James Holehouse

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🌐 My Website
⭘ GitHub
🎓 Scholar
in LinkedIn

Biography

🔖 I'm a postdoc at the Santa Fe Institute (SFI) and I completed my PhD in Mathematical Biology at the University of Edinburgh. I obtained a first-class honors degree in Theoretical Physics (MPhys) from the University of Edinburgh. My main interests span several aspects of complexity science and statistical physics:

- Stochasticity and its non-intuitive consequences.
- The effects of randomness on gene expression.
- Rules and regulations across different complex systems.
- Social choice and complexity economics.

Examples of these interests include work on time-dependent solutions of master equations in mathematical biology and economics, and recent work on the evolution of rules and regulations in documents such as the US Code. I actively engage in teaching and mentoring and have trained in a variety of mathematical, physical and biological topics.

Employment History

October 2022 – Present

🔖 **Postdoc at the Santa Fe Institute.**
Working alongside Sidney Redner, Chris Kempes, Geoffrey West, Vicky Chuqaio Yang and Hyejin Youn.

- I am the current Curriculum Director of the Undergraduate Complexity Researcher program.
- In both 2023 and 2024 I organized the annual SFI postdoc retreat.
- Co-organized a series of talks at St. Johns College from SFI postdocs.
- I was a core member of the SFI postdoc selection process for 2023.

May 2021 – October 2021

🔖 **Economic Modeling Intern at Cambridge Econometrics.**
An industrial internship in complexity economics alongside Hector Pollitt.

Feb 2021 – Feb 2022

🔖 **Tutor at MyTutor.**
I tutored GCSE and A-level Mathematics and Physics to high school students during the pandemic.

Sept 2019 – June 2021

🔖 **Teaching Assistant at the University of Edinburgh.**
I taught Python programming to 1st year Biology students.

June 2017 – Aug 2017

🔖 **NERC Summer Researcher at the University of Edinburgh.**
A climate science summer internship supervised by Simon Tett.

pre 2017

🔖 I worked at various positions in hospitality including, working at a hostel and as a cook in a restaurant.

Education

2018 – 2022   🔖 **PhD, the University of Edinburgh** in *Mathematical Biology*.
Studying stochastic models of gene expression with Prof. Ramon Grima. I organized and instantiated *stochastic problem solving days* and groups retreats in our research group.
I was the winner of the Reinhart Heinrich award from the European Society for Mathematical Biology (2022) for the best thesis in mathematical biology.

2021   🔖 **TensorFlow Certificates** in *Coursera*.
Achieved 99% in courses on *Introduction to TensorFlow for Artificial Intelligence, Machine Learning, and Deep Learning* and *Convolutional Neural Networks in TensorFlow*.

2020 – 2021   🔖 **Centre for Open Learning, the University of Edinburgh** *Introduction to Philosophy*.
I completed a night-school Philosophy course during my PhD studies.

2014 – 2018   🔖 **MPhys, the University of Edinburgh** in *Theoretical Physics*.
I achieved a First Class Honors degree (1:1) and did my Masters project alongside Prof. Richard Blythe. My course choices were tailored to mathematical and statistical physics modules.

2012 – 2014   🔖 **A-Levels, Scarborough Sixth Form College**.
Obtained $A^\star A^\star A$ in Mathematics, Physics and Chemistry respectively ($A^\star$ is top grade), and AS-Levels AA in Further Mathematics and Biology (A is top grade).

Publications

Published Articles

1. **Holehouse, J.**, & Redner, S. (2024). First passage on disordered intervals. *Physical Review E, 109*(3), L032102. **Corresponding author paper.**

2. Wu, B., **Holehouse, J.**, Grima, R., & Jia, C. (2024). Solving the time-dependent protein distributions for autoregulated bursty gene expression using spectral decomposition. *The Journal of Chemical Physics, 160*(7).

3. **Holehouse, J.** (2023). Recurrence and eigenfunction methods for non-trivial models of discrete binary choice. *Entropy, 25*(7), 996.

4. Weidemann, D. E., **Holehouse, J.**, Singh, A., Grima, R., & Hauf, S. (2023). The minimal intrinsic stochasticity of constitutively expressed eukaryotic genes is sub-poissonian. *Science Advances, 9*(32), eadh5138.

5. **Holehouse, J.**, & Moran, J. (2022). Exact time-dependent dynamics of discrete binary choice models. *Journal of Physics: Complexity*. **Corresponding author paper**.

6. **Holehouse, J.**, & Pollitt, H. (2022). Non-equilibrium time-dependent solution to discrete choice with social interactions. *PLoS ONE*. **Corresponding author paper**.

7. Braichenko, S., **Holehouse, J.**, & Grima, R. (2021). Distinguishing between models of mammalian gene expression: Telegraph-like models versus mechanistic models. *Journal of the Royal Society Interface*. **Joint first author publication**.

8. **Holehouse, J.**, Cao, Z., & Grima, R. (2020). Stochastic modeling of autoregulatory genetic feedback loops: A review and comparative study. *Biophysical journal, 118*(7), 1517–1525.

9. **Holehouse, J.**, Gupta, A., & Grima, R. (2020). Steady-state fluctuations of a genetic feedback loop with fluctuating rate parameters using the unified colored noise approximation. *Journal of Physics A: Mathematical and Theoretical, 53*(40), 405601.

