Eduardo J. Izquierdo

CONTACT
INFORMATION

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Rose-Hulman Institute of Technology

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SUMMARY

My research interest is to better understand living organisms through the development of artificial systems that can match their robustness, flexibility, adaptability, and intelligence. An important part of my approach is to understand how organisms operate as integrated wholes, with a particular focus on how behavior arises from the interaction between brains, bodies, and environments. Toward this end, I develop and analyze computational models of complete brain-body-environment systems for idealized model agents as well as for neuromechanical models of animals. My approach integrates research on artificial neural networks, lifetime learning techniques, evolutionary algorithms, information theory, and dynamical systems theory.

RESEARCH
AREAS

Computational Neuroethology, Cognitive Science, Embodied Cognition, Bio-Inspired Artificial Intelligence, Evolutionary Computation, and Complex Systemsm, Computational Neuroscience, Evolutionary Computation, Complex Systems.

ACADEMIC
POSITIONS

Associate Professor   2023–present

Electrical and Computer Engineering
Rose-Hulman Institute of Technology

Assistant Professor   2015–2023

Cognitive Science Program
Luddy School of Informatics, Computing, and Engineering
Indiana University Bloomington

Research Scholar   2010–2015

Cognitive Science Program
Indiana University Bloomington

Research Scholar   2009–2010

Institute of Neuroscience
University of Oregon

Research Scholar   2008–2009

Centre for Systems Biology
University of Birmingham

EDUCATION

Ph.D. in Computer Science and AI   2008

Centre for Computational Neuroscience and Robotics
University of Sussex, Brighton, UK
Thesis topic: Evolving dynamical recurrent neural networks to learn

Master of Science in Intelligent Systems   2004

University of Sussex, Brighton, UK
Thesis topic: Evolution of dynamic recurrent neural networks
Graduated with distinction

Bachelor of Science in Computer Engineering   2002

Universidad Simon Bolivar, Venezuela
Graduated with honors

PUBLICATIONS   **Journal Articles**

Yoder JA, Anderson CB, Cehong W, Izquierdo EJ (2022) Reinforcement learning for central pattern generation in dynamical recurrent neural networks. *Frontiers in Computational Neuroscience* 16:818985.

Campbell CM, Izquierdo EJ, Goldstone RL (2022) Partial copying and the role of diversity in social learning performance. *Collective Intelligence,* 1:1, 1-15.

Olivares E, Izquierdo EJ, Beer RD (2021) A neuromechanical model of multiple network rhythmic pattern generators for forward locomotion in *C. elegans*. *Frontiers in Computational Neuroscience* 15:572339.

Ikeda M, Matsumoto H, Izquierdo EJ (2021) Persistent thermal input controls steering behavior in *Caenorhabditis elegans*. *PLOS Computational Biology* 17(1), e1007916.

Candadai M, Izquierdo EJ (2020) Sources of predictive information in dynamical neural networks. *Scientific Reports* 10, 16901.

Candadai MV, Izquierdo EJ (2020) infotheory: A C++/Python package for multivariate information theoretic analysis. *Journal of Open Source Software* 5(47), 1609.

Rodriguez N, Izquierdo EJ, Ahn YY (2019) Optimal modularity and memory capacity of neural reservoirs. *Network Neuroscience* 3(2):551–566.

Candadai MV, Setzler M, Izquierdo EJ, Froese T. (2019) Embodied dyadic interaction increases complexity of neural dynamics: A minimal agent-based simulation model. *Frontiers in Psychology* 21;10:540.

Izquierdo EJ (2019) Role of simulation models in understanding the generation of behavior in *C. elegans*. Special Issue: Systems biology of model organisms. *Current Opinion in Systems Biology* 13:93–101

Izquierdo EJ, Beer RD (2018) From head to tail: An integrated neuromechanical model of forward locomotion in *C. elegans*. Special Issue: From Connectome to Behavior. *Philosophical Transactions of the Royal Society B: Biological Sciences* 373(1758): 20170374.

Froese T, Izquierdo EJ. (2018) A dynamical approach to the phenomenology of body memory: Past interactions can shape present capacities without neuroplasticity. *Journal of Consciousness Studies* 25(7–8):20–46.

Siqueiros JM, Froese T, Gerhenson C, Aguilar W, Sayama H, Izquierdo EJ (2018) Special Issue: Artificial Life Conference. *Artificial Life* 24(1). MIT Press.

Olivares E, Izquierdo EJ, Beer RD (2017) Potential role of a ventral nerve cord central pattern generator in forward and backward locomotion in *Caenorhabditis elegans*. *Network Neuroscience* 2(3):323–343.

Izquierdo EJ, Beer RD (2016) The whole worm: brain-body-environment models of

C. elegans. *Current Opinion in Neurobiology* 40:23–30.

Gerhenson C, Froese T, Siqueiros JM, Aguilar W, Izquierdo EJ, Sayama H (2016) Proceedings of the Artificial Life Conference. *MIT Press*. ISBN: 9780262339360.

