

Jacob M. Graving

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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: Head of central machine learning research group 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 of 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”

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.

In Review

Graving, J.M., Couzin, I.D. (2020). VAE-SNE: a deep generative model for simultaneous dimensionality reduction and clustering. bioRxiv: <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>

bioRxiv: <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> bioRxiv: <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 laevis*. *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 Hirschhorn, 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