

2020-2023
Postdoc review
Daniel Ari Friedman
September 25, 2023



Roadmap

.0 – Background & Context

.1 – Working Areas

- a. Biology
- b. Entomology
- c. Active Inference
- d. Cognitive Security
- e. Meta-Science
- f. Philosophy & Arts



.2 – Review, Livechats & Onwards

Background & Context

.0





2014

July 2019 Oct. 2020

Oct. 2023

????????????

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National  
Science  
Foundation

## Integrative Research Investigating the Rules of Life Governing Interactions Between Genomes, Environment and Phenotypes

Through this Competitive Area, BIO aims to stimulate creative integration of diverse subdisciplines of biology using combinations of observational, experimental, theoretical, and computational approaches to discover underlying principles operating across hierarchical levels of life, from biomolecules to organisms to ecosystems. Research activities under this Competitive Area should lead to new understanding of how higher-order structures and functions of biological systems result from the interactions of heterogeneous biological components, as shaped by the environment and evolutionary processes furthering predictive capability of how key properties and mechanisms of living systems emerge from the interactions of genomes, environments, and phenotypes.

NSF: 2010290 - October 2020 to October 2023  
Postdoctoral Research Fellowships in Biology (PRFB)

## Insects as/and Complex Biological Systems & Broader Impacts

This action funds an NSF Postdoctoral Research Fellowship in Biology for FY 2020, Integrative Research Investigating the Rules of Life Governing Interactions Between Genomes, Environment and Phenotypes. The fellowship supports research and training of the Fellow that will contribute to the area of Rules of Life in innovative ways. This research investigates the ecology and evolution of the Hymenoptera, the order of insects containing species such as ants, bees, wasps, and sawflies. The work contributes to our scientific understanding of how genetics, epigenetics, behavior, and ecology are related over developmental and ecological time scales, in the context of a well-studied and biodiverse clade of insects. This project addresses fundamental questions in biology including: How did colony living (eusociality) arise in ants and bees from their solitary ancestors? How do colony traits originate and become elaborate? How are the hormonal and neurobiological underpinnings of colony traits linked to genetic and ecological variation among species? How might these insights from eusocial colony evolution help humans design resilient distributed systems, for example to respond to disasters, manage socially-spread pathogens, and improve the security of cyberphysical systems? The Fellow will also actively engage in science communication, mentoring, and outreach programs, with a special emphasis on local underserved communities, team-based remote education, and transdisciplinary approaches such as Complexity Science.

Eusocial (colony-living) insect species display variation within populations and among species in ecologically-important colony traits such as behavior (e.g. collective foraging, search, offense/defense) and reproductive strategies. Tissue-specific gene expression patterns can influence colony traits such as collective behavior in a non-linear fashion through altering colony-level physiological processes. Previous approaches to studying the evolution of eusocial insect colony traits have been of limited phylogenetic scope, have not considered the role of tissue-specific gene expression in colony-level physiological processes, or only considered genes with single-copy orthologs present in all species considered. This project will integrate multiple biological techniques (phylogenomics, transcriptomics, chemical profiling, ecological niche modeling) to investigate the evolutionary and functional roles of lineage-specific genes, complex gene families, and tissue-specific expression patterns in Hymenoptera. More broadly, the theoretical models and bioinformatic pipelines developed in this research will generalize far beyond the Hymenoptera, and provide avenues for integrative synthesis across taxa. The Fellow will be co-trained by Prof. Brian Johnson (University of California, Davis) and Prof. Tim Linksvayer (University of Pennsylvania), and will work to increase participation, inclusion, reproducibility, and transparency in science.

