

Lindsey Robertson Hammerslag
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Education

2005-2010 **B.S.**, Psychology, Arizona State University, Tempe, AZ
2010-2017 **Ph.D.**, Neuroscience Program, University of Illinois Urbana-Champaign.
Mentor: Joshua M. Gulley, Ph.D.
Dissertation: Sex differences in PFC-related behavior after amphetamine exposure and across adolescent development. *Defense and dissertation deposit completed May, 2017.*
Ph.D. Award Date: August, 2017

Research

Postdoctoral Fellow, Professor Michael Bardo, University of Kentucky (June 2017 – Present). I am currently working to elucidate how social influences can affect drug seeking. I have developed a robust preclinical model of socially-induced relapse and I will be using a retrograde DREADD approach to investigate whether the effects I have demonstrated are mediated by oxytocin-releasing projections to the reward system. I am also investigating how economic demand for fentanyl is impacted by exposure to drugs targeting μ opioid receptors. Since joining the lab, I have become proficient in the following techniques: immunohistochemistry, confocal microscopy, retrograde tracing, DREADDs, drug self-administration, behavioral economics, nonlinear mixed effect modeling, and neuropharmacology.

Graduate Student, Professor Joshua Gulley, University of Illinois Urbana-Champaign (June 2010 – Present) Designed, executed and analyzed experiments involving intracranial infusion, *in vivo* electrophysiological recording, western blot, alcohol self-administration, operant behavior, T-maze, open field, and manual and automated behavioral video scoring. Refined stereological surgical techniques through custom designing equipment and improving anesthetic methods. Customized equipment for electrophysiological recording.

Research Assistant, Professor Janet Neisewander, Arizona State University (August 2008 – June 2010) Duties included drug self-administration, injections, catheter and headpiece surgeries, preparing drugs, intracranial infusions, perfusions, locomotor testing, tissue slicing and histology, data entry, interpretation and presentation.

Publications

*indicates student mentee

T.H.C. Cheung, B.C. Nolan, **L. R. Hammerslag**, S.M. Weber, J.P. Durbin, N. A. Peartree, R. H. Mach, R.R. Luedtke, J.L. Neisewander (2012) Phenylpiperazine derivatives with selectivity for dopamine D3 receptors modulate cocaine self-administration in rats. *Neuropharmacology* 63:1346–59.

L. R. Hammerslag, J. M. Gulley (2013) Age and sex differences in reward behavior in adolescent and adult rats. *Developmental Psychobiology* 56(4):611-621.

B. C. Nolan, S. Liu, **L. R. Hammerslag**, T.H.C. Cheung, J. Lenz, R.H. Mach, R.R. Luedtke, J.L. Neisewander (2013) Fos expression in response to phenylpiperazine drugs exhibiting selectivity for dopamine D3 receptors given with or without cocaine. *Synapse* 67:847-855.

L. R. Hammerslag, A. J. Waldman*, J. M. Gulley (2014) Effects of amphetamine exposure in adolescence or young adulthood on inhibitory control in adult male and female rats. *Behavioural Brain Research* 263:22-33.

L. R. Hammerslag, J. M. Gulley (2015) Sex differences in behavior and neural development and their role in adolescent vulnerability to substance use. *Behavioural Brain Research*, 298, 7–11.

E. R. Hankosky, L. K. Sherrill, L. A. Ruvola, R. M. Haake, T. Kim, **L. R. Hammerslag**, D. G. Kougias, J. M. Juraska (2016) Effects of β -hydroxy- β -methyl butyrate on working memory and cognitive flexibility in an animal model of aging. *Nutritional Neuroscience*, 8305(February).

V. G. Weiss, J. R. Yates, J. S. Beckmann, **L. R. Hammerslag**, M. T. Bardo (2018). Social Reinstatement: A Rat Model of Peer-Induced Relapse. *Psychopharmacology*.

L. R. Hammerslag, A. Belagodu, O. A. Aladesuyi Arogundade*, A. G. Karountzos*, Q. Guo*, J. M. Gulley (2019). Adolescent impulsivity as a sex- and subtype-dependent predictor of impulsivity, alcohol drinking, and D₂ receptor expression in adulthood. *Addiction Biology*.

