Jacob Beierle, Ph.D.

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Education

BOSTON UNIVERSITY SCHOOL OF MEDICINE — Boston, MA
Ph.D Student in Biomolecular Pharmacology — **2016 - 2022**
Advisor: Dr. Camron Bryant

UNIVERSITY OF VERMONT — Burlington, VT
Bachelor of Science in Neuroscience — **2010**

Research Experience

KUMAR LABORATORY/THE JACKSON LABORATORY — **2022 – Present**
Post-Doctoral Associate

- Appling supervised machine learning to construct univariate scales for spontaneous pain in high need, clinically relevant models of pain. These include neuropathic pain (spared nerve injury, chronic constriction injury), post-surgical pain (double hind paw incision and laparotomy), osteoarthritis (monoiodoacetate), and migraine (nitroglycerine). These efforts employ a simple OFA arena and quantify disruptions in gait, canonical voluntary behaviors, and open field arena measurements.
- Exploring the use of long-term monitoring in the assessment of spontaneous pain. Monitoring mice in the home cage or over long periods of time allows for the continuous monitoring of social, homeostatic, and circadian behaviors (e.g., drinking, sleeping). I hypothesize that these features will add discriminatory power to our above tools.

BRYANT LABORATORY/BOSTON UNIVERSITY SCHOOL OF MEDICINE — **2017 - 2022**
Ph.D Candidate

- Used an F2 reduced complexity cross between substrains of BALB/c mice to investigate the genetic basis of female specific differences in oxycodone and metabolite brain concentrations and state dependent expression of reward. Combined gene and exon level transcriptomics, brain and liver proteomics, and QTL mapping to identify a candidate gene, *Zhx2*, within a region of chromosome 15 linked to increased brain concentrations of oxymorphone. This finding is particularly interesting given that oxymorphone is 8-10x more potent that its parent compound and may be influencing the female specific differences in state dependent expression of reward.
- Using the same model above, I identified differences in thermal nociception and brain weight between BALB/c substrains and successfully mapped these phenotypes to loci located on chromosome 13 and 5 respectively. From this work, and using the multi-omic approach detailed above, I identified *H2afy* and *Acads* as candidates for these loci.
- Investigated the genetic basis of oxycodone related phenotypes in a panel of 29 inbred mouse strains for haplotype association mapping. Following mapping, assessed candidates for protein expression, RNA expression, and behavioral impacts of genetic ablation. Involved mouse husbandry of cryo-recovered strains.
- In collaboration with the Damaj Lab at VCU I conducted QTL mapping in a model of paclitaxel induced chemotherapy induced peripheral neuropathy, successfully mapping a significant locus for chemotherapy induced mechanical sensitivity.
- I have collaborated with the Damaj and Gould laboratories to assist with RNA transcriptomic analysis to understand the impact of genetic knockouts on chemotherapy induced peripheral neuropathy and models of impaired learning after adolescent alcohol exposure respectively.
- In collaboration with Dr.s Wachman and Zhang at Boston University I established code used for the analysis of the placental methylome in human samples from mother infant duads with and without neonatal opioid withdrawal syndrome.
- Used cellular and molecular techniques to identify mechanisms by which genetic polymorphisms alter sensitivity to methamphetamine and oxycodone in support of other projects. These techniques

include western blotting, native western blotting, cloning and mutagenesis within a reporter vector, as well as fluorescent and DAB microscopy.

BIOGEN NEW INDICATION RESEARCH UNIT **MAY 2017 – July 2017**

Graduate Student Intern

- Used flow cytometry to identify novel populations of human plasmacytoid dendritic cells modulated by novel therapeutics used for alternate indications. These experiments included the isolation of primary bone marrow derived macrophages and the development of a new antibody cocktail to successfully sort populations by flow cytometry.
- Characterized the cellular response to novel antibody therapies in primary human peripheral blood mononuclear cells.

