Adam W. Lester, PhD

Postdoctoral Research Fellow
Neural Circuits for Computation, Cognition and Control (NC4) Lab
School of Biomedical Engineering (SBME)
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Google Scholar
GitHub
Portfolio
LinkedIn

Experience

2021–Present **Postdoctoral Research Fellow**
University of British Columbia, School of Biomedical Engineering, NC4 Lab
- Led end-to-end design and deployment of 2 open-source behavioral platforms (Omniroute, NC4touch), 3 subsystems, and 1 neural implant, used across 2 labs and 6 studies (see Projects)
- Published 2 first-author methods: NC4gate (*eNeuro, in press*) and Omniroute preprint (*bioRxiv, 2025*)
- Conceived, co-led, and secured project funding for 2 studies: a human VR clinical study (completed with research article in preparation), and a rodent navigation-network study (ongoing)
- Established and maintain infrastructure from the NC4 Lab's initial launch, including core experimental rigs, all electrophysiology recording stacks, and shared multi-lab fabrication spaces
- Manage lab-wide sourcing, fabrication, and quality control: run DFM and CAD/ECAD reviews; generate BOMs, RFQs and POs; track builds; perform incoming inspection; maintain revision control

2019–2021 **Postdoctoral Research Associate**
University of Arizona, Arizona Research Labs, Barnes Lab
- Conceived, led, and published an aging navigation study (*Behavioral Neuroscience, 2022*) and authored a funded NIA R01 renewal Specific Aim, both leveraging the ICR Arena from PhD work
- Led academic side of wireless electrophysiology industry collaborations (NeuraLynx and TBSI)
- Developed a Dual-Bundle Electrode Drive for rat neural recordings used in 2 studies (see Projects)

2013–2019 **Graduate Research Associate**
University of Arizona, McKnight Brain Institute, Barnes Lab
- Architected, built, and deployed the Instantaneous Cue Rotation (ICR) Arena rodent behavioral platform (see Projects) with first-author methods (*U. Neurosci. Methods, 2020*)
- Contributed to 4 co-authored studies on neural-behavioral mechanisms in navigation, learning, and decision making, and led a first-author cross-institute review on aging and navigation (*Neuron, 2019*)
- Stood up and maintained all rat and primate electrophysiology at UA and UC Davis sites (5 rigs), maintained related lab codebases, and performed rat surgeries, recordings, histology, and analyses

Mentorship and team-leadership details are consolidated under Leadership & Service

Early Roles – *selected*

2011–2012 **Computational Modeling Intern**
HRL Laboratories, LLC, Center for Human-Machine Collaboration
- Led ANN model development and validation for a UA-HRL collaboration within the **IARPA** *Integrated Cognitive-Neuroscience Architectures for Understanding Sensemaking* (**ICArUS**) program
- Contributed a 4-layer inhibitory-gating network, published a first-author IJCNN paper, and handed off reusable models, scripts, and reports that informed subsequent ICArUS modeling

2009–2010 **Database Specialist**
University of Arizona, in collaboration with **Tucson VA Medical Center**
- Managed multi-site polysomnography datasets and developed EEG spectral and statistical analysis codebases, translating findings into plain-language reports for UA researchers and VA physicians

2007–2009 **Research Assistant**
University of Arizona, Departments of Psychology and Physiology

- Contributed across 3 labs and 4 studies: co-designed a porcine stereotaxic frame with cardiology collaborators, and collected, processed, and analyzed human EEG and fMRI data

Education

2019 **PhD in Neuroscience**, University of Arizona, Tucson, AZ, USA
- Thesis topic: Developing a system to test dynamic external cue use during navigation in aged rats
- Supervisor: Carol A. Barnes

2005 **BA in Philosophy**, University of California, Santa Cruz, Santa Cruz, CA, USA

Leadership & Service

Product & Platform Leadership
- **Founding Product Lead**, MAPS Canada, Research Database Development (2023–Present)
  Lead a 5-developer team building MAPS Canada's public research database: biweekly planning, system integration, and board-aligned roadmapping; rollout targeted for Q1 2026
- **Platform Lead**, NC4 Lab, University of British Columbia (2022–2025)
  Led cross-functional teams for Omniroute and NC4touch platform development (see Projects)
  Omniroute: Mechanical build (team of 6), PCB development (team of 2), validation (team of 4)
  NC4touch: Mechanical build (team of 4), embedded systems (team of 3), validation (team of 3)