V. G. Weiss, **L. R. Hammerslag**, M. T. Bardo (*in press*) Effect of a social peer on risky decision-making in adolescent male Sprague Dawley rats. *Experimental and Clinical Psychopharmacology*.

M. T. Bardo, E.D. Denehy, **L. R. Hammerslag**, L. P. Dwoskin, B. E. Blough, A. Landavazo, J. Bergman and S. J. Kohut (*accepted pending revision*). Effects Methamphetamine Isomers on d-Methamphetamine Self-Administration and Food-Maintained Responding in Male Rats.

L. R. Hammerslag, R. S. Hofford, J. S. Beckmann, M. T. Bardo (*in preparation*). Changes in fentanyl demand following naltrexone, morphine, and buprenorphine in male rats.

L. R. Hammerslag, J. S. Beckmann, M. T. Bardo (*in preparation*). A robust model of social drug seeking in rats: comparison to nonsocial drug-seeking and examination of chemogenetic activation of oxytocin-releasing hypothalamic cells.

Conference presentations

*indicates student mentee

B.C. Nolan, N.A. Cole, **L.M. Robertson**, S. M. Weber, M. Barajas, J. Durbin, R.H. Mach, R.R. Luedtke, J.L. Neisewander (2009, October) Attenuation of cocaine self-administration by novel dopamine D₃ receptor ligands. Poster presentation at the annual meeting of the Society for Neuroscience, Chicago, IL.

B.C. Nolan, **L.M. Robertson**, J.M. Pang, M. Barajas, S.M. Weber, J. Durbin, N.A. Peartree, R.H. Mach, R.R. Luedtke, J.L. Neisewander (2010, June) Attenuation of cocaine self-administration by novel dopamine D₃ receptor ligands. Poster presentation at the College on Problems of Drug Dependence annual meeting, Scottsdale, AZ

L.A. Pockros, N.S. Pentkowski, S.E. Swinford, **L.M. Robertson**, M. Ostos, J.L. Neisewander (2010, June) Blockade of 5-HT_{2A} receptors in the medial prefrontal cortex attenuates cue-elicited reinstatement of cocaine-seeking behavior in rats. Poster presentation at the College on Problems of Drug Dependence annual meeting, Scottsdale, AZ

B.C. Nolan, S. Liu, **L.M. Robertson**, R.H. Mach, R.R. Luedtke, J.L. Neisewander (2010, November) Fos expression by systemic administration of D3 receptor ligands. Poster presentation at the annual meeting of the Society for Neuroscience, San Diego, CA

N.S. Pentkowski, T.H.C. Cheung, W.A. Toy, M. Adams, A. Jensen, C. Valles, J. Alba, S. Liu, **L. Robertson**, J.F. Neumaier, J.L. Neisewander (2010, November) Elevated expression of serotonin 1B (5-HT_{1B}) receptors in the mesolimbic pathway enhances the reinforcing effects of cocaine yet reduces cocaine-seeking behavior. Poster presentation at the annual meeting of the Society for Neuroscience, San Diego, CA.

L.M. Robertson, N.B. Senese*, B.A. Marcus*, A.J. Waldman*, J.M. Gulley (2011, June) Adolescent male and female rats show enhanced responding to sucrose reward in a Pavlovian conditioning paradigm. Poster presentation at the College on Problems of Drug Dependence annual meeting, Hollywood, FL.

L.M. Robertson, A.J. Waldman*, R.R. Marreddy*, S.H. Shah*, & J.M. Gulley (2011, November). Sex- and age-dependent differences in reward processing in adolescent and adult rats trained in a Pavlovian approach paradigm. Poster presentation at the Annual Meeting of the Society for Neuroscience, Washington, DC.

L. Hammerslag, A. Waldman*, O. Aladesuyi Arogundade*, J. Weaver*, J. Gulley (2013, June). Sex differences in impulsive action: Dissociation between systemic and intra-mPFC glutamate antagonism and effect of amphetamine exposure. Poster slated to present at the International Behavioral Neuroscience Society annual meeting, Dublin, Ireland.