SHANJANA AWASTHI LABORATORY / OKLAHOMA UNIVERSITY

Research Technician **2015 – 2016**

- Worked to identify the cellular mechanisms by which a novel TLR-4 binding peptide exerts anti-inflammatory effects in immortalized dendritic cells and primary lung macrophages. Included qPCR of cytokine responses to intratracheal bacterial installation, cell culture of antigen presenting innate immune cells, and the collection and testing of primary alveolar macrophages.
- Worked to identify the modulation of the inflammatory response to bacterial lung infection after treatment with a novel TLR-4 binding peptide in a mouse model in a BSL2 environment.

WILLIAM FALLS LABORATORY/UNIVERSITY OF VERMONT

Undergraduate Research Assistant **2011 – 2014**

- Investigated the anxiolytic effects of exercise before and after chronic stress, and the modulation of the neuroendocrine responses associated with those effects using a mouse model. Included behavioral assays (chronic variant stress, acoustic startle) dexamethasome challenge, perfusions, dissections, and immunohistochemistry.

Publications

Borrelli, K. N., Wingfield, K. K., Yao, E. J., Zamorano, C. A., Sena, K. D., **Beierle, J. A.**, Roos, M.A., Zhang, H., Wachman, E.W., Bryant, C. D. (2023). Decreased myelin-related gene expression in the nucleus accumbens during spontaneous neonatal opioid withdrawal in the absence of long-term behavioral effects in adult outbred CFW mice. Neuropharmacology, 240, 109732.

Sabnis, G. S., Hession, L. E., Kim, K., **Beierle, J. A.**, & Kumar, V. (2022). A high-throughput machine vision-based univariate scale for pain and analgesia in mice. bioRxiv, 2022-12.

Sena, K. A., **Beierle, J.A.**, Richardson, K.T., Kantak, K., Bryant, C.D. (2022). Assessment of binge-like eating of unsweetened versus sweetened chow pellets in BALB/c substrains. *Frontiers in Behavioral Neuroscience*.

Beierle, J. A., Yao, E. J., Goldstein, S. I., Lynch, W. B., Scotellaro, J. L., Shah, A.A., Sena, K. D., Wong, A.L., Linnertz, CL, Averin, O., Moody, D.E., Reilly, C.A., Peltz, G., Emili, A., Ferris, M.T., & Bryant, C. D. (2022). Zhx2 is a candidate gene underlying oxymorphone metabolite brain concentration associated with state-dependent oxycodone reward. *Journal of Pharmacology and Experimental Therapeutics*.

Beierle, J.A., Yao, E.Y., Goldstein, S.I., Scotellaro, J.L., Sena, K.D., Linnertz, C.A., Willits, A.B., Kader, L., Young, E.Y., Peltz, G., Emili, A., Ferris, M.T., Bryant, C.D. (2022). Genetic basis of thermal nociceptive sensitivity and brain weight in a BALB/c reduced complexity cross. *Molecular Pain*, 18, 17448069221079540.

Borrelli, K. N., Wachman, E. M., **Beierle, J. A.,** Taglauer, E. S., Jain, M., Bryant, C. D., & Zhang, H. (2022). Effect of Prenatal Opioid Exposure on the Human Placental Methylome. *Biomedicines*, *10*(5), 1150.

Goldberg, L. R., Yao, E. J., Kelliher, J. C., Reed, E. R., Wu Cox, J., Parks, C., Kirkpatrick, S. L., **Beierle, J. A.**, Chen, M. M., Johnson, W. E., Homanics, G. E., Williams, R. W., Bryant, C. D., & Mulligan, M. K. (2021). A quantitative trait variant in Gabra2 underlies increased methamphetamine stimulant sensitivity. *Genes, brain, and behavior*, *20*(8), e12774.

