



# Eddie Lee principles of emergent things

## Big questions

What mathematical laws that constrain living systems like society and biology? I am inspired by concepts, intuition, and models from statistical physics to search for fundamental principles in collective behavior that connect biology and society.

## Education

**2014-2019**

Ph.D. in Physics from Cornell University  
*Quantitative modeling of collective behavior. Advised by Paul Ginsparg*

**2008-2012**

A.B. in Physics & Certificate in Biophysics from Princeton University  
*Degree awarded cum laude*

## Work experience

**2022-2025**

Austrian Science Fund ESPRIT fellow at Complexity Science Hub Vienna  
*Independent position with PhD student and postdoc*

**2021-2022**

Postdoctoral fellow at Complexity Science Hub Vienna  
*Independent position with PhD student. Universality & scaling in social dynamics*

**2020-2021**

Program Postdoctoral Fellow at Santa Fe Institute  
*Universality & scaling in conflict dynamics. Metabolic scaling in biology*

**2018-2019**

Santa Fe Institute Graduate Fellow  
*Conflict dynamics & statistical physics of voting*

**2015-2018**

National Science Foundation Graduate Research Fellow  
*Theoretical analysis of plastic deformation & experiments in virtual reality for exploring interpersonal coordination of motion*

## Grants, honors, awards

**2023**

Poster prize, Collective Intelligence Symposium  
*3rd place, \$500*

**2022**

Austrian Science Fund ESPRIT Fellowship  
*Early career award, €300,000*

**2017**

STIR grant from Army Research Office



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- "Determining the limits of human coordination" (drafted by me), PI Itai Cohen, \$60,000*
- 2016** Poster Award at Active Matter  
*2nd place*
- 2015** Dirksen Congressional Center Dissertation Grant  
*Influential voters in Congress, \$4,000*  
NSF Graduate Research Fellowship  
*Competitive national competition to fund graduate education*  
Best Poster Award at Computational Social Science Summit
- 2013** Sigma Xi Research Showcase Division 1st place  
*National competition for video explaining research*
- 2011, 2012** Kusaka Memorial Prize  
*For excellence in undergraduate research, \$2,000*
- 2010** Health Grand Challenges Initiative Grant  
*From Princeton Environmental Institute to study HIV*

### Publications

- Kushwaha, N. & **Lee, E.D.** Discovering the mesoscale for chains of conflict. PNAS Nexus 2, pgad228 (2023). <https://doi.org/10.1093/pnasnexus/pgad228>
- Lee, E.D.**, Chen, X. & Daniels, B.C. Discovering sparse control strategies in neural activity. PLoS Comput Biol 18, e1010072 (2022). <https://dx.plos.org/10.1371/journal.pcbi.1010072>
- Lee, E.D.**, Kempes, C.P. & West G.B. Growth, death, and resource competition in sessile organisms. PNAS 118, e2020424118 (2021). <https://doi.org/10.1073/pnas.2020424118>
- Lee, E.D.**, Daniels, B.C., Myers, C.R., Krakauer, D.C. & Flack, J.C. Scaling theory of armed-conflict avalanches. Phys. Rev. E 102, 042312 (2020). <https://doi.org/10.1103/PhysRevE.102.042312>
- Lee, E.D.**, Katz, D.M., Bommarito II, M.J. & Ginsparg, P.H. Sensitivity of collective outcomes identifies pivotal components. Journal of The Royal Society Interface 17 (2020). <https://doi.org/10.1098/rsif.2019.0873>



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**Lee, E.D.**, Esposito, E. & Cohen, I. "Audio cues enhance coordination of motion when visual cues are scarce." *Journal of the Royal Society Interface*, 16(154) (2019). <https://doi.org/10.1098/rsif.2018.0903>

**Lee, E.D.** & Daniels, B.C. "Convenient Interface to Inverse Ising (ConIII): A Python 3 Package for Solving Ising-Type Maximum Entropy Models." *Journal of Open Research Software*, 7(3):1-8 (2019). <https://doi.org/10.5334/jors.217>

**Lee, E.D.** "Partisan Intuition Belies Strong, Institutional Consensus and Wide Zipf's Law for Voting Blocs in US Supreme Court." *Journal of Statistical Physics* 173(6):1722-1733 (2018). <https://doi.org/10.1007/s10955-018-2156-0>

**Lee, E.D.**, Daniels, B.C., Krakauer, D.C. & Flack, J.C. "Collective Memory in Primate Conflict Implied by Temporal Scaling Collapse." *Journal of the Royal Society Interface*, 14:20170223 (2017). <http://dx.doi.org/10.1098/rsif.2017.0223>

Sethna, J.P., Bierbaum, M.K., Dahmen, K.A., Goodrich, C.P., Greer, J.R., Hayden, L.X., Kent-Dobias, J.P., **Lee, E.D.**, Liarte, D.B., Ni, X. & Quinn, K.N. "Deformation of crystals: Connections with statistical physics." *Annual Review of Materials Research*, 47(14):1-13 (2017). <https://doi.org/10.1146/annurev-matsci-070115-032036>

**Lee, E.D.**, Broedersz, C.P. & Bialek, W. "Statistical Mechanics of the US Supreme Court." *Journal of Statistical Physics*, 160(2):275-301 (2015). <https://doi.org/10.1007/s10955-015-1253-6>

### Working papers

**Lee, E.D.**, Daniels, B.C., Myers, C.R., Krakauer, D.C. & Flack, J.C. "Emergent regularities and scaling in armed conflict data," arXiv:1903.07762, 2019. <https://arxiv.org/abs/1903.07762>



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**Lee, E. D.**, Kwan, A. P., Hanel, R., Bhatt, A., Neffke, F. Scaling in the information costs of firms. Preprint at <http://arxiv.org/abs/2210.07418> (2022). Under review.

