Jesse D. Cushman, Ph.D.

National Institute of Environmental Health Sciences
Director, Neurobehavioral Core Laboratory
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EDUCATION

University of California, Los Angeles Los Angeles, CA
PhD, Interdepartmental Neuroscience Program 2010
Dissertation:
The role of the dentate gyrus in the formation of cognitive maps:
Insights from Pavlovian fear conditioning in genetically modified mice

University of Florida Gainesville, FL
BS, *summa cum laude*, Neurobiology 2002

GRANTS AND HONORS

NIH Special Act Award 2018
National Institute of Environmental Health Sciences

NIH Supplemental Award for Dr. Fanselow's R01 MH062122 2015
Applied computational modeling of contextual fear conditioning
Budget: $78,813

3 R's Pilot Funding, UCLA Animal Research Council 2015
Validating a computational model of contextual fear conditioning
Budget: $8,000

UCLA Grand Challenges, Neuroscience Focus Funding 2014
Adding optogenetic capability to the UCLA Behavioral Testing Core
Budget: $70,000

Invited Topic Editor of a Frontiers Research Topic 2013
Juvenile Neurogenesis in Structural and Functional Brain Development

T32 Training Program in Neural Repair 2011-2012
University of California, Los Angeles

T32 Training Program in Mol. and Cellular Neurobiology 2008-2010

University of California, Los Angeles

T32 Training Program in Behavioral Neuroscience 2007-2008
University of California, Los Angeles

RESEARCH EXPERIENCE

University of California, Los Angeles 8/1/2013-Present
Assistant Research Scientist/Adjunct Assistant Professor
Supervisor of the Behavioral Testing Core Facility

- Manage the core facility which provides equipment and space for a wide range of behavioral tasks designed to assess learning and memory, fear, anxiety, sociability and basic sensorimotor abilities.
- Provide training and guidance for experimental design, and statistical analysis for researchers at UCLA and from outside institutions
- Secured funding to add behavioral optogenetics capability to the core. Managed the purchasing of necessary equipment, validation of the techniques and implementation on several research projects.
- Teach an undergraduate Neurobiology of Learning lab course utilizing Behavioral Testing Core facility equipment

University of California, Los Angeles 10/1/2010-9/30/2013
Postdoctoral Scholar; Advisor: Mayank R. Mehta
Hippocampal mechanisms of multimodal integration in navigation and associative learning

- Collaboratively developed a novel rat virtual reality apparatus
- Developed behavioural procedures for training rats to behave in virtual environments, designed tasks to assess beacon and spatial navigation while simultaneously measuring associative learning
- Utilized in-vivo electrophysiological methods to record from hippocampal neurons during virtual and real world tasks

University of California, Los Angeles 9/1/2004-9/30/2010
Graduate Researcher; Advisor: Michael S. Fanselow
Behavioral pharmacogenetic analysis of dentate gyrus function

- Studied the behavioural consequences of manipulations targeted at the dentate gyrus region of the hippocampus with a primary focus on GABAergic signalling and post-natal neurogenesis
- Developed novel behavioural techniques to: 1) study the ethanol mediated impairment of hippocampal function and 2) more accurately measure Pavlovian tone fear conditioning in transgenic mice

University of Florida 6/1/2002-8/31/2004
Lab Manager; Principle Investigator: John M. Petitto
Neuroimmune modulation of hippocampal function

- Conducted behavioural experiments in transgenic mice: Morris water maze, contextual fear conditioning, novel object recognition, open field, elevated plus
- Managed mouse breeding colony, conducted PCR genotyping, organized and maintained laboratory, ordered products and supplies

TEACHING EXPERIENCE

Lectureships

Lecturer, *Neurobiology of Learning Lab*, UCLA Spring, Summer, 2014/15

- Developed course to be taught using the Behavioral Testing Core facilities, prepared lectures on background material, assigned background reading material and graded reaction papers, trained students in animal handling and experimental design, supervised behavioral experiments, graded APA-style term papers

Mentor, *Bioengineering Capstone Senior Project* Fall 2015, Winter 2016

- Mentor six undergraduates on a project to develop a low cost wireless optogenetic device suitable for use in mice, guide development of hardware and software, implant prototype in transgenic mice to determine viability and efficacy

Teaching Assistantships

Graduate Student Instructor, *Neuroanatomy*, UCLA Spring, 2006

- Attended weekly teaching meetings, conducted review sessions, prepared study guides, graded exams