Mentorship & Supervision
- **Co-Supervisor**, NC4 Lab, University of British Columbia (2021–Present)
  Mentoring 4 graduate and 11 undergraduate trainees across 8 projects
  Highlights: Conceived and co-supervised Annie Kim's MSc (graduated) to completion and developed behavioral platforms used in Gelareh Modara's MSc (graduated) and Afsoon Gharib's PhD
- **Supervisor**, Engineering Interdisciplinary Capstone, University of Arizona (2020)
  Oversaw a 4-student senior capstone team from project scoping to delivery and handoff
- **Co-Supervisor**, McKnight Brain Institute, University of Arizona (2013–2019)
  Mentored 10 undergraduate trainees across 4 projects
  Highlights: Supervised 3 Honors theses, 2 using the ICR Arena (PhD work), including those of Blum (Wildcat Excellence), Philpot (UBRP Scholar), Kapellusch (Dean's List with Highest Honors)

Academic–Industry Partnership
- **Co-Founder**, Open-source instrumentation spinout, NC4 Lab (2025–Present)
  Cross-department-backed, early-stage venture open-sourcing custom tools from UBC labs
- **Site Lead**, University of Arizona and UC Davis, in collaboration with TBSI and NeuraLynx (2019)
  Led lab-side beta testing and validation for 2 wireless electrophysiology industry partnerships
  TBSI: Identified critical flaws in the deployed flagship system, triggering a vendor recall and redesign
  NeuraLynx: Oversaw FreeLynx system validation in rats and primates across UA and UC Davis sites

Scholarly Service
- **Organizer**, Ephys Workshop, Neural Systems, Memory and Aging, University of Arizona (2021)
  Developed and taught a 6-week NSMA trainee lab in single-unit and LFP analysis (8 students)
- **Ad Hoc Reviewer** for peer-reviewed journals *Human Brain Mapping* and *Neuron*

Technical Skills

Full-stack skills for building and deploying research instruments and end-to-end platforms

Languages Python · C/C++ · C# · MATLAB · R

Platforms ROS 1/2 · Git · GitHub · PlatformIO · Linux (Ubuntu, WSL2) · Conda · Jupyter

Control & Robotics Embedded systems & firmware (C/C++, AVR/ARM, Raspberry Pi) · Closed-loop control · Motion control (stepper, servo, GRBL) · Hardware I/O (I^2C, SPI, UART, EtherCAT, TTL) · UI & APIs

Design & Fabrication Mechanical CAD (SolidWorks) · DFM · BOMs · jigs & fixtures · ECAD (Altium) · Soldering & rework · Wiring harnesses · Subtractive (laser, waterjet, CNC) · Additive (FDM, SLA) · Hand (mill, lathe, general)

Analytical Methods Experimental design · Data integration & standardization · Signal processing · Population-level analyses · State-space modeling · Computational modeling · Visualization · Statistics

▬▬▬ Projects

Projects selected for end-to-end leadership and real-world use, with links to portfolio pages

Behavioral Platforms – *fully integrated HW–SW systems for rodent behavioral neuroscience*

Omniroute

Omniroute Maze System: rodent maze with fully automatable routes, cues, and reward delivery
- **Scope**: 90 × 90 cm platform with 60 motorized gates (NC4gate), 4 projectors for floor and gate-face visual cues, XY liquid-reward gantry, real-time 3D tracking, and unified closed-loop control via ROS
- **Role**: End-to-end lead – CAD (SolidWorks), ROS (Python, C++), GUI (Python), and firmware (Embedded C/C++); led cross-functional teams (mechanical, PCB development, validation)
- **Status**: In use (2023–Present) across 3 NC4 Lab studies; methods preprint (*bioRxiv, 2025*) and NC4gate standalone methods (in press, *eNeuro*), with in-rig timing and behavioral performance; open release of design files and codebase (OSF)

NC4touch

NC4touch Behavioral Apparatus: touchscreen chamber for mouse and rat experiments
- **Scope**: Three 3.5″ 320×480 capacitive touchscreens, automated liquid reward (IR sensors, peristaltic pump), overhead video, and multi-chamber Raspberry Pi-based real-time closed-loop control
- **Role**: Co-architect & hardware lead – CAD (SolidWorks) and hardware integration; firmware contributor; led cross-functional teams (mechanical, embedded systems, validation)
- **Status**: 6 rigs in use (2024–Present) across 2 UBC labs and 3 studies, plus a partner-lab prepaid order for 9 rigs; methods preprint (*in preparation*) with bench hardware and behavioral validation in rats and mice; open release of design files and codebase (OSF)

