Jacob M. Graving

Max Planck Institute of Animal Behavior
University of Konstanz, Department of Biology
Centre for the Advanced Study of Collective Behaviour
Universitätsstr. 10
Konstanz, Germany 78464

✉ jgraving@gmail.com

🌐 jakegraving.com
🐦 twitter.com/jgraving
⚙ github.com/jgraving

Research Interests	Computational models for the study of animal behavior, Bayesian statistical inference, machine/deep learning, computer vision, probabilistic programming, nonlinear dynamics

Positions

2020–present	**Research Scientist** Max Planck Institute of Animal Behavior **Role:** Research Scientist in the Advanced Research Technology (ART) Unit tasked with developing novel, general-purpose methods for the study of animal behavior in laboratory and field environments using computer vision, machine/deep learning, and modern statistical techniques, such as Bayesian causal inference.

Education

2021	**Ph.D. (Dr.rer.nat.), Biology** Department of Collective Behaviour, Max Planck Institute of Animal Behavior Department of Biology, University of Konstanz Centre for the Advanced Study Collective Behaviour, University of Konstanz International Max Planck Research School (IMPRS) for Organismal Biology **Advisor**: Prof. Dr. Iain D. Couzin **Thesis Title**: "Computer Vision and Deep Learning Methods for Measuring and Modeling Animal Behavior" **Grade**: 0,0 (summa cum laude)
2015	**M.S., Biology** Department of Biological Sciences, Bowling Green State University **Advisor**: Prof. Daniel D. Wiegmann **Thesis Title**: "Nocturnal Homing in Amblypygids"
2013	**B.S., Biology** Department of Biological Sciences, Bowling Green State University

Publications

In Revision	Bath, D.E., **Graving, J.M.**, Walter, T., Sridhar, V.H., Vizcaíno, J.P., Couzin, I.D. Collective detection and processing of distributed information by fish schools. In revision.
	Graving, J.M., Couzin, I.D. Probabilistic self-supervised deep learning reveals the structure of high-dimensional data. bioRχiv: https://doi.org/10.1101/2020.07.17.207993
2020	Li, L., Nagy, M., **Graving, J.M.**, Bak-Coleman, J., Guangming X., Couzin, I.D. (2020). Vortex phase matching as a strategy for schooling in robots and in fish. Nature Communications 11, 5408 https://doi.org/10.1038/s41467-020-19086-0
2019	**Graving, J.M.**, Chae, D., Naik, H., Li, L., Koger, B., Costelloe, B.R., Couzin, I.D. (2019). DeepPoseKit, a software toolkit for fast and robust animal pose estimation using deep learning. eLife, 8. https://doi.org/10.7554/elife.47994 bioRχiv: https://doi.org/10.1101/620245 Code: https://github.com/jgraving/deepposekit Press: Quanta Magazine, Nature Methods, Nature News & Views, eLife Science Digests

2018	Alarcón-Nieto, G.*, **Graving, J.M.***, Klarevas-Irby, J.A.*, Maldonado-Chaparro, A.A., Mueller, I., and Farine, D.R. (2018) An automated barcode tracking system for behavioural studies in birds. Methods in Ecology and Evolution 9 (6), 1536-1547. https://doi.org/10.1111/2041-210X.13005 bioRχiv: https://doi.org/10.1101/201590 *contributed equally
2017	**Graving, J.M.**, Bingman, V.P., Hebets, E.A., and Wiegmann, D.D. (2017). Development of site fidelity in the nocturnal amblypygid *Phrynus marginemaculatus*. Journal of Comparative Physiology A, 203(5), 313-328. https://doi.org/10.1007/s00359-017-1169-5
	Bingman, V.P., **Graving, J.M.**, Hebets, E.A., and Wiegmann, D.D. (2017). Importance of the antenniform legs, but not vision, for homing by the neotropical whip spider *Paraphrynus laevifrons*. Journal of Experimental Biology, 220(5), 885-890. https://doi.org/10.1242/jeb.149823 Press: Discover Magazine, National Geographic
2016	Wiegmann, D.D., Hebets, E.A., Gronenberg, W., **Graving, J.M.**, and Bingman, V.P. (2016). Amblypygids: model organisms for the study of arthropod navigation mechanisms in complex environments. Frontiers in Behavioral Neuroscience, 10, 47. https://doi.org/10.3389/fnbeh.2016.00047

Teaching

2019	**ASAB 2019 Summer Conference, University of Konstanz** Workshop Organizer and Lecturer – Seminar on "Machine Learning in the Behavioral Sciences" – Practical Workshop on "Quantifying Behavior with Machine Learning"
2016–2020	**University of Konstanz, Department of Biology** Lecturer and Project Advisor, Intensive Research Course for Master's Students – Measuring Animal Behavior with Computer Vision – Analyzing Behavioral Data – Introduction to Programming in Python
2013–2015	**Department of Biological Sciences, Bowling Green State University** Graduate Assistant – Advanced Biostatistics – Introduction to Biostatistics – Population and Community Ecology – Introductory Biology for Non-Science Majors – Guest Lecture on "Arthropod Navigation", Animal Behavior

Invited Talks

2019	**Revealing the Behavioral Algorithms of Social Animals** Princeton Neuroscience Institute (PNI) Princeton University, Princeton, New Jersey, USA July 2, 2019
2018	**Perception and Motion in Locust Swarms** Integrated Behavioral Research Group (IBRG) Princeton University, Princeton, New Jersey, USA March 16, 2018
	Perception and Motion in Locust Swarms Department of Biological Sciences Seminar Series Bowling Green State University, Bowling Green, Ohio, USA February 28, 2018

Outreach

2017–2019	**Konstanzer Lange Nacht Der Wissenschaft** "Long Night of Science" Public Outreach Event Volunteer

Konstanz, Germany

2016   **Das Schwarmverhalten der Fische**
Public Seminar by Prof. Jens Krause
Volunteer Co-organizer
Konstanz, Germany

2013–2014   **Kid's Tech University, Bowling Green State University**
Public Outreach Event for Schoolchildren Grades K–8
Volunteer
Bowling Green, Ohio, USA

Advisees

Graduate

Simon Gommel, M.S. Biology, University of Konstanz
Taylor Carter, M.S. Biology, University of Konstanz
Ingabritta Hormann, M.S. Biology, University of Konstanz

Undergraduate

Nicole Meister, B.S. Computer Science, Princeton University
Chiara Hirschkorn, B.S. Biology, University of Konstanz
Daniel Chae, B.S. Computer Science, Princeton University
Connie Santangelo, B.S. Biology, Bowling Green State University
Lindsey Cunningham, B.S. Biology, Bowling Green State University
Tracy Togba, B.S. Biology, Bowling Green State University

Peer Review

Journals: eLife, Science Advances, PNAS, Methods in Ecology and Evolution
Grants: IMPRS Project Grant, IMPRS Travel Grant

Skills

Languages: Python (Expert), R (Intermediate)
Applications: Bayesian inference, statistical analysis, data visualization,
                     machine learning, deep learning, computer vision, and image processing
Libraries: Stan, TensorFlow, PyTorch, Numpyro, scikit-learn, OpenCV