James Heald

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Summary

Embodied AI researcher specializing in dexterous manipulation and reinforcement learning, with broader expertise in latent-variable dynamics models. Ten years of research experience spanning simulated robotics and human motor control. Strong record of high-impact publications (Nature, NeurIPS, ICML), spotlight papers (ICML) and competition wins (NeurIPS MyoChallenge). Builds scalable JAX systems with GPU-accelerated MuJoCo simulation for large-scale RL experimentation.

Experience

Postdoctoral Research Fellow Dec 2022 - Mar 2026

Gatsby Unit, University College London

- Developed reinforcement learning methods for high-dimensional dexterous manipulation, enabling dexterous coordination in tendon-driven hands (ICML 2026 Spotlight) and unsupervised discovery of dexterous skills (NeurIPS 2026, Under Review).
- Won 1st place in the Manipulation Track of the NeurIPS 2024 MyoChallenge competition.

Postdoctoral Researcher 2020 - 2022

Zuckerman Institute, Columbia University

- Developed a switching state-space model of context-dependent motor learning that unified disparate classical phenomena. Confirmed novel predictions. Published as first author in *Nature*.

Recent Projects

Joint-Space Empowerment for Dexterous Coordination in Tendon-Driven Hands Project Page

Developed an information-theoretic framework for discovering low-dimensional action manifolds in tendon-driven hands. Across both musculoskeletal and robotic hands, policies trained on these manifolds achieved greater dexterity, sample efficiency and generalization (Python, JAX). An early version was presented at RSS workshop on Dexterous Manipulation: Scalable Learning for Human-Level Skills.

MyoChallenge 2024: Physiological Dexterity and Agility in Bionic Humans NeurIPS Oral

Developed a reinforcement learning method to solve a bimanual manipulation challenge. Outperformed competitors across every metric (score, time, effort, peak contact force) and achieved 1000× higher learning efficiency than the winning solution from the previous year (Python, JAX).

Maximum-Likelihood Learning of Latent Dynamics Without Reconstruction ICML

Co-developed a maximum-likelihood framework for learning latent dynamics models; by avoiding reconstruction, the model directs its full capacity toward dynamically relevant state, yielding greater robustness to visual distractors (Python, JAX).

Dexterous Skill Discovery via Topology-Aware Wasserstein Dependency

Developed an unsupervised skill discovery method that optimizes a Wasserstein dependency between skills and object motions. By formulating object motions in the Lie algebra $\mathfrak{se}(3)$, the skills respect the non-Euclidean topology of object pose space, enabling continuous object translation and rotation.

Open-Source Contributions

2025 Contributor to MyoSuite, porting environments to MuJoCo XLA for massively parallel, GPU-accelerated simulation (8,000+ agents on GPU) and building APIs to extend MuJoCo models.

Awards

2026 Spotlight paper (top 2.2% of submissions), ICML 2026
2024 Manipulation Award, 1st Place, NeurIPS 2024 MyoChallenge ($2000 prize)
2015 EPSRC Scholarship, University of Cambridge
2012 David Marr Prize (ranked 1st on MSc), University of Sheffield

Education

2015 - 2019 PhD (Engineering), University of Cambridge, UK
2011 - 2012 MSc (Cognitive and Computational Neuroscience), The University of Sheffield, UK
2007 - 2013 MD (Medicine), The University of Manchester, UK

Select Publications

[1] **J. Heald**, V. Caggiano, V. Kumar, and M. Sahani. "Joint-Space Empowerment for Dexterous Coordination in Tendon-Driven Hands". In: *International Conference on Machine Learning (ICML) (**Spotlight**)*. 2026.

[2] **J. Heald**, K. Biegun, A. Galashov, and M. Sahani. "Dexterous Skill Discovery via Topology-Aware Wasserstein Dependency". In: *Advances in Neural Information Processing Systems (NeurIPS) (Under Review; Decision Expected Sept 24)*. 2026.

[3] S. Hromadka, K. Biegun, L. Fox, **J. Heald**, and M. Sahani. "Maximum-Likelihood Learning of Latent Dynamics Without Reconstruction". In: *International Conference on Machine Learning (ICML)*. 2026.

[4] L. Fox, K. Biegun, **J. Heald**, S. Hromadka, A. Rosinski, and M. Sahani. "RAMP: Recognition Parametrisation by Amortised Message Passing". In: *ProbML*. 2026.

[5] C. Wang*, C. Tan*, B. Hodossy*, E. Lyu*, P. Schumacher*, **J. Heald**, et al. "MyoChallenge 2024: A New Benchmark for Physiological Dexterity and Agility in Bionic Humans." In: *NeurIPS 2025 Datasets & Benchmarks Track* (2025).

[6] **J. Heald**, M. Lengyel, and D. Wolpert. "Contextual inference underlies the learning of sensorimotor repertoires". In: *Nature* 600 (2021), pp. 489–493.

Technical Skills

Languages & ML Frameworks: Python, JAX, PyTorch, TensorFlow, Weights & Biases, Hydra
Simulation & Scale: MuJoCo, MuJoCo XLA (MJX), Brax; GPU-accelerated RL training

Mentorship & Outreach

Advanced AI Instructor, UCL March 2025
Designed and delivered a lecture on Reinforcement Learning (RL) to Ph.D. students.

Data Science Expert, ThAIMed Initiative (Thailand) Aug 2024 (1-week intensive)
Provided technical support to medical professionals decoding movement intention from EEG.

Thesis Supervisor & Project Lead, UCL May-Sep 2023 and May-Sep 2024
Designed and supervised two MSc Machine Learning thesis projects, mentoring students in developing state-of-the-art methods (e.g., latent-space diffusion models for planning).