ICR Arena

Instantaneous Cue Rotation (ICR) Arena: augmented-reality rodent behavioral apparatus
- **Scope**: 1.4 m circular track with 68 cm rear-projection walls displaying a 360° cue panorama from 4 short-throw projectors, overhead video tracking, synchronized event timing, electrophysiology integration, and mobile feeder robot reward system with onboard control and track cleaning
- **Role**: End-to-end lead – CAD (SolidWorks), electronics, and control software & GUI (MATLAB, C#, Embedded C/C++); led mechanical build and validation teams
- **Status**: In use (2017–Present) in the Barnes Lab; published methods paper (*J. Neurosci. Methods, 2020*), and follow-up aging navigation study (*Behavioral Neuroscience, 2022*)

Modular Systems & Instruments – *selected (all in active use)*

Subsystems

NC4gate Automatable Gate Module: an addressable motorized gate for programmatically configurable rodent mazes, developed for the NC4 Omniroute and open-sourced as a standalone module with design files and codebase (OSF; 2023) – end-to-end lead

Two-Axis Feeder Gantry: CNC-based XY gantry for automated, targeted food-reward delivery, developed for the Omniroute (2023) – end-to-end lead

Track-Mounted Feeder Cart: servo-gated mobile feeder with IR sensing for automated reward delivery, developed for use in the NC4 rodent VR Dome apparatus (2024) – end-to-end lead

Implants

Silicon Probe Microdrive Housing: implantable, low-profile 3-part housing and custom interface PCB for chronic silicon probe recordings in freely moving rats (2023) – end-to-end lead

Dual-Bundle Electrode Drive: 18-shuttle implantable drive with independent depth control and bundle positioning for dual-site electrode recordings in freely moving rats (2020) – end-to-end lead

▬▬▬ Teaching

W2 2021, 2022 **Guest Lecturer**, **Biomedical Robotics (BMEG 400F)**, University of British Columbia
Developed and taught a two-part lecture series on principles of design and fabrication (~30 students)

Spring 2012 **TA & Guest Lecturer**, **Neuro Methods (NRSC 315)**, University of Arizona
Developed and taught a two-part programming lab (4 hours each) on EEG analysis (25 students)

Fall 2010, 2011 **Co-Organizer**, **Theoretical Neuro JC (NRSC 595B)**, University of Arizona
Co-developed and co-led a 1-unit journal club in computational neuroscience (~10 students)

Invited Talks

2024 — **Research Retreat**, Djavad Mowafaghian Centre for Brain Health, University of British Columbia
Topic: The Omniroute Maze System – design, validation, and research applications
Best Trainee Talk – *selected from approximately 50 presentations*

2022–2024 — **Seminar Series**, Behavioral Neuroscience Program, University of British Columbia
Topics: 3 research talks covering research instrumentation and behavioral task design

2019 — **Conference**, Arizona Alzheimer's Consortium Scientific Conference
Topic: The Instantaneous Cue Rotation Arena – design, validation, and research applications

2013–2017 — **Seminar Series**, Neuroscience Seminar & Neurophysiology Forum, University of Arizona
Topics: 6 research talks covering spatial cognition, neural systems, and experimental methods

Publications

Doctoral Thesis

- **Lester, A.W.** (2019). Developing a system to investigate age-related differences in the real-time utilization of dynamically changing external cues during navigation. University of Arizona. *Doctoral dissertation*.

Journal Articles – *peer-reviewed*

1. **Lester, A.W.**, Kaur, G., Mombeini, A.G., Djafri, N., & Madhav, M.S. (in press). A modular gate system for autonomous control of rodent behavior. *eNeuro*. – *accepted September 2025*

2. **Lester, A.W.**, Jordan, G.A., Blum, C.J., Philpot, Z.P., & Barnes, C.A. (2022). Differential effects in young and aged rats' navigational accuracy following instantaneous rotation of environmental cues. *Behavioral Neuroscience*, 136(6), 561–574.

3. **Lester, A.W.**, Kapellusch, A.J., & Barnes, C.A. (2020). A novel apparatus for assessing visual cue-based navigation in rodents. *Journal of Neuroscience Methods*, 338, 108667.

4. Kapellusch, A.J., **Lester, A.W.**, Schwartz, B.A., Smith, A.C., & Barnes, C.A. (2018). Analysis of learning deficits in aged rats on the W-track continuous spatial alternation task. *Behavioral Neuroscience*, 132(6), 512–519.

5. **Lester, A.W.**, Moffat, S.D., Wiener, J.M., Barnes, C.A., & Wolbers, T. (2017). The aging navigational system. *Neuron*, 95(5), 1019–1035.

6. Samson, R.D., **Lester, A.W.**, Duarte, L., Venkatesh, A., & Barnes, C.A. (2017). Emergence of β-band oscillations in the aged rat amygdala during discrimination learning and decision-making tasks. *eNeuro*, 4(5).