Roberts WM, Augustine SB, Lawton KJ, Lindsay TH, Thiele TR, Izquierdo EJ, Faumont S, Lindsay RA, Britton MC, Pokala N, Bargmann CI, Lockery SR (2016) A stochastic neuronal model predicts random search behaviors at multiple spatial scales in *C. elegans*. *eLife* 5:e12572.

Izquierdo EJ, Williams P, Beer RD (2015) Information flow through the *C. elegans* klinotaxis circuit. *PLOS ONE* 10(10):e0140397.

Izquierdo EJ, Beer RD (2013) Connecting a connectome to behavior: An ensemble of neuroanatomical models of *C. elegans* klinotaxis. *PLOS Computational Biology* 9(2):e1002890.

Izquierdo EJ, Lockery SR (2010) Evolution and analysis of minimal neural circuits for klinotaxis in *C. elegans*. *Journal of Neuroscience* 30:12908–12817.

Izquierdo EJ, Harvey I, Beer RD (2008) Associative learning on a continuum in evolved dynamical neural networks. *Journal of Adaptive Behavior* 16, 361–384.

Izquierdo EJ, Almeida e Costa F. (2006) Special Issue on the dynamical systems approach to cognition. *Journal of Adaptive Behavior* 14(2).

Refereed Conference Articles

Izquierdo EJ, Candadai, M (2022) What does functional connectivity tell us about the behaviorally functional connectivity of a multifunctional neural circuit? In *Proceedings of the Artificial Life Conference*.

Izquierdo EJ, Severino G, Merrit H (2022) Perpetual crossers without sensory delay: revisiting the perceptual crossing simulation studies. In *Proceedings of the Artificial Life Conference*.

Leite A, Izquierdo EJ (2021). Generating reward structures on a parameterized distribution of dynamics tasks. In *Proceedings of the Artificial Life Conference* 118–.

Leite A, Candadai M, Izquierdo EJ (2020). Reinforcement learning beyond the Bellman equation: Exploring critic objectives using evolution. In *Proceedings of the Artificial Life Conference* 441–449.

Benson L, Candadai M, Izquierdo EJ (2020). Neural reuse in multifunctional neural networks for control tasks. In *Proceedings of the Artificial Life Conference* 210–218.

Dahlberg B, Izquierdo EJ (2020). Contributions from parallel strategies for spatial orientation in *C. elegans*. In *Proceedings of the Artificial Life Conference* 16–24.

Luthra M, Izquierdo EJ, Todd P (2020). Cognition evolves with the emergence of environmental patchiness. In *Proceedings of the Artificial Life Conference* 450–458.

Todd G, Candadai M, Izquierdo EJ (2020). Interaction between evolution and learning in NK fitness landscapes. In *Proceedings of the Artificial Life Conference* 751–767.

Sheybani S, Izquierdo EJ, Eatai, R. (2020). Exploring dyadic strategies for cooperative physical tasks. In *2020 IEEE Haptics Symposium (HAPTICS)* 684–689.

Campbell C, Izquierdo EJ, Goldstone R (2020). How much to copy from others? The role of partial copying in social learning. In *Proceedings of the 42nd Annual Conference of the Cognitive Science Society.* London, UK: Cognitive Science Society.

Yoder J, Izquierdo EJ (2018) Behavioral stability in the face of neuromodulation in brain-body-environment systems. In *Proceedings of the International Conference on Artificial Life.* Tokyo Japan. 30:268–275.

Candadai MV, Izquierdo EJ (2018) Multifunctionality in embodied agents: Three levels of neural reuse. In *Proceedings of Conference of the Cognitive Science Society.* Madison, Wisconsin.

Aguilera M, Alquezar C, Izquierdo EJ (2017) Signatures of criticality in a maximum entropy model of the *C. elegans* brain during free behaviour. In *Proceedings of the 14th European Conference of Artificial Life.* Lyon, France.

Candadai MV, Izquierdo EJ (2017) Information bottleneck in control tasks with recurrent spiking neural networks. In *Proceedings of the 26th International Conference on Artificial Neural Networks.* Sardinia, Italy.

Candadai MV, Izquierdo EJ (2017) Evolution and analysis of embodied spiking neural networks reveals task-specific clusters of effective networks. In *Proceedings of The Genetic and Evolutionary Computation Conference.* Berlin, Germany: ACM.

Setzler M, Izquierdo EJ (2017) Adaptability and neural reuse in minimally cognitive agents. In *Proceedings of the 39th Annual Conference of the Cognitive Science Society.* London, UK: Cognitive Science Society.