Borrelli, K. N., Yao, E. J., Yen, W. W., Phadke, R. A., Ruan, Q. T., Chen, M. M., Langan, C.R., Scotellaro, J.L., Babbs, K.R., **Beierle, J.**, Logan, R.W., Wachman, E.M., Cruz-Martin, A., & Bryant, C. D. (2021). Sex differences in behavioral and brainstem transcriptomic neuroadaptations following neonatal opioid exposure in outbred mice. *Eneuro*, *8*(5).

Awasthi, S., Kumar, G., Ramani, V., Awasthi, V., Rodgers, K. K., Xie, J., **Beierle, J.**, Kyere-Davies, G., Singh, B., Rahman, N., Chowdhury, A.A., & Chataut, N. (2021). Mechanism of Anti-Inflammatory Activity of TLR4-Interacting SPA4 Peptide. *ImmunoHorizons*, *5*(8), 659-674.

Babbs, R. K., **Beierle, J. A**., Yao, E. J., Kelliher, J. C., Medeiros, A. R., Anandakumar, J., Shah, A. A., Chen, M. M., Johnson, W. E., & Bryant, C. D. (2020). The effect of the demyelinating agent cuprizone on binge-like eating of sweetened palatable food in female and male C57BL/6 substrains. *Appetite*, *150*, 104678.

Wachman, E. M., Wang, A., Isley, B. C., Boateng, J., **Beierle, J. A.**, Hansbury, A., Shrestha, H., Bryant, C., & Zhang, H. (2020). Placental OPRM1 DNA methylation and associations with neonatal opioid withdrawal syndrome, a pilot study. *Exploration of medicine*, *1*(3), 124.

Ruan, Q. T., Yazdani, N., Reed, E. R., **Beierle, J. A.**, Peterson, L. P., Luttik, K. P., Szumlinski, K.K, Johnson, W.E., Ash, P.E., Wolozin, B., & Bryant, C. D. (2020). 5′ UTR variants in the quantitative trait gene Hnrnph1 support reduced 5′ UTR usage and hnRNP H protein as a molecular mechanism underlying reduced methamphetamine sensitivity. *The FASEB Journal*, *34*(7), 9223-9244.

Ruan, Q. T., Yazdani, N., Blum, B. C., **Beierle, J. A**., Lin, W., Coelho, M. A., Fultz, E. K., Healy, A. F., Shahin, J. R., Kandola, A. K., Luttik, K. P., Zheng, K., Smith, N. J., Cheung, J., Mortazavi, F., Apicco, D. J., Ragu Varman, D., Ramamoorthy, S., Ash, P., Rosene, D. L., Emili, A., Wolozin, B., Szumlinski, K.K., & Bryant, C. D. (2020). A Mutation in *Hnrnph1* That Decreases Methamphetamine-Induced Reinforcement, Reward, and Dopamine Release and Increases Synaptosomal hnRNP H and Mitochondrial Proteins. *The Journal of Neuroscience: the official journal of the Society for Neuroscience*, *40*(1), 107–130.

Babbs, R. K., **Beierle, J. A.**, Ruan, Q. T., Kelliher, J. C., Chen, M. M., Feng, A. X., Kirkpatrick, S.L., Benitez, F.A., Rodrigues, F.A., Pierre, J.J., Anandakumar, J., Kumar, V., Mulligan, M.K., & Bryant, C. D. (2019). Cyfip1 haploinsufficiency increases compulsive-like behavior and modulates palatable food intake in mice: dependence on Cyfip2 genetic background, parent-of origin, and sex. *G3: Genes, Genomes, Genetics*, *9*(9), 3009-3022.

Ruan, Q. T., Yazdani, N., **Beierle, J. A.**, Hixson, K. M., Hokenson, K. E., Apicco, D. J., Luttik, K.P., Zheng, K., Maziuk, B.F., Ash, P.E., Szumlinski, K.K., Russek, S.J., Wolozin, B., & Bryant, C. D. (2018). Changes in neuronal immunofluorescence in the C-versus N-terminal domains of hnRNP H following D1 dopamine receptor activation. *Neuroscience letters*, *684*, 109-114.