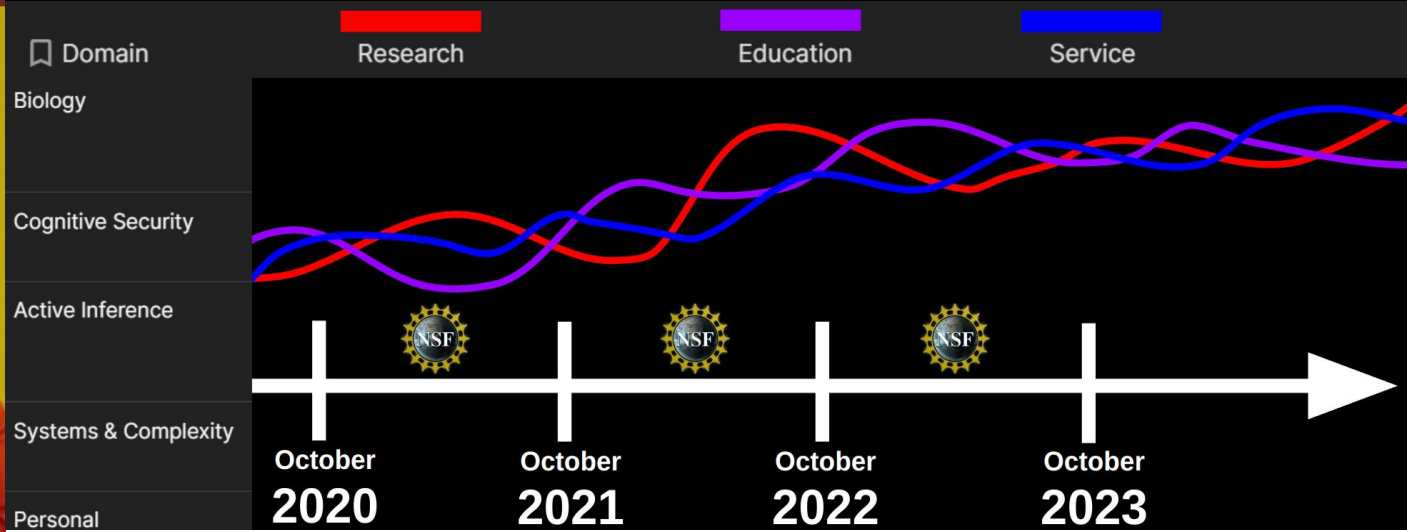
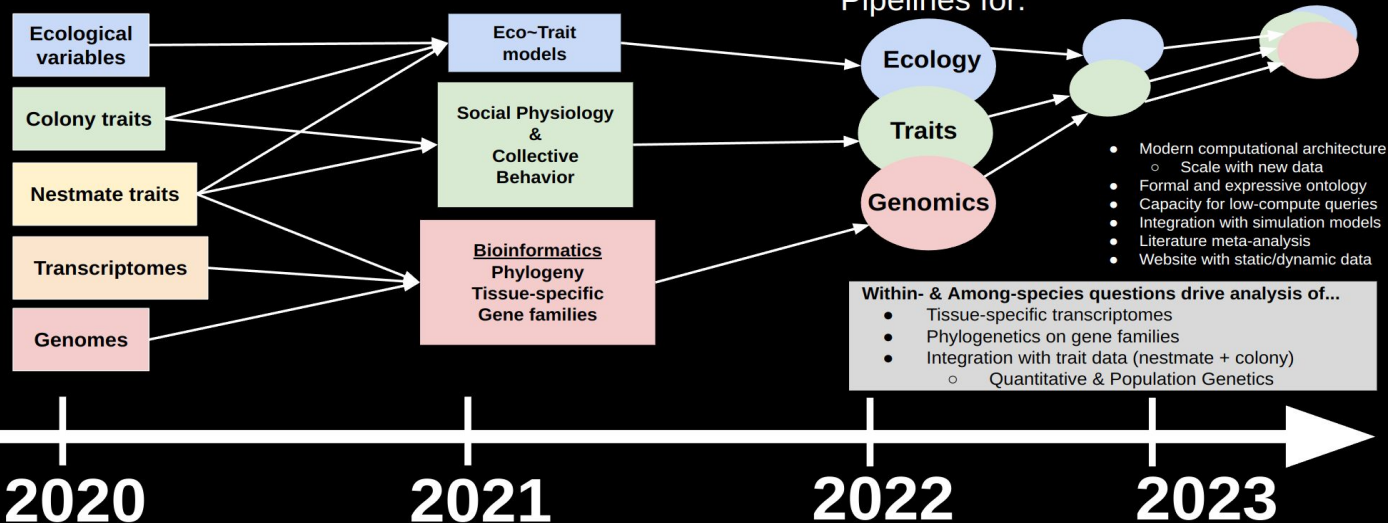