Chen P, Evans T, Frisby M, Izquierdo EJ, Plale B (2016). A hybrid approach to population construction for agricultural agent-based simulation. In *Proceedings of IEEE 12th International Conference on eScience.* Baltimore, Maryland.

Izquierdo EJ, Beer RD (2015). An integrated neuromechanical model of steering in *C. elegans.* In *Proceedings of European Conference of Artificial Life 2015* (pp. 199–206). MIT Press.

Izquierdo EJ, Aguilera M, Beer RD (2013). Analysis of ultrastability in small dynamical recurrent neural networks. In *Proceeding of the European Conference of Artificial Life: ECAL 2013* (pp. 51-58).

Izquierdo EJ, Buhrmann T (2008) Analysis of a dynamical recurrent neural network evolved for two qualitatively different tasks: Walking and chemotaxis. In Bullock S et al., (Eds.) *Proceedings of the 11th Conference on Artificial Life.* MIT Press, Cambridge, MA. Best student paper award.

Izquierdo EJ, Fernando C (2008) The evolution of evolvability in gene transcription networks. In Bullock S et al., (Eds.) *Proceedings of the 11th Conference on Artificial Life.* MIT Press, Cambridge, MA.

Izquierdo EJ, Harvey I (2007) The dynamics of associative learning in an evolved situated agent. In *Proceedings of the 9th European Conference on Artificial Life.*

Springer-Verlag.

Fine P, Di Paolo EA, Izquierdo EJ (2007) Adapting to your body. In F. Almeida e Costa et al. (Eds.), *Advances in Artificial Life: Proceedings of the Ninth European Conference on Artificial Life* (pp. 203–211). Springer.

Froese T, Virgo N, Izquierdo EJ (2007) Autonomy: a review and reappraisal. In F. Almeida e Costa et al. (Eds.), *Advances in Artificial Life: Proceedings of the Ninth European Conference on Artificial Life* (pp. 455–464). Springer.

Izquierdo EJ, Harvey I (2007) Hebbian learning using fixed weight evolved dynamical 'neural' networks. In H.A. Abbass et al (Eds.) *Proceedings of the First IEEE Symposium on Artificial Life.* pp394–401. IEEE Press.

Izquierdo EJ, Harvey I (2006) Learning on a continuum in evolved dynamical node networks. In L. Rocha et al. (Eds.) *Proceedings of the Tenth International Conference on the Simulation and Synthesis of Living Systems* (pp. 507–512). MIT Press.

Izquierdo EJ, Di Paolo EA. (2005) Is an embodied system ever purely reactive? In M. Capcarrere et al. (Eds.) *Advances in Artificial Life: Proceedings of the Eight European Conference on Artificial Life* (pp. 252–261). Springer-Verlag.

Izquierdo EJ (2004) The role of nearly neutral networks in the evolution of dynamical neural networks. In J. Pollack et al. (Eds.) *Proceedings of the Ninth International Conference on the Simulation and Synthesis of Living Systems* (pp. 322–327). MIT Press.

Peer-reviewed Abstracts for Conferences

Candadai M, Izquierdo EJ (2022) Challenges and Approaches to an Information-Theoretic Framework for the Analysis of Embodied Cognitive Systems. Presented at NeurIPS 2022 Workshop Information-Theoretic Principles in Cognitive Systems, December 3, 2022.

Laborde Z, Izquierdo EJ (2022) Spatial embedding of edges in a synaptic generative model of C. elegans. Society for Neuroscience 2022. November 12-16 in San Diego, California.

Stolting L, Beer R, Izquierdo EJ (2022) Characterizing the role of activity-dependent homeostatic plasticity in central pattern generating circuits. European Neuroscience Conference by Doctoral Students (ENCODS) 2022.

Candadai M, Izquierdo EJ (2019) Information dynamics in embodied multifunctional neural networks. Society for Neuroscience 2019. Chicago, IL. October, 2019.

Izquierdo EJ, Olivares E (2019) A computational model of mixed pattern generation for forward locomotion in *C. elegans*. Society for Neuroscience 2019. Chicago, IL. October, 2019.

Izquierdo EJ, Olivares E (2019) A computational model of mixed pattern generation for forward and backward locomotion in *C. elegans*. 22nd International *C. elegans* Conference. Los Angeles, CA. June, 2019.

Campbell C, Izquierdo EJ, Goldstone RL (2019) The great melting Pot: generating

diversity by combining solutions across a global population. Collective Intelligence Conference. Carnegie Mellon University. June 13-14, 2019.

Olivares E, Izquierdo EJ, Beer RD (2018) A central pattern generator driven neuromechanical model of forward locomotion in *C. elegans*. Proceedings of the Seventh Annual Midwestern Cognitive Science Conference. Indiana University, Bloomington. May 12-13, 2018.