**Lee, E. D.**, Flack, J. C., Krakauer, D. C. Outsourcing Memory Through Niche Construction. Preprint at <https://arxiv.org/abs/2209.00476> (2022).

**Lee, E.D.** Closely estimating the entropy of sparse graph models. Preprint at <http://arxiv.org/abs/2301.04768> (2023). Under review.

**Lee, E.D.**, Cantwell, G. Valence in a statistical mechanics of voting (2023). Under review.

## Research presentations (selected)

2023

"Rethinking a statistical mechanics of voting," *Complexity in Law & Governance, Vanderbilt Law School (invited)*

"Idea engines: Unifying innovation & obsolescence from markets & evolution to science," *SIAM Dynamical Systems minisymposium, Portland (invited)*

"Scaling in the information costs of firms," *Santa Fe Institute seminar*

"Discovering components, mechanism, and structure" in *"The Database of Religious History and Cultural Evolutionary Analysis," Santa Fe Institute working group (invited)*

"Diversity and universality in the laws of life," *Visualizing Complexity Science Workshop, Complexity Science Hub Vienna (invited)*

"Innovation, obsolescence, and the space of the possible," *NICO Complex Systems Seminar, Northwestern (invited)*

"Validating scaling in armed conflict," *Theoretical Ecology Lab Tea, Princeton*

Seminar, *Network Research Institute, Northeastern (invited)*

INET seminar, *Oxford (invited)*



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- 2022** "Idea engines," *Colloquium on Complex and Biological Systems, Potsdam University (invited)*  
"Idea engines," *Innovation Lab at Northwestern University (invited)*  
"Idea engines," *Dutch Institute for Emergent Phenomena (invited)*  
"Innovation, obsolescence, & the space of the possible," *Organized workshop with invited participants*
- 2021** "Growth, death, and resource competition in sessile organisms" *University of Bristol, Engineering Mathematics seminar (invited)*  
"Measuring institutional integrity with the judiciary," *Organized working group with invited participants*
- 2019** "Emergent regularities and scaling in armed conflict data," *SIAM, online minisymposium "Modeling collective human behavior in social systems" (invited)*  
"Dynamics of growth, death, and resource competition in sessile organisms," *March APS*  
"Coarse-graining armed conflict," *March APS, Boston*
- 2018** "Keeping it together: How humans coordinate motion with low information," *March APS, Los Angeles*  
"Collective memory in primate conflict implied by temporal scaling collapse," *Bifi, Zaragoza*  
"Renormalization group & armed conflict" (invited) *Santa Fe Institute*  
"Statistical physics of collective behavior" (invited) *Santa Fe Institute*
- 2016** "Voting in the Supreme Court, conflict in pigtailed macaques, & statistical physics" (invited)

### Service & outreach

Reviewer for *Journal of Statistical Mechanics, PLoS Computational Biology, PLoS One, MDPI Social Science, American Political Science Review, Neuroscience Letters, Nature Communications Physics, Science Advances, Cliodynamics*

- 2023** Session chair, *DPG Dresden*



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- Program committee, *Collective Intelligence Santa Fe*  
Program committee, *NetSci Vienna*  
Session chair, *IC2S2 Copenhagen*
- 2020** Colloquium Committee Chair, *Santa Fe Institute*  
STEM Santa Fe volunteer  
*Math festival for middle-schoolers*
- 2019-2020** Participant in Letters to Pre-Scientist  
*Pen pal program with elementary school students*
- 2018** Cornell Center for Material Research outreach volunteer
- 2017** Physics Dept. colloquium committee student representative
- 2015-2016** Physics representative to Graduate & Professional Student Assembly
- 2014** Education Outreach Initiative Wisconsin Institute for Discovery  
*Developed and taught curriculum on complex systems for middle school students in coordination with the Discovery Outreach Center*
- 2013** Lecturer at Humanities Hackathon at Wisconsin Institute for Discovery  
*A weeklong course about using R for the digital humanities*
- 2012** Volunteer physics tutor at Princeton High School  
*After school help sessions with students in physics*
- Media**
- 2023** Conflict research covered in BBC Newsday, *Salzburger Nachrichten*, Sabine Hossenfelder's Youtube channel  
*Science without the gobbledygook*
- 2021** Conflict research cited in Bloomberg Opinion by Niall Ferguson  
"Cascading Conflicts: What is the Science of Violence?"  
Santa Fe Council on Int'l Relations  
*Panelist in conversation moderated by policy analyst Rachel Kleinfeld*
- 2020** Swing voter work covered by Cornell Chronicle and SFI Press



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- 2019** Conflict research covered by [Cornell Chronicle](#)
- 2018** Conflict research covered in [Cosmos Magazine](#)  
Supreme Court paper covered in the [Cornell Chronicle](#)  
and [Ars Technica](#)
- 2014** Supreme Court paper covered in *Wired*

### **Mentees**

- 2021-2023** Niraj Kushwaha, PhD student, *University of Vienna & CSH*
- 2023** Ernesto Ortega, *CSH postdoc*  
Gavin Rees, *Post-baccalaureate intern, IST Austria*  
Victor Odouard, *Post-baccalaureate intern, Santa Fe Institute*
- 2021-2022** Fabian Windbacher, *Masters' student, Technical University Vienna*
- 2022** Anna Eaton, *Undergraduate intern, Princeton*
- 2021** Ashwin Kumar, *World Bank undergraduate intern, Cambridge University*  
Alfian Tjandra, *World Bank undergraduate intern, Harvard University*