Graduate Student Instructor, *Learning and Behavior*, UCLA Fall, 2006

- Led weekly discussion sections, independently prepared lectures based on the text book, held office hours, led review sessions, wrote exam questions, graded exams and term papers

Guest Lectures

Undergraduate course: *Neurophysics of the Mind Brain Problem* Fall, 2010

PROFESSIONAL ASSOCIATIONS

Pavlovian Society
Society for Neuroscience

AD-HOC REVIEWING

Annals of Neurology
Behavioral Neuroscience
Journal of Experimental Psychology: Animal Behavioral Processes
Psychopharmacology
Genes, Brain and Behavior
Biology of Reproduction

PEER-REVIEWED PUBLICATIONS

Ago Y, Hayata-Takano A, Kawanai, T, Yamauchi R, Takeuchi S, **Cushman JD,** Rajbhandari AK, Fanselow MS, Hashimoto H, Waschek JA (2017). Impaired extinction of cued fear memory and abnormal dendritic morphology in the prelimbic and infralimbic cortices in VPAC2 receptor (VIPR2)-deficient mice. Neurobiology of Learning and Memory. 145, 222-231

Dagnew R, Lin YY, Agatep , Cheng,M., Jan A., Quach V, Monroe M, Singh G, Minasyan A, Hakimian J, Kee T, **Cushman JD**, Walwyn W. (2017). CerebraLux: a low-cost, open-source, wireless probe for optogenetic stimulation. Neurophotonics, 4(04)

Hersman S, **Cushman JD**, Lemelson N, Wassum K, Lotfipour S, Fanselow, MS. (2017). Optogenetic excitation of cholinergic inputs to hippocampus primes future contextual fear associations. Scientific Reports, 7(1), 2333

Lotfipour, S, Mojica C, Nakauchi S, Lipovse , Silverstein, S, **Cushman JD** Tirtorahardjo J, Poulos A, Elgoyhen AB, Sumikawa K, Fanselow MS, Boulter J (2017). a 2 ∗ Nicotinic acetylcholine receptors influence hippocampus-dependent learning and memory in adolescent mice. Learn Mem. 2017 May 15;24(6):231-244

Kan S, Le SQ, Bui QD, Benedict B, **Cushman JD**, Sands MS, Dickson PI. (2016). Behavioral deficits and cholinergic pathway abnormalities in male Sanfilippo B mice. *Behavioural Brain Research* 312, 265-271

Brown RJ, Jun BJ, **Cushman JD**, Nguyen C, Beighley AH, Blanchard J, Iwamoto K, Schaue D, Harris NG, Jentsch JD, Bluml S, McBride WH. (2016). Changes in Imaging and Cognition in Juvenile Rats After Whole-Brain Irradiation. *International Journal of Radiation Oncology.* 96 (2), 470-478

Ago Y, Condro MC, Tan Y, Ghiani CA, Colwell CS, **Cushman JD**, Fanselow MS, Hashimoto H, Waschek JA. (2015). Reductions in synaptic proteins and selective alteration of prepulse inhibition in male C57BL/6 mice after postnatal administration of a VIP receptor (VIPR2) agonist. *Psychopharmacology.* 232 (12), 2181-2189

Campagna M, Faure-Kumar E, Treger J, **Cushman JD**, Kasahara N, Lawson G. (2015). Determining factors in the selection of surface disinfectants for use in a laboratory animal setting. *Journal of the American Association for Laboratory Animal Science.* 55(2), 175-188

Petitto JM, **Cushman JD**, Huang Z. (2015). Effects of Brain-Derived IL-2 Deficiency and the Development of Autoimmunity on Spatial Learning and Fear Conditioning. *Journal of Neurological Disorders.* 3:1

Krasne F, **Cushman JD**, Fanselow MS (2015). A Bayesian Context Fear Learning Algorithm/Automaton. *Frontiers in Behavioral Neuroscience*. Epub Apr 15.

Ago Y, Condro MC, Tan YV, Ghiani CA, Colwell CS, **Cushman JD**, Fanselow MS, Hashimoto H, Waschek JA (2015). Reductions in synaptic proteins and selective alteration of prepulse inhibition in male C57BL/6 mice after postnatal administration of a VIP receptor (VIPR2) agonist. *Psychopharmacology (Berl).* Epub Jan 11.