Prof. Brian  
Johnson



Prof. Tim  
Linksvayer









# 1 Working Areas

Not covered in this stream:

- Things I've forgotten
- Works in progress or review
- Private, Secret, & Silent work
- Local Davis engagements & activities

Working Areas

~# of  
works  
20-23



Biology

1



Entomology

5



Active  
Inference

12



COGSEC

22



Meta-Science

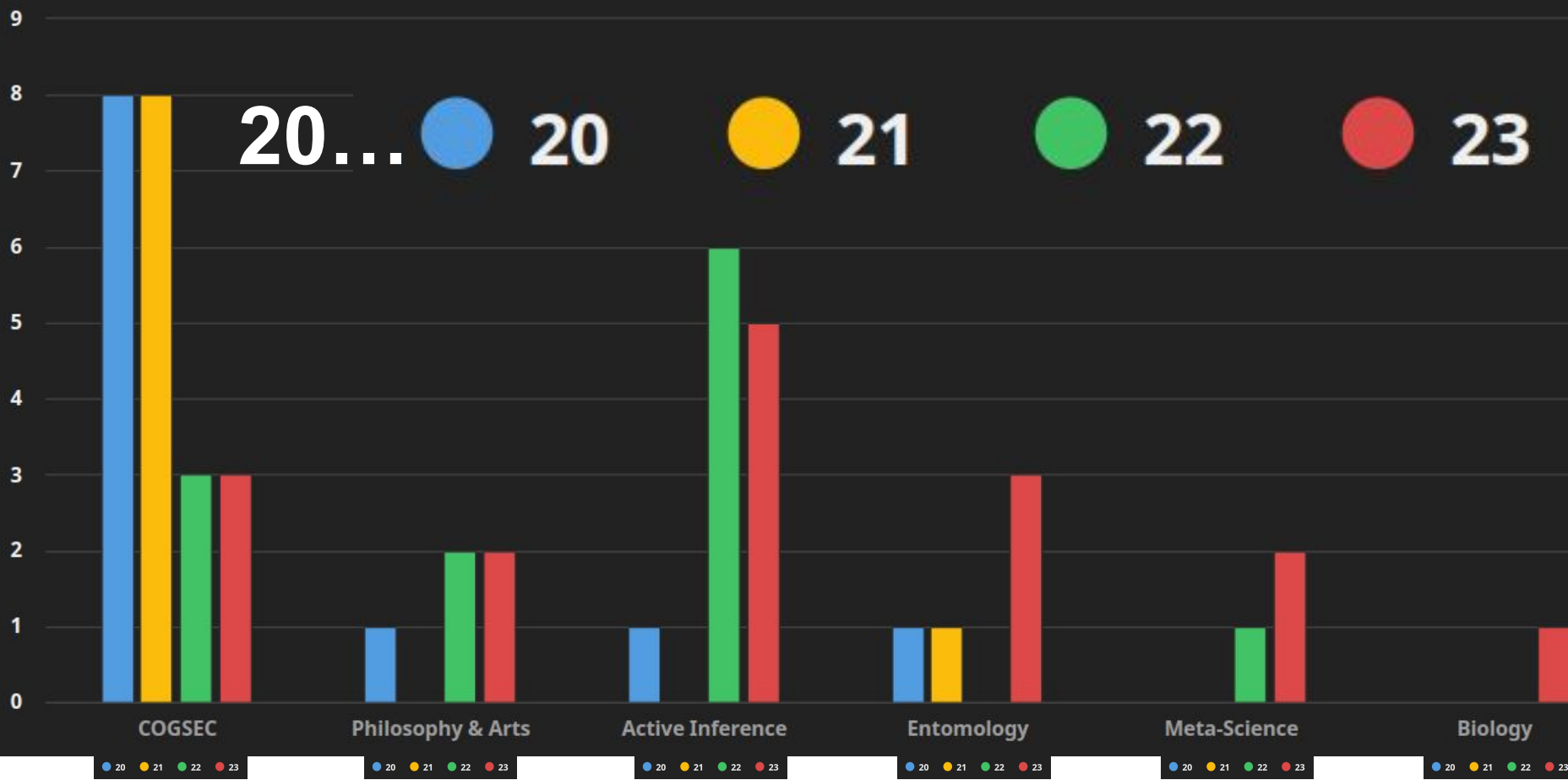
3



Philosophy &  
Arts

5

# # of publications by year per Working Area





# CognitiveSecurity.us

For this presentation, I used GPT4 via Perplexity.ai to upload each paper and ask the following prompt

-----  
*Please deeply analyze the attached paper and do all needed background research in order to be a professional expert in the area. Then, output 3 semantically-crystalline paragraphs of 2-6 sentence which to a human reader will elegantly convey the paper's:*

- *CONTEXT (the broader background of the work, which does not mention the paper's contribution/approach at all)*
- *CONTRIBUTIONS (specifically what the paper uniquely did, developed, and introduced)*
- *IMPLICATIONS (the causal consequences of the paper in our complex world, and directions for future work and research).*

-----

The next part of this stream will be over at the Coda website <https://cognitivesecurity.us/>

I will quickly describe each of the works carried out and how it related to the primary Working Area.

