysis Tool Reveals Associations between the Maternal Brain and Mental Health Disorders, Including Autism." *BMC Neuroscience* 14: 147.
PubMed ID: 24245670

2013: **Saul MC**, Stevenson SA, and Gammie SC. "Sexually Dimorphic, Developmental, and Chronobiological Behavioral Profiles of a Mouse Model for Mania." *PLoS ONE* 8(8): e72125.
PubMed ID: 23967278

2013: Eisinger BE, Zhao C, Driessen TM, **Saul MC**, and Gammie SC. "Large Scale Expression Changes of Genes Related to Neuronal Signaling and Developmental Processes Found in Lateral Septum of Postpartum Outbred Mice." *PLoS ONE* 8(5): e63824.
PubMed ID: 23717492

2012: Zhao C, **Saul MC**, Driessen TM, and Gammie SC. "Gene Expression Changes in the Septum: Possible Implications for MicroRNAs in Sculpting the Maternal Brain." PLoS ONE 7(6): e38602.
PubMed ID: 22701680

2012: **Saul MC**, Gessay GM, and Gammie SC. "A New Mouse Model for Mania Shares Genetic Correlates with Human Bipolar Disorder." *PLoS ONE* 7(6): e38128.
PubMed ID: 22675514

Preprints

2020: **Saul MC**, Bagley JR, Bailey LS, Datta U, Dickson PE, Dodd R, Gagnon LH, Huggett SB, Kimble VM, Leonardo M, Kim S-M, Olson A, Roy T, Schoenrock SA, Wilcox T, Jentsch JD, Logan RW, McClung CA, Palmer RHC, Philip VM, Reinholdt LG, Sukoff Rizzo SJ, Tarantino LM, and Chesler EJ. "Consideration of genetic and sex effects in mice enhances consilience with human addiction

studies." bioRxiv, posted 2020-07-28 (in revision).
doi: https://doi.org/10.1101/2020.02.14.949784

Presentations

Invited Talks

2018: "Mathematics of whole genome and neural circuitry analysis." CIFAR/Jacobs Foundation Joint Conference on Reconciling Genes and Context, Marbach Castle, Germany.

2017: "The neural transcriptome of mice born to run supports a link between chromatin structure and motivation for exercise." International Roundtable on the Genetic Regulation of Physical Activity, College Station, TX, USA.

Contributed Talks

2019: "Reference traits bridge drug use phenotypes and drug-naïve brain gene expression in Diversity Outbred mice." Complex Traits Consortium annual meeting, San Diego, CA, USA.

2019: "Individual differences govern cocaine-related neurobehavioral phenotypes." IBANGS annual meeting, Edinburgh, Scotland, UK.

2016: "Transcriptional dynamics and the neural response to social challenge in mice." IBANGS annual meeting, Bar Harbor, ME, USA.

2016: "Transcriptional regulatory dynamics set the stage for metabolic and neural response to social threat-induced emotional learning in mice." IGB Fellows Symposium, Urbana, IL, USA.

General Audience Lectures

2015: "This is your brain on exercise: how your brain's genes influence your motivation to work out." Chambana Science Café, Urbana, IL, USA.

Posters

2021: "The 5-HT1D Receptor Modulates Volitional Cocaine-Related Behaviors." NIDA GECCRT, Virtual Conference.

2019: "Correlation among striatum coexpression networks and drug-related sensation-seeking behaviors in Diversity Outbred mice." Society for Neuroscience annual meeting. Chicago, IL, USA.

2019: "Genetics and sex govern the striatum transcriptional response to cocaine." NIDA Genetics Consortium. Bethesda, MD, USA.

2016: "Cross-species network analyses reveal conserved genomic toolkits involved in response to social challenge." RSG with DREAM meeting of the ISCB. Phoenix, AZ, USA.

2015: "Born to run: The neural transcriptomic signature of mice selectively bred for high voluntary wheel running." IBANGS annual meeting. Uppsala, Sweden.

2013: "Exome resequencing of the Madison mania model reveals variants associated with chromatin structure, glutamate metabolism, and cannabinoid signaling." Society for Neuroscience annual meeting. San Diego, CA, USA.

2011: "Dysregulation of multiple genes linked to bipolar disorder in a potential new mouse model for mania." Society for Neuroscience annual meeting. Washington, DC, USA.

Code

msaul (personal R package, github.com/msaul/msaul, includes Orthoverlap), released under the GPL v3.

MSET (Modular Single-set Enrichment Test, sourceforge.net/projects/mset2013), written with Brian Eisinger, released under the Apache License v2.

Research Experiences

2019-Present: Research Scientist, The Jackson Laboratory. PI: Elissa Chesler.

2018-2019: Postdoctoral Associate, The Jackson Laboratory. PI: Elissa Chesler.

2014-2018: GNDP Postdoctoral Fellow, Institute for Genomic Biology, UIUC. PI: Lisa Stubbs

2010-2013: Graduate Research Assistant: (3 semesters, 3 summers), Department of Zoology, University of Wisconsin-Madison. PI: Stephen Gammie.

2009-2010: Field Assistant, Lomas Barbudal Monkey Project, UCLA. PI: Susan Perry.

2008-2009: Research Assistant, Department of Neurology, UIHC. PI: Daniel Tranel.

2007-2008: Honors Research Assistant, Department of Biology, University of Iowa. PI: Steven Green.