Hare, B. D., **Beierle, J. A.**, Toufexis, D. J., Hammack, S. E., & Falls, W. A. (2014). Exercise-associated changes in the corticosterone response to acute restraint stress: evidence for increased adrenal sensitivity and reduced corticosterone response duration. *Neuropsychopharmacology*, *39*(5), 1262-1269.

Oral Scientific Presentations

Jacob A. Beierle, Emily J. Yao, Stan I. Goldstein, Julia L. Scotellaro, Katherine D. Sena, Olga Averin, David E. Moody, Christopher A. Reilly, Andrew Emili, Gary Peltz, Martin T. Ferris, Camron D. Bryant. A reduced

complexity cross between BALB/c substrains identifies Zhx2 as a candidate gene underlying oxycodone metabolite brain concentration and state-dependent learning of opioid reward. Oral presentation at: Russek Student Achievement Day; April 11, 2022.

Jacob A. Beierle, Emily J. Yao, Stan I. Goldstein, Julia L. Scotellaro, Katherine D. Sena, Olga Averin, David E. Moody, Christopher A. Reilly, Andrew Emili, Gary Peltz, Martin T. Ferris, Camron D. Bryant. A reduced complexity cross between BALB/c substrains identifies Zhx2 as a candidate gene underlying oxycodone metabolite brain concentration and state-dependent learning of opioid reward. Oral presentation at: Boston University Genome Science Institute Research Symposium; November 11, 2021.

Jacob A. Beierle, Emily J. Yao, Julia L. Scotellaro, Olga Averin, David E. Moody, Gary Peltz, Martin Ferris, Camron D. Bryant. A BALB/c reduced complexity cross identifies Zhx2 as a candidate underlying oxycodone metabolite brain concentration and state-dependent learning. Oral presentation at: World Congress of Psychiatric Genetics; October 12, 2021.

Jacob A. Beierle, Emily J. Yao, Julia L. Scotellaro, Olga Averin, David E. Moody, Gary Peltz, Martin Ferris, Camron D. Bryant. BALB/c substrain differences in whole brain concentrations of the highly potent oxycodone metabolite oxymorphone map to chromosome 15 in a reduced complexity cross. Oral presentation at: Complex Trait Consortium; September 2, 2021.

Jacob A. Beierle, Emily J. Yao, Julia L. Scotellaro, Olga Averin, David E. Moody, Gary Peltz, Martin T. Ferris, Camron D. Bryant. A major QTL on chromosome 15 underlying BALB/c subsrain differences in whole brain concentration of the potent oxycodone metabolite oxymorphone: Nomination of Zhx2 as a candidate gene underlying pharmacokinetics and behavior. Oral presentation at: Russek Student Achievement Day; May 6, 2021; Boston, MA.

Jacob A. Beierle, Emily J. Yao, Julia L. Scotellaro, Olga Averin, David E. Moody, Gary Peltz, Martin Ferris, Camron D. Bryant. BALB/c substrain differences in whole brain concentrations of the highly potent oxycodone metabolite oxymorphone map to chromosome 15 in a reduced complexity cross. Oral presentation at: International Behavioral and Neural Genetics Society; May 11, 2021.

Jacob A. Beierle, Emily Yao, Julia Scotellaro , Gary Peltz, Camron D. Bryant. Identification of major QTLs underlying BALB/c substrain differences in oxycodone state- dependent conditioned place preference in a reduced complexity cross. Oral presentation at: Boston University Genome Science Institute Research Symposium; November 12, 2020.

Jacob A. Beierle, Emily Yao, Julia Scotellaro , Gary Peltz, Camron D. Bryant. Differences in oxycodone state dependent learning between nearly isogenic BALB/cJ and BALB/cByJ mouse substrains map to chromosomes 14 and 6. Oral presentation at International Narcotics Research Conference; July 22, 2020.