You can pause the video to read the GPT4 Context, Contributions, Implications, which I will scroll over.

You can visit the website and click the Perplexity link to “continue the conversation” and interact with the work!

Following the overview section, I will cover 10 highlights.  
The highlights are sorted by working area, not relevance.



# Biology

A scenic view of a river flowing through a forested area. The river is calm, reflecting the surrounding greenery and trees. The banks are covered in dense vegetation, including tall grasses and shrubs. In the foreground, there are some wooden posts or stakes driven into the ground near the water's edge. The overall atmosphere is peaceful and natural.

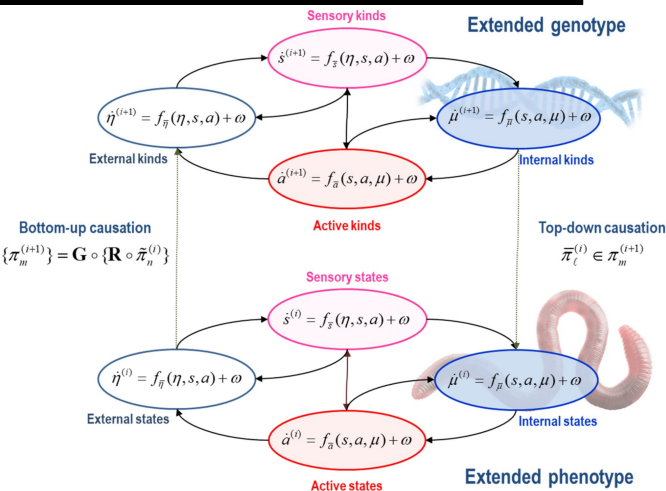


# A Variational Synthesis of Evolutionary and Developmental Dynamics

<https://www.mdpi.com/1099-4300/25/7/964>

Karl Friston, Daniel A. Friedman, Axel Constant, V. Bleu Knight, Chris Fields, Thomas Parr, and John O. Campbell  
*Entropy*

2023



- Foundational work that provides a multiscale analytic framework based upon Active Inference & the Free Energy Principle.
- Reflecting discourse with the authors and others in ActInf Ecosystem since 2017, and setting directions for some time to come!

Figure 2. Schematic showing the hierarchical relationship between particles at scales  $i$  and  $i + 1$ .