L.R. Hammerslag, O.A. Aladesuyi Arogundade*, A.G. Karountzos*, J.M. Gulley (2013, November). A longitudinal study of impulsive action and choice in female rats tested during adolescence and young adulthood. Poster presentation at the Annual Meeting of the Society for Neuroscience, San Diego, CA.

L.R. Hammerslag, O.A. Aladesuyi Arogundade*, A.G. Karountzos*, J.M. Gulley (2014, November). Impulsive choice, but not impulsive action, is stable from adolescence to adulthood and predicts ethanol drinking in male and female rats. Poster presentation at the Annual Meeting of the Society for Neuroscience, Washington, DC.

L.R. Hammerslag, A.J. Contreras-Rogers*, P.B. Shah*, A.N. Marks*, J.M. Gulley (2015, October). Effects of amphetamine exposure during adolescence on orbitofrontal cortex neurons that encode goal-directed and habitual behaviors. Poster presentation at the Annual Meeting of the Society for Neuroscience, Chicago, IL.

L.R. Hammerslag, J.S. Beckmann, M.T. Bardo (2018, April). A preclinical model for socially-induced cocaine relapse. Poster presentation at the Bluegrass Society for Neuroscience Annual Meeting, Lexington, KY.

M.Z. Slusarewicz*, **L.R. Hammerslag**, E.D. Denehy, D. Vasquez-Sanroman, M.T. Bardo (2018, April). Activation of the Reward Circuit by Social Play in Adolescent Rats. Poster presentation at the Bluegrass Society for Neuroscience Annual Meeting, Lexington, KY.

J.R. Johnson*, **L.R. Hammerslag**, M.T. Bardo (2018, April). Oxytocin as Preclinical Treatment for Socially-Induced Reinstatement. Poster presentation at the Bluegrass Society for Neuroscience Annual Meeting, Lexington, KY.

K.R. Einloth*, **L.R. Hammerslag**, D.V. Sanroman, E.D. Denehy, M.T. Bardo (2018, April). Oxytocin and Reward Pathway Activation Following Social Play. Poster presentation at the Bluegrass Society for Neuroscience Annual Meeting, Lexington, KY.

L. R. Hammerslag, J. S. Beckmann, M. T. Bardo (2018, June). The wrong crowd: social influences on cue-induced cocaine seeking. College on Problems of Drug Dependence annual meeting, San Diego, CA.

L.R. Hammerslag, R. Hofford, J.S. Beckmann, M.T. Bardo (2018, November). Behavioral economic analysis of fentanyl demand following treatment with naltrexone, morphine, or buprenorphine. Society for Neuroscience annual meeting, San Diego, CA.

L.R. Hammerslag, E.D. Denehy, M.Z. Slusarewicz*, J.R. Johnson*, M.J. Clancy*, M.T. Bardo (2019, March). Hypothalamic oxytocin release induced by DREADDs blocks peer-induced cocaine seeking. Poster slated to present at Substance Use Research Day, Lexington, KY.

M.Z. Slusarewicz*, **L.R. Hammerslag**, E.D. Denehy, M.T. Bardo (2019, March). Validating DREADDs to assess the mechanism of oxytocin as a treatment for stimulant abuse. Poster slated to present at Substance Use Research Day, Lexington, KY.

M.J. Clancy*, **L.R. Hammerslag**, J.R. Johnson*, M.T. Bardo (2019, March). Comparing reinstatement induced by social versus nonsocial discriminative stimuli. Poster slated to present at Substance Use Research Day, Lexington, KY.

L.P. Dwoskin, M.T. Bardo, E.D. Denehy, **L.R Hammerslag**, B. Blough, J. Bergman, S.J. Kohut (2019, June). Effects of methamphetamine isomers on d-methamphetamine self-administration and food-maintained responding in male rats. Poster slated to present at the College on Problems of Drug Dependence annual meeting, San Antonio, TX.

S. Malone*, **L.R. Hammerslag**, M.T. Bardo (2019, June). Escalation and reinstatement of fentanyl self-administration in rats. S.M will present talk at the College on Problems of Drug Dependence annual meeting, San Antonio, TX.