Olivares E, Izquierdo EJ, Beer RD (2018) A central pattern generator driven neuromechanical model of forward locomotion in *C. elegans*. 25th Annual Animal Behavior Conference. Center for the Integrative Study of Behavior, Indiana University. Feb 2018.

Izquierdo EJ, Beer RD (2018) Integrating stretch-receptor feedback and multiple intrinsic oscillators in a model of forward locomotion. CeNeuro 2018. Madison, Wisconsin. June 25-28.

Olivares E, Izquierdo EJ, Beer RD (2018) A network of intrinsic oscillators can drive forward locomotion in *C. elegans*. 27th Annual Computational Neuroscience Meeting (CNS 2018). Seattle, US. July 13-18.

Olivares E, Izquierdo EJ, Beer RD (2017) A CPG-driven neuromechanical model of forward locomotion in *C. elegans*. Society for Neuroscience Conference, 2017. Washington D.C.

Izquierdo EJ, Beer RD (2017) Integrated neuromechanical model shows stretch-reception can generate and propagate wave responsible for forward locomotion. Society for Neuroscience Conference, 2017. Washington D.C.

Olivares E, Izquierdo EJ, Beer RD (2017) Connectome analysis shows the feasibility of ventral cord central pattern generators driving locomotion inÂ *C. elegans*. 21st International *C. elegans* Conference. Los Angeles.

Izquierdo EJ, Beer RD (2017) Integrated neuro-mechanical model shows stretch-reception can generate and propagate wave responsible for forward locomotion. 21st International *C. elegans* Conference. Los Angeles.

Olivares E, Izquierdo EJ, Beer RD (2017) From connectome to behavior: Circuit motifs that generate oscillations to drive forward and backward locomotion in *C. elegans*. NetSci 2017. Indianapolis.

Izquierdo EJ, Beer RD (2017) From connectome to behavior: an integrated neuromechanical model of forward locomotion in *C. elegans*. NetSci 2017. Indianapolis.

Izquierdo EJ, Beer RD (2016) Propagation of rhythmic dorsoventral wave in a neuromechanical model of locomotion in *Caernohabditis elegans*. Proceedings of the Artificial Life Conference 2016, Cancun, Mexico.

Izquierdo EJ, Beer RD (2015) Evolution and analysis of an integrated neuromechanical model of forward locomotion in *C. elegans*. 2015 Meeting Planner. Society for Neuroscience. Chicago.

Izquierdo EJ, Beer RD (2014) Steering in *C. elegans*: An integrated neuromechanical model of klinotaxis. ESF-EMBO Flies, worms and robots: combining perspectives on

minibrains and behaviors. Sant Feliu, Spain.

Izquierdo EJ, Beer RD (2014) Information flow through a sensorimotor circuit: Spatial orientation in *C. elegans*. Computational and Systems Neuroscience Conference (COSYNE) 2014. Salt Lake City, Utah.

Izquierdo EJ, Lockery SR (2009) A minimal neural network model of klinotaxis behavior in *C. elegans*. 17th International *C. elegans* meeting. University of California, Los Angeles.

Izquierdo EJ, Harvey I (2006) A situated, embodied and dynamical systems approach to understanding learning and memory. 50th Anniversary Summit of Artificial Intelligence. Switzerland, 9-14 July, 2006.

Izquierdo EJ, Harvey I (2005) Learning to discriminate between multiple possible environments: an imprinting scenario. In Workshop on Memory and Learning Mechanisms in Autonomous Robotics (ECAL 2005). Canterbury, UK.

Other

Izquierdo, E.J. (2012). Connectome of *Caenorhabditis elegans*. Standalone figure in Eric Kandel's *Principles of Neural Science*. Fifth edition. pp 1523-1524. McGraw-Hill.

Ph.D. Thesis

Izquierdo, E.J. (2008). The dynamics of learning behavior: A situated, embodied, and dynamical systems approach. University of Sussex.

GRANTS AWARDED

NSF CAREER: From connectome to behavior: computational models of multifunctional neural circuits in *C. elegans* (2019–2024) NSF/IIS 1845322. $882,772.00. PI.

NSF Workshop grant: Functional logic of neural circuits: diamonds in the rough (Part 2) NSF 2234198 (2022-2023) $50,000.00. Co-PI.

NSF Workshop grant: Functional logic of neural circuits: diamonds in the rough (Part 1) (2021-2022) $50,000.00. Co-PI.

NSF Supplemental grant: Reinforcement learning in dynamical recurrent neural networks (2021) NSF 2114455. $50,683.00. PI.

NSF Robust Intelligence: An ensemble of neuromechanical models of *C. elegans* forward locomotion (2015–2018) NSF/IIS 1524647. $492,189.00. Co-PI.

NSF Robust Intelligence: The whole worm: a brain-body-environment model of nematode chemotaxis (2012–2015) NSF/IIS 1216739, $489,440.00. Lead contributor.