Jacob A. Beierle, Emily Yao, Julia Scotellaro, Gary Peltz, Camron D. Bryant (2019). Nearly isogenic BALB/cJ and BALB/cByJ substrains differ in opioid state dependent learning, spontaneous withdrawal, and weight loss in response to oxycodone: Planning a reduced complexity cross. Oral presentation at the International Behavioral and Neural Genetics Society, Edinburgh, Scotland.

Jacob A. Beierle, Lisa R. Goldberg, Julia C. Kelliher, Kimberly P. Luttik, Julia L. Scotellaro, Alex M. Luong, Jiayi Wu, Eric R. Reed, David F. Jenkins, Qiu T. Ruan, Ali Al Abdullatif, Stacey L. Kirkpatrick, Cory Parks, Christine Watkins, Morgan Dickerson, Sufiya Khanam, Sydney B. Crotts, Timothy A. Drescher, Neema Yazdani, Robert W. Williams, Gregg E. Homanics, William E. Johnson, Benjamin Wolozin, Megan K. Mulligan, Camron D. Bryant (2018). Systems genetics, fine mapping, and validation of candidate genes involved in opioid and psychostimulant addiction traits in a reduced complexity cross. Oral presentation at the International Behavioral and Neural Genetics Society, Rochester, MN.

Scientific Poster Presentations

Sabnis, G. S., Hession, L. E., Kim, K., **Beierle, J. A.**, & Kumar, V. (2022). A high-throughput machine vision-based univariate scale for pain and analgesia in mice. Poster presentation at the NIDA Genetics and Epigenetics Cross-Cutting Research Meeting.

Sabnis, G. S., Hession, L. E., Kim, K., **Beierle, J. A.**, & Kumar, V. (2022). A high-throughput machine vision-based univariate scale for pain and analgesia in mice. Poster presentation at The State of AI in Maine.

Jacob A. Beierle, Emily J. Yao, Stan I. Goldstein, Julia L. Scotellaro, Katherine D. Sena, Olga Averin, David E. Moody, Christopher A. Reilly, Andrew Emili, Gary Peltz, Martin T. Ferris, Camron D. Bryant (2022). A BALB/c reduced complexity cross identifies Zhx2 as a candidate underlying oxycodone metabolite brain concentration and state-dependent learning. Poster presentation at Experimental Biology.

Jacob A. Beierle, Emily J. Yao, Stan I. Goldstein, Julia L. Scotellaro, Katherine D. Sena, Olga Averin, David E. Moody, Christopher A. Reilly, Andrew Emili, Gary Peltz, Martin T. Ferris, Camron D. Bryant (2021). A BALB/c reduced complexity cross identifies Zhx2 as a candidate underlying oxycodone metabolite brain concentration and state-dependent learning. Poster presentation at Boston Area Neurogroup Fall Symposium, Virtual meeting.

Jacob A. Beierle, Emily J. Yao, Julia L. Scotellaro, Olga Averin, David E. Moody, Gary Peltz, Camron D. Bryant (2021). Zhx2 is a candidate gene underlying brain oxymorphone concentration and oxycodone state-dependent learning of opioid reward in a BALB/c reduced complexity cross. Poster presentation at Taste of International Narcotics Research Consortium, Virtual meeting.

Jacob A. Beierle, Emily J. Yao, Julia L. Scotellaro, Olga Averin, David E. Moody, Gary Peltz, Camron D. Bryant (2021). BALB/c substrain differences in whole brain concentrations of the highly potent oxycodone metabolite, oxymorphone map to chromosomes 5, 10, and 16 in a reduced complexity cross. Poster presentation at NIDA Genetics Consortium, Rockville, MD.

Jacob A. Beierle, Emily Yao, Julia Scotellaro , Gary Peltz, Camron D. Bryant. Identification of Major Qtls Underlying BALB/c Substrain Differences in Oxycodone State Dependent CPP in a Reduced Complexity Cross (2020). Poster presented at: World Congress of Psychiatric Genetics, Virtual meeting.