L.R. Hammerslag, J.S. Beckmann, M.T. Bardo (2019, June). Comparing social and nonsocial influences on cocaine seeking in male rats. L.R.H will present talk at the College on Problems of Drug Dependence annual meeting, San Antonio, TX.

L.R. Hammerslag, E.D. Denehy, V. Grinevich and M.T. Bardo (2019, August) Chemogenetic activation of hypothalamic oxytocin neurons reduces peer-induced cocaine seeking. Submitted to present at EBPS Biennial Meeting, Braga, Portugal

L.R. Hammerslag, E.D. Denehy, K.E. Saatman, and M.T. Bardo (2019, October) Projections from oxytocin-releasing cells in paraventricular nucleus of hypothalamus to nucleus accumbens in male and female rats. Poster slated to present at the Society for Neuroscience Annual Meeting, Chicago, IL

Invited Talks

L.R. Hammerslag (2018, April). The role of decision making in the cycle of addiction. Everything is Science Festival: *Kentucky Anonymous – the Science of Substance Use Disorder & Recovery*. Lexington, KY

Employment

Laboratory Technician, Neisewander Lab, Arizona State University (Feb 2009 - June 2010) Responsibilities included self-administration chamber maintenance, surgery preparation, equipment and supplies purchasing, chemical and biological supplies purchasing, management and scheduling of undergraduate research

assistants, safety training, preparation of drugs, coordinating veterinary care of animals, general lab maintenance and equipment troubleshooting.

Clinical Research Recruiter, Reaven Endocrine Research Lab, Veterans Administration Foundation.(Feb 2008 – Feb 2009) Screened patients to determine their eligibility to participate in clinical research, developed advertising strategies, coordinated with IRB and researchers, evaluated screening criteria.

Honors

Provost's Scholarship, 2005-2007

Dean's List, Arizona State University, 2009

Neuroscience Program Graduate Student Fellowship, 2010-2011

NIDA Women & Sex/Gender Junior Investigator Travel Award for CPDD, 2011

CPDD Travel Award for Early Career Investigators, 2019

Professional activities

Senior theses mentored: Nick Senese (November 2010-April 2011), Rakesh Marreddy (January 2011-May 2011), Alex Waldman (December 2010-May 2012), Bankole Aladesuyi (January 2013-May 2014), Alex Contreras-Rogers (June 2015-June 2016), James R. Johnson (January 2018-December 2018).

Undergraduates and high school students mentored: Maria Pineros, Nick Senese, Alex Waldman, Ben Marcus, Rakesh Marreddy, Sapan Shah, Joachim Veit, Rubing Pan, Jon Ervin, John Weaver, Bankole Aladesuyi, Angela Karountzos, Dhruv Joshi, Parshva Shah, Maria Arulraja, Allison Marks, Alexander Contreras-Rogers, Junaid Sandozi, Anushree Dighe, Jojo Guo, Kaylin Laslo, Karen Lai, Vraj Patel, Thomas Fernandez, Reid Johnson, Katelyn Einloth, Megan Slusarewicz

Professional Affiliations

Society for Neuroscience (2009-Present)

CPDD (2011-Present)

IBNS (2013-Present)

APA Division 28 (2018-Present)

Professional Service

Vice President – Society for Postdoctoral Scholars at UKY (2018-present)

Webmaster, Symposium Planning Committee – Society for Postdoctoral Scholars at UKY (2017-2019)

Organizer, Secretary – UIUC Neuroscience Student Organization (2011-2012)

Ad Hoc Reviewer – Addiction Biology, Behavioural Pharmacology, Journal of Neuroendocrinology

Classes Taught

Teaching Assistant, *Behavioral Neuroscience* (2012-2013)

Instructor, *Biological Techniques in Psychology* (2013)

Teaching Assistant, *Psychopharmacology* (2014)

Teaching Assistant, *Capstone Undergraduate Research* (2014-2015)

Teaching Assistant, *The Molecular and Cellular Basis of Life* (2017)