10. **Holehouse, J.**, Sukys, A., & Grima, R. (2020). Stochastic time-dependent enzyme kinetics: Closed-form solution and transient bimodality. *The Journal of Chemical Physics, 153*(16), 164113.

11   **Holehouse, J.**, & Grima, R. (2019). Revisiting the reduction of stochastic models of genetic feedback loops with fast promoter switching. *Biophysical journal, 117*(7), 1311–1330.

12   **Holehouse, J.**, & Cameron, B. (2017). Meteorological visibility observations: A user's guide. *Times Educational Supplement.*

Other and In Progress

1   **Holehouse, J.** (2024a). Principles of bursty mRNA expression and irreversibility in single cells and extrinsically varying populations. arXiv preprint arXiv:2405.12897.

2   **Holehouse, J.** (2024b). Thesis summary: Model reduction, mechanistic modelling and transience in models of stochastic chemical kinetics. *European Communications in Mathematical and Theoretical Biology 26, 6-14.*

3   **Holehouse, J.** (2022). Model reduction, mechanistic modelling and transience in models of stochastic chemical kinetics. *The University of Edinburgh.*

4   **Holehouse, J.**, & Blythe, R. A. (2018). Cross-situational learning of large lexicons with finite memory. arXiv preprint arXiv:1809.11047.

Seminars, Posters and Invited Talks

2024   **Plenary talk** at the European Conference for Mathematical and Theoretical Biology 2024 in Toledo.
Breaking steady state assumptions in models of stochastic chemical kinetics.

Contributed talk at the European Conference for Mathematical and Theoretical Biology 2024 in Toledo.
The statistical physics of transcription and mRNA expression heterogeneity.

Contributed talk at the 10th International Conference on Computational Social Science (IC^2S^2) in Philadelphia.
Scaling of diversity and specialization across socioeconomic and biological complex systems.

Invited talk at the University of California Berkeley at the lab of Prof. Hernan Garcia.
What are the benefits of bursty transcription?

Invited talk at St. Johns College, Santa Fe.
A complexity approach to rules, regulations and bureaucracy. This is part of the ongoing seminar series I am co-organizing.

2023   **Workshop talk** at the Santa Fe Institute.
A unified mechanistic model of diversity in cities, cells and companies.

2022   **Poster presentation** at the European Conference for Mathematical and Theoretical Biology 2022 in Heidelberg.
Analytics and Bimodality in Transient Michaelis-Menten Kinetics.

Seminar at Cambridge Econometrics.
Stochastic methods for binary decision models.

Seminar at Scuola Superiore Sant'Anna.
Stochastic methods for binary decision models.

Invited talk at the Santa Fe Institute.
Time-dependent solutions to master equations in chemical kinetics and opinion formation.

2021   **Seminar** at the University of St. Andrews.
Stochastic time-dependent enzyme kinetics: Closed-form solution and transient bimodality.

2019   **Invited talk** at the University of Edinburgh.
Using moment-based maximum likelihood inference to infer parameters from experimental data.

Mentoring

2023-present ▌ **Anish Pandya (The University of Texas at Austin)** at the Santa Fe Institute.
Volume-dependence in stochastic gene expression—presented at the Bulletin of the American Physical Society in Austin, TX.
Causation does not imply correlation: non-intuitive insights from a simple genetic mechanism.

2023 ▌ **Nathan Hasegawa (Harvey Mudd College)** at the Santa Fe Institute.
Island growth models with preferential attachment.

2024 ▌ **Shloka Janapaty (Colombia University)** at the Santa Fe Institute.
Reaction-diffusion equations of biocrust growth.

▌ **Elena Parkerson (Carleton College)** at the Santa Fe Institute.
Finite state projection and stochastic simulation for viral infections.

Grants

2020 ▌ **Scottish Mathematical Biology Forum (SMBF) 2020 Research Collaboration Prize** for £500 alongside Jochen Kursawe (University of St. Andrews).
The physical meaning and application of Hill functions in gene regulatory networks.

2023 ▌ **Lou Schuyler Grant** for $14,640 from the Santa Fe Institute.
Understanding the trade-offs between diversity, robustness and performance across the tree of life.

2024 ▌ **SFI working group** for $6,104 alongside Asher Leeks (Yale University). Participants: Brandon Schlomann and William DeWitt.
Modeling the evolutionary dynamics of cheating in natural viral infections.

▌ **SFI working group** for $4,536. Participants: Augustinas Sukys and Kaan Öcal.
On the origins of transient bimodality.

Service and Skills

Journal Reviewing

2020–present ▌ **Reviewer** for Mathematical Biosciences.

2021–present ▌ **Reviewer** for PLoS One.

▌ **Reviewer** for Physical Review E.

2023–present ▌ **Reviewer** for Physical Review Letters.

▌ **Reviewer** for Biophysical Journal.

2024–present ▌ **Reviewer** for Chaos: An Interdisciplinary Journal of Nonlinear Science.

Programming Languages

Julia ▌ Very proficient, preferred language.

Mathematica ▌ Very proficient, preferred language.

Python ▌ Very proficient.

References

Please reach out to request references from: Ramon Grima (ramon.grima@ed.ac.uk), Chris Kempes (ckempes@gmail.com), Geoffrey West (gbw@santafe.edu), Sidney Redner (redner@santafe.edu) and Hyejin Youn (hyejin.youn@kellogg.northwestern.edu).