Jacob A. Beierle, Emily Yao, Julia Scotellaro , Gary Peltz, Camron D. Bryant (2020). Nearly isogenic BALB/cJ and BALB/cByJ substrains differ in opioid state dependent learning, spontaneous withdrawal, and weight loss in response to oxycodone: Planning a reduced complexity cross. Poster presentation at NIDA Genetics Consortium, Rockville, MD.

Jacob A. Beierle, Emily Yao, Julia Scotellaro, Gary Peltz, Camron D. Bryant (2019). Nearly isogenic BALB/cJ and BALB/cByJ substrains differ in opioid state dependent learning, spontaneous withdrawal, and weight loss in response to oxycodone: Planning a reduced complexity cross. Poster presented at the NIDA Genetics Consortium, Rockville, MD

Jacob A. Beierle, Emily Yao, Julia Scotellaro, Gary Peltz, Camron D. Bryant (2019). Nearly isogenic BALB/cJ and BALB/cByJ substrains differ in opioid state dependent learning, spontaneous withdrawal, and weight loss in response to oxycodone: Planning a reduced complexity cross. Poster presentation at the Boston Area Neuroscience Group (SFN affiliate), Boston,MA

Jacob A. Beierle, Julia L. Scotellaro, Emily Yao, Julia C. Kelliher, Richard K. Babbs, Ming Zheng, Gary Peltz, Camron D. Bryant (2019). Mouse inbred strain survey of oxycodone addiction traits in an opioid multi-stage addiction assessment paradigm. Poster Presentation at the INRC, New York, NY

Jacob A. Beierle, Julia L. Scotellaro, Emily Yao, Julia C. Kelliher, Richard K. Babbs, Ming Zheng, Gary Peltz, Camron D. Bryant (2019). Mouse inbred strain survey of oxycodone addiction traits in an opioid multi-stage addiction assessment protocol. Poster Presentation at the NIDA Genetics Consortium, Rockville, MD

Lisa R. Goldberg, Stacey L. Kirkpatrick, Alex M. Luong, Julia C. Kelliher, Kimberly P. Luttik, Jiayi Wu, Eric R. Reed, David F. Jenkins, **Jacob A. Beierle**, Julia L. Scotellaro, Timothy A. Drescher, Neema Yazdani, W. Evan Johnson, Megan K. Mulligan, Camron D. Bryant (2018). Systems genetic analysis and positional cloning in a reduced complexity cross identifies a major QTL on distal chromosome 1 underlying opioid addiction traits. Poster presented at the NIDA Genetics Consortium, Rockville, MD

Jacob A. Beierle, Julia L. Scotellaro, Emily Yao, Julia C. Kelliher, Richard K. Babbs, Ming Zheng, Gary Peltz, Camron D. Bryant (2018). Mouse inbred strain survey of oxycodone addiction traits in an opioid multi-stage addiction assessment protocol. Poster Presentation at Society for Neuroscience, San Diego, CA

Awards and Funding

Russek Student Achievement Day graduate student award, 1st place	**2022**
Russek Student Achievement Day graduate student award, 3rd place	**2021**
Outstanding young investigator award, International Behavior and Neurogenetics Society	**2021**
Outstanding graduate student award, 3rd place: Complex Trait Consortium	**2021**
Boston University Genome Science Institute $5k RNAseq Award	**2021**
Boston Area Neuroscience Group Graduate Student Poster Award	**2019**
Boston University School of Medicine	
Translational Training Program in Addiction Science	**2016, 2017**
A 2-year training grant focused on the translation of addiction research	

Affiliations

American Society for Pharmacology and Experimental Therapeutics	**2021-Present**
International Behavioral and Neural Genetics Society	**2018 – Present**
Society for Neuroscience	**2018 – 2019**