RECENT INVITED TALKS

Invited as keynote speaker to the 15th annual Midwest Undergraduate Cognitive Science Conference. April 2022.

Invited to the Computational and Theoretical; Neuroscience Colloquium series at Duke University. Talk title: "The Whole Worm: Brain-Body-Environment Models of C. elegans." Dec 2022.

Virtual Workshop on Motor Control. Organized by Prof. Hillel Chiel (CWRU), Silvia Daun (University of Cologne), and Peter Thomas (CWRU). Mechanisms of robust and flexible locomotion in *C. elegans*. Oct. 26-29th, 2020.

Informatics Colloquium Series and NSF-NRT Interdisciplinary Program in Complex Networks and Systems Colloquium. Beyond AI: evolving and analyzing artificial systems with the flexibility and robustness of living organisms. Nov. 13th, 2020.

Machine Learning and Control Theory for Whole Brain Activity session at the SIAM Conference on Mathematics of Data Science, Cincinnati, Ohio. Organized by Megan J. Morrison and Charles Fieseler (University of Washington). Mixed pattern generation for locomotion in *C. elegans*. May 5-8, 2020.

Math and Biology seminar series. Organized by Prof. Robert Guy and Prof. Tim Lewis. UC Davis. Mixed pattern generation for locomotion in *C. elegans*. March, 2020

Midwest *C. elegans* Meeting. Ann Arbor, Michigan. A computational mdel of mixed pattern generation for forward locomotion in *C. elegans*. April, 2019.

Neurolocomotion session at the SIAM Dynamical Systems meeting. Snowbird, Utah, US. Organized by Robert Guy and Tim Lewis. Evolution and analysis of integrated neuromechanical models of *C. elegans* locomotion. May 19-23, 2019.

Mechanical Engineering Seminar. University of Michigan. Organized by Eleni Gourgou. Towards a brain-body-environment computational model of a living organism. Nov., 2018.

Intelligent System Engineering Colloquium Series. Luddy School of Informatics, Computing, and Engineering, Indiana University. Towards computational models of a whole living organism. Sept., 2018.

Connectome to Behavior: Modeling *C. elegans* at cellular resolution. The Royal Society. London, UK. Connecting a connectome to behavior: evolution and ensemble analysis of integrated neuromechanical models of *C. elegans*. Jan., 2018.

Evolutionary and Adaptive Systems Seminar. University of Sussex. Brighton, UK. The whole organism: brain, body, environment models of *C. elegans*. Feb., 2018.

Workshop on Worm's Neural Information Processing. Neural Information Processing Systems Conference (NeuroIPS). Long Beach, California. Evolving neural circuits for behavior: *C. elegans* locomotion. Dec., 2017.

EON Workshop: Sensors, Motors, and Behavior at the Origin of Life. Earth-Life Science Institute. Tokyo Institute of Technology. Tokyo, Japan. Towards brain-body-environment models of behavior in living organisms. July, 2017.

Regional Worm Meeting. Bloomington, Indiana. Towards brain-body-environment computational models of a living organism. June, 2017.

TEACHING
Indiana University
C105: Brains & Minds, Robots & Computers. Spring 2016, Fall 2016, Fall 2017, Fall 2019, Fall 2020, Spring 2022.
Q700: Modeling Evolutionary and Adaptive Systems. Fall 2015, Spring 2018, Spring 2019, Fall 2021.

Q320: Computation in Cognitive Science. Spring 2013, Spring 2016, Spring 2017, Spring 2019. Spring 2021, Spring 2023.
Q260: Introduction to Programming in the Cognitive and Information Science. Spring 2013, Spring 2016, Spring 2017, Spring 2019.
Q530: Programming Methods for the Cognitive Sciences. Fall 2012, Fall 2016, Fall 2018, Spring 2021, Fall 2022, Spring 2023.
Q230: Math and Logic for Cognitive Science. Fall 2012.
X101: Simulating Disease Spread. Fall 2020.

University of Oregon

Teacher Assistant. Techniques in Computational Neuroscience. Organized by Prof. Shawn Lockery. Spring 2009.

University of Sussex

Teacher Assistant. Artificial Life. Organized by Prof. Inman Harvey. Fall 2005, 2006, 2007.
Teacher Assistant. Non-Symbolic Artificial Intelligence. Spring 2005, 2006, 2007.
Teacher Assistant. Foundations of Computation. Fall 2007, 2008.
Voluntary teacher. Homework Club. UNICEF. Brighton, U.K. Fall 2007.

MENTORING

Postdoc

Dr. Erick Olivares. Computational Neuroethology Lab. Co-advised with Prof. Beer. 2016–2020.