Teaching Activity

Teaching Experiences

8 full semesters of teaching including 2 semesters as instructor. Badged Carpentries instructor.

2021: Completed development of online mini-course on complex traits genetic mapping in mice with JAX Education.

2021: JAX Genetics of Addiction Short Course lectures: “A Brief Introduction to Mouse Genetics Populations” and “Integrating Functional Genomics with Genetic Diversity in Mice.”

2021: Guest Lecturer, Tufts Genetics. “Mapping Complex Traits in Mice”
Course: Mammalian Genetics

2020: **Instructor** (1 semester), School of Biology and Ecology, University of Maine.
Course: Introduction to Neuroscience.

2019: Trained as badged Carpentries instructor.

2015-2018: Guest Lecturer, Department of Statistics, UIUC. Lecture: “A brief introduction to RNA-Seq analysis.”
Course: Bioinformatics

2014: Guest Lecturer, School of Molecular and Cellular Biology, UIUC. Lecture: “Analyzing complex designs in RNA-Seq experiments.”
Course: Special Topics in Cell and Developmental Biology – Genomic Biology Workshop.

2014: **Instructor** (1 semester) Department of Zoology, University of Wisconsin-Madison.
Course: Comparative and Evolutionary Physiology Lab.

2011-2013: Teaching Assistant (4 semesters) Department of Zoology, University of Wisconsin-Madison.
Courses: Comparative and Evolutionary Physiology Lab, Introductory Zoology Lab.

2007-2008: Teaching Assistant (2 semesters) Department of Biology, University of Iowa.
Courses: Introduction to Neurobiology, Biology of the Brain.

Mentorship

Graduate Students

2020: Tionna Ouellette. Tionna rotated through Elissa Chesler’s lab as a neuroscience graduate student. I worked with Tionna on smFISH design.

2019: Ahmed Almaghasilah. Primary mentor for Ahmed as part of his graduate rotation with Elissa Chesler in new computational approaches to analyzing behavior.

2014-2018: Abbas Bukhari. Assisted in mentoring Abbas with a specific emphasis on the computational aspects of his Ph.D. project.

2014-2015: Kavya Kannan. Co-mentored Kavya on her master’s project on alternative splicing in the brain.

Undergraduate Students

2021: Bailey West. Bailey worked on comparative genomics of addiction in the JAX Summer Student program.

2019: Violet Kimble. Violet worked on computational genomics in the JAX Summer Student program.

2016-2018: Navroop Gill. Trained Navroop in neuropathology and routine PCR applications.

2017: Elliot Ping. Worked as an undergraduate funded through an NSF REU program. Trained on R programming and on CLARITY for brain clearing.

2015-2016: Hao Sun. Co-mentored Hao Sun with Chris Seward of the Stubbs Lab. Hao worked won pathology experiments, contributing sufficiently to become a co-author on a paper.

2015-2016: Yujun Wu. Yujun assisted on mouse behavioral and molecular work.

2011-2013: Anna Whitlinger. Worked with Anna during her undergraduate effort in the Gammie Lab.

2010-2012: Tyler Wied. Tyler's research project examined somatostatin receptor expression in the maternal brain.

2010-2011: Katie Engh. Oversaw Katie's biology major requirement for lab work.

Workshops Attended

2021: High-Value Talent Retreat for development of intellectual property (UConn)

2018: Carpentries workshop in Python for reproducible statistical analysis (The Jackson Laboratory)

2018: Addiction Short Course (High Seas Conference Center at The Jackson Laboratory)

2015: IGB at BGI Workshop in Genomics (held at BGI in Shenzhen, China)

Skills and Proficiencies

Computational biology experience includes: core competency in UNIX command line work, programming (R, Python 3), statistical graphics (ggplot2, lattice), sequencing analysis software (alignment, read counting, EM calculations), bioinformatics analysis (edgeR, DEXSeq, WGCNA), reproducible research (Jupyter, RStudio), and genetics (r/qtl2).

Molecular biology laboratory experience includes: nucleic acid extraction, sequencing library preparation and QC, cloning, real-time PCR, confocal and conventional microscopy, Western blotting, and immunoassays.

Laboratory behavior experience includes: high-throughput computer vision analysis, observation of honeybees and mice, analysis of aggression and nurturance.

Field behavior experience includes: ethological data collection, GPS mapping, field site maintenance.

Basic computer literacy includes: graphics (Adobe CS), office tools (MS Office, OpenOffice), and web management and CMS (WordPress, HTML and CSS).

Service and Outreach

2016-2017: World of Genomics station member, "Understanding Behavior: From Honey Bees to Humans."

2014-2017: Genome Day participant and activity coordinator. "Your Genome and Your Senses" and "Understanding Behavior".

2014-2015: Co-Chair, IGB Fellows Symposium. Jointly organized a day-long symposium with multiple speakers including a keynote from Bonnie Bassler.

2013-2014: Student Member, University of Wisconsin-Madison Department of Zoology Faculty Search.

Peer Reviewer: *Genome Biology and Evolution*, *Neuropharmacology*, *PLoS ONE*, *BMC Biology*, *BMC Systems Biology*, *BMC Evolutionary Biology*, *Psychoneuroendocrinology*, *Behavioral Ecology and Sociobiology*, *PLoS Genetics*, *PNAS*.