Acharya L*, Aghajan ZM*, Moore J, **Cushman JD**, Vuong C, Mehta MR. (2014) Intact phase precession but impaired spatial selectivity in two-dimensional virtual reality. *Nature Neuroscience.* Epub Nov 24.

Cushman JD, Moore MD, Olsen RW, Fanselow MS (2014). The Role of the δ GABA (A) Receptor in Ovarian Cycle-Linked Changes in Hippocampus-Dependent Learning and Memory. *Neurochemical Research.* 39(6) 1140-1146.

Cushman JD*, Aharoni D*, Willers B, Ravassard P, Kees A, Vuong C, Popeney B, Arisaka K, Mehta MR (2013). Multisensory control of multimodal behavior: Do the legs know what the tongue is doing?. *PLoS ONE.* (8) 11: e80465.

Ravassard P*, Kees A*, Willers B*, Ho D, Aharoni DA, **Cushman JD**, Aghajan ZM, Mehta MR (2013). Multi-sensory control of hippocampal spatiotemporal selectivity. *Science.* Jun. 340: 1342-1346.

Nakashiba T, **Cushman JD**, Pelkey KA, Renaudineau S, Buhl DL, McHugh TJ, Rodriguez-Barrera V, Chittajallu R, Iwamoto KS, McBain CJ, Fanselow MS, Tonegawa S (2012). Young dentate granule cells mediate pattern separation, whereas old granule cells facilitate pattern completion. *Cell*. Epub Feb 23.

Eadie BD, **Cushman JD**, Kannangara TS, Fanselow MS, Christie BR (2012). NMDA receptor hypofunction in the dentate gyrus and impaired context discrimination in adult Fmr1 knockout mice. *Hippocampus*. Feb; 22(2): 241-54.

Cushman JD*, Maldonado J*, Kwon EE, Garcia AD, Fan G, Imura T, Sofroniew MV, Fanselow MS (2012). Juvenile neurogenesis makes essential contributions to adult brain structure and plays a sex-dependent role in fear memories. *Frontiers in Behavioral Neuroscience*. Epub Feb 3.

Cushman JD, Moore MD, Olsen RW, Fanselow MS (2011). Behavioral pharmacogenetic analysis on the role of the alpha4 $GABA_AR$ subunit in the ethanol-mediated impairment of hippocampus-dependent contextual learning. *Alcoholism: Clinical and Experimental Research*. Nov. 35(11): 1948-59.

Jacobs NS*, **Cushman JD***, Fanselow MS (2010). The accurate measurement of fear memory in Pavlovian conditioning: Resolving the baseline issue. *J Neurosci Methods*. Jul 15; 190(2): 235-9.

Moore MD, **Cushman JD**, Chandra D, Homanics GE, Olsen RW, Fanselow MS (2010). Trace and contextual fear conditioning is enhanced in mice lacking the alpha4 subunit of the GABAA receptor. *Neurobiology of Learning and Memory*. Mar; 93(3):383-7.

Beck RD Jr, King MA, Ha GK, **Cushman JD**, Huang Z, Petitto JM (2005). IL-2 deficiency results in altered septal and hippocampal cytoarchitecture: relation to development and neurotrophins. *J Neuroimmunol*. Mar; 160(1-2):146-53.

Beck RD Jr, Wasserfall C, Ha GK, **Cushman JD**, Huang Z, Atkinson MA, Petitto JM (2005). Changes in hippocampal IL-15, related cytokines, and neurogenesis in IL-2 deficient mice. *Brain Res*. Apr 18; 1041(2):223-30.

Cushman JD, Lo J, Huang Z, Wasserfall C, Petitto JM (2003). Neurobehavioral changes resulting from recombinase activation gene 1 deletion. *Clin Diagn Lab Immunol*. Jan; 10(1):13-8.