Current graduate students

Andrew Claros. Informatics and Cognitive Science (CNS-NRT). Co-advised with Prof. Sporns. 2021–present.
Lindsay Stolting. Neuroscience and Cognitive Science. Co-advised with Prof. Beer. 2021–present.
Zachary Laborde. Neuroscience and Cognitive Science. Main advisor. 2021–present.
Haily Merritt. Informatics and Neuroscience (CNS-NRT). Co-advised with Prof. Betzel. 2021–present.
Josh Nunley. Informatics and Mathematics (CNS-NRT). Co-advised with Prof. Moss. 2021–present.
Patrick Wall. Informatics and Biology (CNS-NRT). Advisory committee. 2022–present.
Ling Sun. Linguistics and Cognitive Science. Advisory committee. 2022–present.
Siyu Yao. Philosophy of Science and Cognitive Science. Advisory committee. 2022–present.
Chaundy McKeever. Informatics and Physics (CNS-NRT). Advisory committee. 2022–present.
Connor McShaffrey. Cognitive Science. Advisory committee. 2021–present.
Eden Forbes. Cognitive Science. Advisory committee. 2021–present.
Jacob Tanner. Informatics and Neuroscience (CNS-NRT). Advisory committee. 2020–present.
Maria Pope. Informatics and Neuroscience (CNS-NRT). Advisory committee. 2021–present.
Kenzie Givens. Informatics and Biology (CNS-NRT). Advisory Committee. 2018–present.
Derek Whitley. Complex Systems. Advisory committee. 2017–present.
Saber Sheybani. Intelligent Systems Engineering. Advisory committee. 2017–present.

Former graduate students

Dr. Brad Rogers. Cognitive Science. Advisory Committee. 2023.

Dr. Thomas Varley. Neuroscience and Informatics. Advisory Committee. 2021–2023.

Dr. Mahi Luthra. Cognitive Science. Advisory committee. 2019–2023.

Dr. Justin Slattery. Cognitive Science. Advisory committee. 2019–2023.

Aditya Ramesh. MS in Data Science Residential Program. Research rotation. 2021.

Lauren Benson. Informatics and Cognitive Science (CNS-NRT). Advisory committee. 2019–2021.

Dr. Nathaniel Rodriguez. Informatics. Advisory committee. 2016–2020.

Dr. Zoe Tosi. Informatics and Cognitive Science. Advisory committee. 2016–2021.

Dr. Madhavun Candadai Vasu. Cognitive Science. Advisor. 2016–2020.

Dr. Matt Setzler. Cognitive Science. Advisory Committee. 2016–2020.

Brian Dahlberg. Cognitive Science. Advisory Committee. 2018–2020.

Everett Green. Computational Linguistics. Research rotation. 2018–2019.

Sikander Khare. Masters in Complex Systems, Informatics. Advisor. 2019–2020.

Dr. Jason Yoder. Informatics and Cognitive Science. Advisor. 2016–2018.

Dr. Katherine Metcalf. Computer Science. Advisory Committee. 2016–2018.

Daniel Simpson. Bioinformatics. Research rotation. 2015–2016.

Dr. Miguel Aguilera. Visiting Research Scholar. 2013.

Thomas Baker. Master in Evolutionary and Adaptive Systems. University of Sussex. 2006–2007.

Former undergraduate students

Aida Niese. Emerging Scholars Research Experience for Undergraduate Women. 2021–2022.

Jazmine Susana. Emerging Scholars Research Experience for Undergraduate Women. 2021–2022.

Neha Shah. Emerging Scholars Research Experience for Undergraduate Women. 2021–2022.

Alexander Mervar. Cognitive Science student. Research experience for undergraduates. 2021–2022.

Cooper Anderson. Rose-Hulman Institute of Technology. Co-mentoring with Dr. Jason Yoder. 2021.

Abe Leite. Cognitive Science. Independent study. 2019–2021.

Chelsea Campbell. Informatics and Cognitive Science. Cox Research Scholar. Independent study. 2017–2021.

Josheta Srinivasan. Emerging Scholars Research Experience for Undergraduate Women. 2020–2021.

Marynancy Mwakalindile. Emerging Scholars Research Experience for Undergraduate Women. 2020–2021.

Claire Malone. Emerging Scholars Research Experience for Undergraduate Women. 2020–2021.

Zachary Petroff. Cognitive Science. Independent study. 2020–2021.

Kira Breithaupt. Cognitive Science. Independent study. 2020–2021.

Luke Brown.Cognitive Science. Independent study. 2021.

Jae H. Woo. Cognitive Science. Cognitive Science. Independent study. 2019.

Adam Ratzman. Computer Science. UROC@SICE. Indendent study. 2019–2020.

Nadine Templeton. Emerging Scholars Research Experience for Undergraduate Women. 2019–2020.

Evan Blanke. Computer Science. UROC@SICE Research. Engaged in undergraduate research. Fall 2018, Spring 2019.