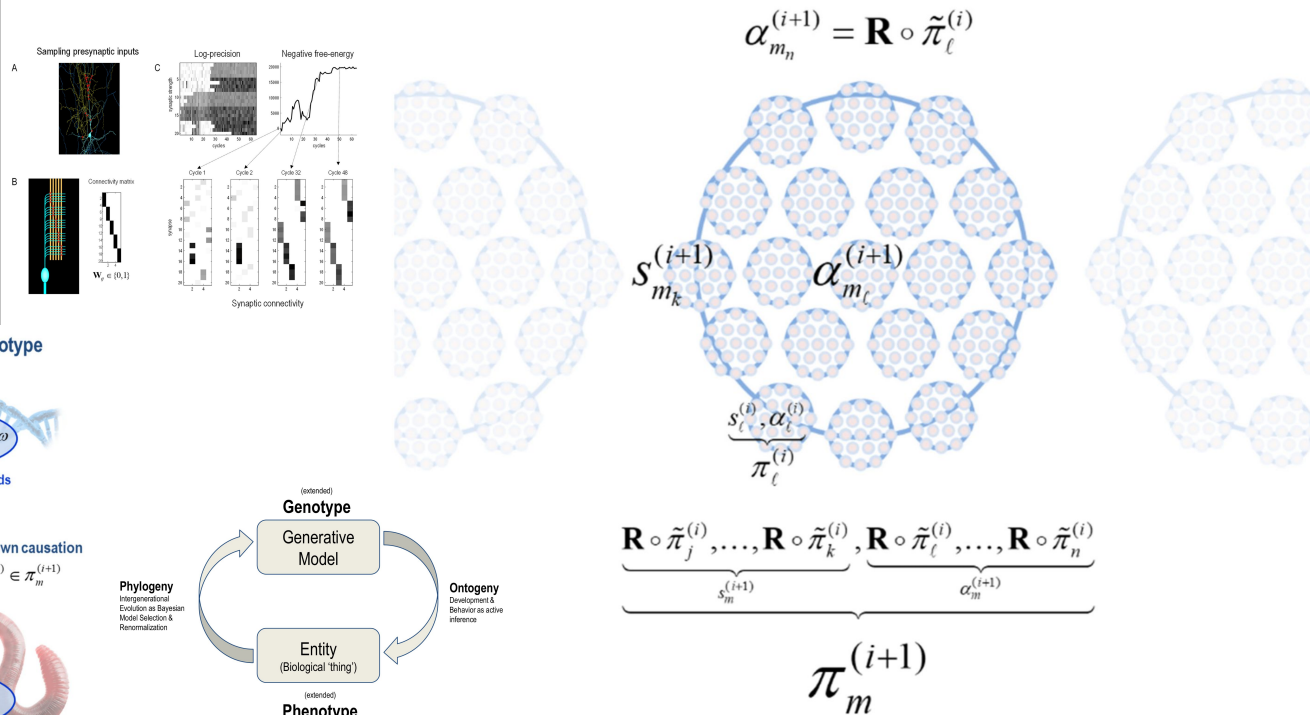


Figure 1. Schematic (i.e., influence diagram) illustrating the sparse coupling among states that constitute a particular partition at two scales.

A single-phormone model accounts for empirical patterns of ant colony foraging previously modeled using two pheromones

Eric Saund<sup>a</sup>, Daniel Ari Friedman<sup>b,c</sup>

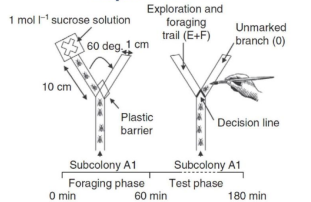
A single-phormone model accounts for empirical patterns of ant colony foraging previously modeled using two pheromones

<https://www.sciencedirect.com/science/article/pii/S1389041723000207>

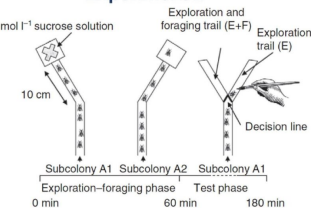
Eric Saund, Daniel Ari Friedman  
Cognitive Systems Research