* Indicates shared first-authorship

BOOK CHAPTERS

Cushman JD, Fanselow MS. (2012) Context Fear Learning. *In Encyclopedia of the Sciences of Learning.* Springer Science and Business, Media LLC

Cushman JD, Fanselow MS. (2010) Fear Conditioning. *In Encyclopedia of Behavioral Neuroscience* (Article 136). Oxford: Elsevier

CONFERENCE PRESENTATIONS

Hersman JS, **Cushman JD,** Wassum K, Fanselow MS (2015). Optogenetic activation of medial septum cholinergic neurons improves contextual fear learning and alters choline levels in hippocampus. *Society for Neuroscience Abstracts:* 126.05

Moore JJ, Acharya L, **Cushman JD**, Vuong C, Aghajan ZM, Popeney B, Mehta MR (2015). Hippocampal neural dynamics in a virtual Morris water maze navigation task. *Society for Neuroscience Abstracts:* 632.16

Dickson P, Le SQ, Kan SH, Benedict B, Bui Q, **Cushman JD**, Sands MS (2015). *Society for Neuroscience Abstracts:* 824.09

Kranse FB, Fanselow MS, **Cushman JD** (2015). The indirect pathway from entorhinal cortex to CA3 should be used during recall of hippocampal conjunctive representations. *Society for Neuroscience Abstracts: 824.09*

Mahal A, Nguyen, J, Tiacharoen M, **Cushman JD** (2014). Sex differences in hippocampal dependent tasks: Female dominance in Fear Conditioning, Novel Object Recognition and Morris Water maze. *Pavlovian Society Meeting Abstracts.*

Aghajan ZM, Acharya L, **Cushman JD**, Moore J, Vuong C, Mehta MR (2014). Hippocampal motifs: Intact phase procession in the absence of spatial selectivity. *Society for Neuroscience Abstracts:* 94.24.

Acharya L, Aghajan ZM, **Cushman JD**, Vuong C, Moore J, Mehta MR (2014). Impaired spatial selectivity in two-dimensional virtual reality. *Society for Neuroscience Abstracts:* 94.27.

Aharoni D, Willers B, **Cushman JD**, Arisaka K, Mehta MR (2012). Development of a non-invasive multimodal virtual reality system for use in rats. *Society for Neuroscience Abstracts:* 812.10.

Cushman JD, Aharoni D, Willers B, Ravassard P, Vuong C, Popeny B, Mehta MR (2012). Multimodal Navigation in Virtual Space. *Society for Neuroscience Abstracts:* 812.01.

Nakashiba T, **Cushman JD**, Pelkey KA, McBain CJ, Fanselow MS, Tonegawa S (2010). Mossy fiber input for pattern separation and pattern completion. *Society for Neuroscience Abstracts:* 405.14.

Jacobs N, **Cushman JD**, Fanselow MS (2009). Summation of context fear during tests of tone fear conditioning: Evaluation of statistical and methodological techniques for dealing with differences in baseline freezing. *Society for Neuroscience Abstracts*: 479.10.

Cushman JD, Moldanado J, Sofroniew MV, Fanselow MS (2009). Loss of post-natal neurogenesis produces a specific impairment of incidental contextual learning. *Society for Neuroscience Abstracts*: 479.12

Moore MD, **Cushman JD**, Chandra D, Homanics GE, Olsen RW, Fanselow MS (2008). Development of a Novel Low Dose Ethanol Behavioral Assay. *Research Society on Alcoholism.*

Moore MD, **Cushman JD**, Chandra D, Homanics GE, Fanselow M, Olsen RW (2007). Enhanced trace fear conditioning in GABAA receptor alpha-4 deficient mice. *Society for Neuroscience Abstracts*: 529.4.

Ponnusamy R, **Cushman JD**, Fanselow MS (2006). Enhanced cue-fear extinction in corticotropin releasing hormone over-expressing mice. *Society for Neuroscience Abstracts*: 464.19.

Cushman JD, Madsen S, Fanselow M (2006). Impairment of hippocampus-dependent learning and memory during diestrus in mice. *Society for Neuroscience Abstracts*: 266.12.

Cushman JD, Sanders MJ, Homanics G, Fanselow MS (2005). Influence of the delta subunit of the GABAA receptor on context fear acquisition and context discrimination in mice. *Society for Neuroscience Abstracts*: 316.17.

Cushman JD, Huang Z, Ha G, Beck R, Lo J & Petitto JM (2004). Contextual fear discrimination learning and memory is disrupted in IL-2 knockout mice. *Society for Neuroscience Abstracts*: 322.20.

Cushman JD, Wasserfall C, Huang Z, Ha G, Kapturczak MH, Ellis T, Atkinson M, Goodman WK & Petitto JM (2003). Immune reconstitution restores components of neurobehavioral performance in Recombinase Activation Gene-1 Knockout mice. *Society for Neuroscience Abstracts*: 964.11.