Christian Gonzalez. Computer Science. Faculty Mentoring Services. Engaged in undergraduate research. Fall 2018, Spring 2019.

Mary Slaughter. Emerging Scholars Research Experience for Undergraduate Women. 2018–2019.

Meghan Reddy. Emerging Scholars Research Experience for Undergraduate Women. 2018–2019.

Graham Todd. Computer Science and AI from Stanford. Independent study. 2018–2019.

Pari Revankar. Cognitive Science. Independent study. 2018.

Alex DeCourcy. Informatics and Cognitive Science. Independent study. 2017.

Marc Dillon. Informatics and Cognitive Science. Indepenent study. 2012.

Margaret Antonik. SPUR undergraduate, Institute of Neuroscience, University of Oregon. 2009.

HONORS
&
AWARDS

Robert J. Glushko Research Excellence Award for outstanding oral presentation to undergraduate student, Neha Shah, for work in collaboration. Midwestern Undergraduate Cognitive Science Conference. 2022.

First place Research Poster Competition to undergraduate student, Neha Shah, for work in collaboration. Center for Women & Technology. 2022.

Trustees Teaching Award from Indiana University. 2021.

President's Diversity Fellowship from Indiana University to graduate student, Andrew Claros, to join our research group. 2021.

Outstanding Student Paper Award from International Society for Artificial Life for our paper titled: "Sources of predictive information in dynamical neural networks" published in Scientific Reports to graduate student, Madhavun Candadai. 2021.

Outstanding Achievement Award from Cognitive Science Program to undergraduate student, Abe Leite, for work in our research group. 2021.

Best Poster Award from International Society for Artificial Life for our paper titled "Interaction between evolution and learning in NK fitness landscapes" published in the Artificial Life 2020 conference to undergraduate student, Graham Todd. 2020.

Outstanding Research Award from the Cognitive Science Program to graduate student, Madhavun Candadai, for work in collaboration. 2020.

Outstanding Research Award from the Cognitive Science Program to undergraduate student, Abe Leite, for work in collaboration. 2020.

Hutton Honors College Research Grant to undergraduate student, Chelsea Campbell, for work in collaboration. 2020.

Summer Research Grant from the Cognitive Science Program to undergraduate student, Chelsea Campbell, for work in collaboration. 2020.

First Place Winner Award in National Data Analytics Challenge from Wells Fargo Data Analytics Summit to undergraduate student, Chelsea Campbell, for work in collaboration. 2019.

First place Research Poster Competition to undergraduate student, Chelsea Campbell. Center for Women & Technology, for work in collaboration. 2019.

Sayan Gul Award from Collective Intelligence International Conference to undergraduate student, Chelsea Campbell, for work in collaboration. 2019.

NSF-NRT Research Traineeship Award from the Complex Networks and Systems at Indiana University to graduate student, Madhavun Candadai, for work in collaboration. 2019.

Second place Research Poster Competition IU Research Symposium to undergraduate student, Chelsea Campbell, for work in collaboration. 2018.

Supplemental Research Fellowship from Cognitive Science Program to graduate student, Madhavun Candadai, for work in collaboration. 2017.

Best Student Paper from International Society for Artificial Life for paper titled "Analysis of a dynamical recurrent neural network evolved for two qualitatively different tasks: Walking and chemotaxis." 2008.

Service to the Program, School, University, and Local Community

Outreach

Panelist at Cognitive Science welcome to graduate students. 2022.

Panelist to NSF CAREER Expert Panel. 2020.

Designed and ran a booth for Science Fest titled "Building to Understand" in collaboration with Prof. Erik Ragsdale (attended by 150-200 middle school students). 2019.

Diversity

Organized events to talk to Hispanic students on campus about my path to becoming a scientist, in collaboration with IU's Latino Cultural Center, La Casa. 2018–present.

Empowered women in science and technology through mentoring a total of 9 undergraduate students from Emerging Scholars Research Experience for Undergraduate Women. 2018–present.

Served as poster judge for Women's Research Poster Competition from the Emerging Scholar Program at the IU Center of Excellence for Women & Technology. 2019–present.

Committees

Chair of Colloquium committee for Cognitive Science Program. 2022–present.

Award committee for Neuroscience Program. 2022–present.

Hiring Search committee for Informatics Department (Artificial Intelligence and Complex Systems position). 2021–2022.

Graduate committee for Informatics Department. 2020–present.

Undergraduate committee for Cognitive Science Program, 2018.

Undergraduate committee for Informatics Department. 2018–2020.

Colloquium committee for Neuroscience Program, 2017–2018.

Graduate admissions committee for Cognitive Science Program. 2015–2017.

Research committees. Yearly serve in 3-4 for graduate students as well as 1-2 independent studies and research rotations.

Other

Peer-review of teaching: Q320 Dotun (Fall 2020), Q320 Prof. Betzel (Spring 2022), Q540 Prof. Barwich (Spring 2022).