7. Samson, R.D., Venkatesh, A., **Lester, A.W.**, Weinstein, A.T., Lipa, P., & Barnes, C.A. (2015). Age differences in strategy selection and risk preference during risk-based decision making. *Behavioral Neuroscience*, 129(2), 138–148.

8. Maurer, A.P., **Lester, A.W.**, Burke, S.N., Ferng, J.J., & Barnes, C.A. (2014). Back to the future: Preserved hippocampal network activity during reverse ambulation. *The Journal of Neuroscience*, 34(45), 15022–15031.

Preprints & In Preparation

- Modara, G., **Lester, A.W.**, Schwein, I., & Madhav, M.S. (2025). NC4touch: An open-source modular touchscreen apparatus for rodent behavioral testing. *bioRxiv*. – *in preparation*

- **Lester, A.W.**, Mombeini, A.G., & Madhav, M.S. (2025). The Omniroute maze: a novel rodent navigation apparatus that integrates dynamically configurable routes, sensory cues and automated reward delivery. *bioRxiv*. https://doi.org/10.1101/2025.09.01.672969

Conference Publications

- (*Abstract*) Niederhauser, T., **Lester, A.W.**, Miolane, N., Duc, K.D., & Madhav, M.S. (2022). Testing geometric representation hypotheses from simulated place cell recordings. NeurIPS 2022 Workshop on Symmetry and Geometry in Neural Representations.
- (*Peer-reviewed proceeding*) **Lester, A.W.**, Howard, M., Fellous, J.M., & Bhattacharyya, R. (2013). A computational model of perirhinal cortex: Gating and repair of input to the hippocampus. Proceedings of the International Joint Conference on Neural Networks (IJCNN), Dallas, Texas, August 4–9, 2013.

Conference Posters – *selected from 20+ posters*

- **Lester, A.W.**, Mombeini, A.G., Kaur, G., Djafri, N., Dhir, A., Narimani, M., & Madhav, M.S. (2024). The Omniroute maze: a novel rodent navigation apparatus that integrates dynamically configurable routes, sensory cues and automated reward delivery. *Canadian Association for Neuroscience*, Program No. P2-G-325.
- Mombeini, A.G., **Lester, A.W.**, Nguyen, H.C., Kim, A.R., & Madhav, M.S. (2023). Development of a Behavioural Biomarker for Cognitive Impairment using Navigation in Virtual Reality. *Canadian Association for Neuroscience*, Program No. P3-C-618.
- **Lester, A.W.**, Kapellusch, A.J., & Barnes, C.A. (2019). A computational model of aged head direction network updating in the presence of sudden spatial cue mismatch. *Society for Neuroscience*, Program No. 600.16.
- **Lester, A.W.**, Koutia, A.J., Screen, R.T., & Barnes, C.A. (2016). Aged rats fail to integrate conflicting spatial reference frames. *Society for Neuroscience*, Program No. 182.10.
  Third Place – *Evelyn F. McKnight Brain Institute Society for Neuroscience Poster Competition*
- **Lester, A.W.**, & Barnes, C.A. (2014). Age-related changes in entorhinal-hippocampal dynamics. *Gordon Research Conference*.
- Smith, R.L., **Lester, A.W.**, & Cowen, S.L. (2014). Multi-electrode microdrive array for recording neural processes in cost-benefit-based decisions. *Society for Neuroscience*, Program No. 560.01.
- **Lester, A.W.**, Maurer, A.P., Burke, S.N., Hoang, L.T., & Barnes, C.A. (2013). Preserved neural dynamics during reverse locomotion. *Society for Neuroscience*, Program No. 390.13.

Grants

Awarded Research Grants

2024–2025 **Kickstart Grant**, Djavad Mowafaghian Centre for Brain Health
"Effects of Psilocybin on Hippocampal Cognitive Map Stability and Plasticity"
Investigators: Manu S. Madhav (PI); Catharine A. Winstanley (Co-PI)
Contribution: Conceived the study and authored the full application

2021–2023 **Alzheimer's Disease Research Grant**, Djavad Mowafaghian Centre for Brain Health
"Developing a Behavioural Biomarker for Alzheimer's Disease Diagnosis"
Investigators: Manu S. Madhav (PI); Thalia S. Field (Co-PI)
Contribution: Conceived the study and authored the full application

Major Grant Contributions

2020–2025 **R01**, National Institutes of Health, National Institute on Aging
"Neurobehavioral Relations in Senescent Hippocampus (AG003376)" — *competitive renewal*
Investigators: Carol A. Barnes (PI); Arne D. Ekstrom (Co-PI)
Contribution: Conceived the experiment and led authorship for one Specific Aim