Recruitment. Across the Informatics, Cognitive Science, and Neuroscience Programs, I have participated in most recruitment events I have seen offered (including preparing "lightning talks" for graduate and undergraduate students and visitors to learn more about the work of faculty members in these programs).

Recommendation letters. On average, 5-6 recommendation letters per year for undergraduate and graduate students.

Talks at student organized meetings. I have participated in meetings organized by The Student Organization for Cognitive Science (SOCS) to discuss my research about once a year over the past five years.

Guest lectures. Typically guest lecture once or more a semester, including guest lectures in ENGR-E506 "Intro to Engineering" by Prof. Garyfallidis; COGS-Q355 "Neural Networks and the Brain" by Prof. Brown; COGS-Q400 "Senior Seminar in Cognitive and Information Sciences" by Prof. Landy; COGS-Q101 "Intro to Cognitive Science" by Prof. Schoenemann; COGS-Q610 "Networks of the Brain" by Prof. Sporns.

Professional Development

Persistence and Resilience: Envisioning what Institutions can do for Faculty 13th

Annual Conference for Assistant Professors. Organized by Purdue University. Sept. 15-16 2022.

Neural Networks and Deep Learning. Taught by Andrew Ng and Organized by DeepLearning.AI. First course of the Deep Learning Specialization. 2022.

Leadership Training Program. Organized by Luddy School of Informatics, Computing, and Engineering. 2021–2022.

Beyond Bias: Bystander Intervention & Gender Allyship. Organized by the Faculty Advocates & Allies for Equity from the IU Center of Excellence for Women & Technology. 2022.

Hiring Diversity Training. Organized by Indiana University. 2021.

Intro to Bias & Gender Equity Workshop. Organized by the Faculty Advocates & Allies for Equity from the IU Center of Excellence for Women & Technology. 2021.

Service to the International Scientific Community

Co-organizer for Artificial Life International Conference to be held in Japan in 2023.

Co-organizer of NSF-funded Workshop titled "Functional Logic of Neural Circuits: Diamonds in the Rough." First phase held online in 2021 and attended by over 500 participants with 20 invited panelists. Second phase held in person in Puerto Rico, February 2022. Workshop made up of 30 global leaders with the goal of identifying new directions of funding at the intersection between experimental, theoretical, and computational neuroethology.

Poster Judge. Served as poster judge for the GSA 23rd International *C. elegans* Conference (2021), the 7th Midwest C. elegans meeting (2019), and the CeNeuro 2018 International Conference.

NSF Grant Review Panelist. Served as NSF panel reviewer to the Collaborative Research in Computational Neuroscience program (CRCNS) (2019, 2020, 2021) and to the Robust Intelligence program (Spring 2017).

Reviewer for over 20 journals, including Nature, eLife, Scientific Reports, Journal of Neuroscience, Frontiers Neuroscience, Frontiers Computational Neuroscience, Frontiers Physics, Frontiers Robotics and AI, Biological Cybernetics, Adaptive Behavior Journal, Cognitive Systems Research, PLOS Computational Biology, PLOS ONE, Journal of Neural Engineering, Symmetry, Entropy, Complexity Journal, Neural Computation.

Program Committee. On the Program Committee for the Artificial Life International Conference (2014–present); European Conference on Artificial Life (2007-present); Conference on Complex Systems (2017–2019); Cognitive Science Conference (2016–present); IEEE ALife (2022); Biologically Inspired Cognitive Architectures (2015–present); IEEE Congress on Evolutionary Computation (2009); Worm's Neural Information Processing Workshop as part of the Natural Information Processing Conference (2017).

Editorial Board. On the Editorial Board of Adaptive Behavior Journal, PLOS ONE, and Frontiers in Robotics and AI.

Panelist. Member of panel discussions at OpenWorm meetings. Dec, 2015. Jan, 2016.

Co-organizer for the International Conference of Artificial Life. Mexico, 2016.

Co-Organizer of Dynamics of Learning Behavior and Neuromodulation Workshop as part of the European Conference on Artificial Life. 2007.

Organizer of the workshop Active Agents and their Environments as Dynamical Systems as part of the European Conference on Artificial Life. 2005.

Organizer of the workshop Dynamical Systems approach to Life and Cognition at the University of Sussex. 2005.

Co-founder and organizer of the seminar groups: activate.d and Life and Mind seminar group as part of the Centre for Computational Neuroscience and Robotics in the University of Sussex.

REFERENCES   **Prof. Randall D. Beer**, Provost Professor, Cognitive Science, Indiana University.

Prof. Peter Todd, Provost Professor, Psychological and Brain Sciences, Indiana University.

Prof. Joshua Bongard, Professor, Computer Science, University of Vermont.

Prof. Melanie Mitchell, Davis Professor, Santa Fe Institute.