2023

### Experiment 1

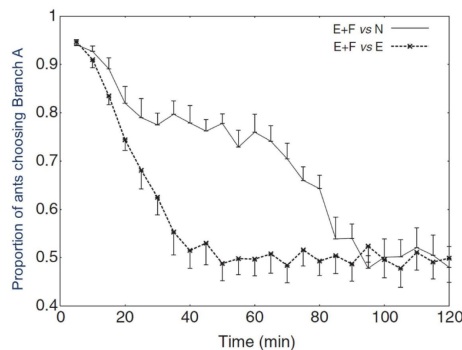


### Experiment 2



a

### Dussotour's experiment



b

- Big headed ants (*Pheidole megacephala*) are able to forage in a Y-maze for food.
- Previously, investigators modeled *P. megacephala* with a two-phormone model.
- We account for empirical results of *P. megacephala* foraging with a one-phormone model.
- Our one-phormone model recapitulates key patterns and is biologically plausible.
- This work demonstrates principles of sensory-cognitive modeling and ant foraging.

Fig. 3. Proposed phormone measurement function  $M$  is a power-law amplification of the raw phormone level  $ph$ , subtracting a small base level noise factor,  $B$ .

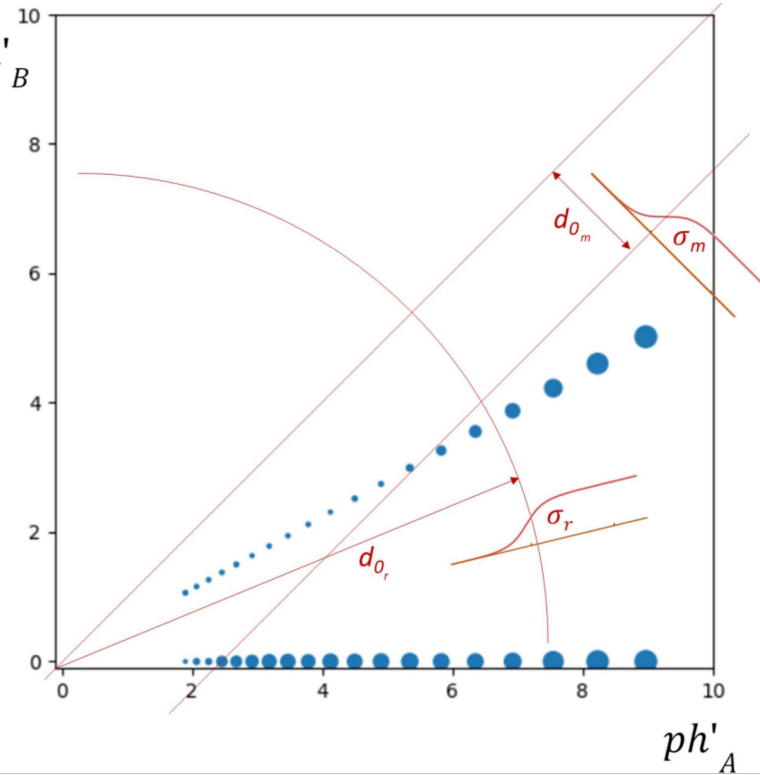
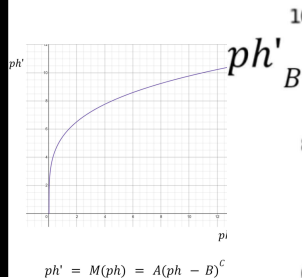


Fig. 5. Modeling the branch preference function as a product of sigmoid squashing functions.

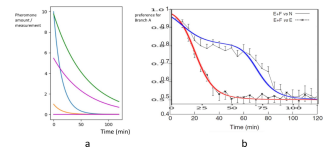


Fig. 6. a. Simulated trajectories of phormone amounts and measurements under the one-phormone model.



# Active Inference





# Active Inference: An Active Inference Framework for Ant Colony Behavior

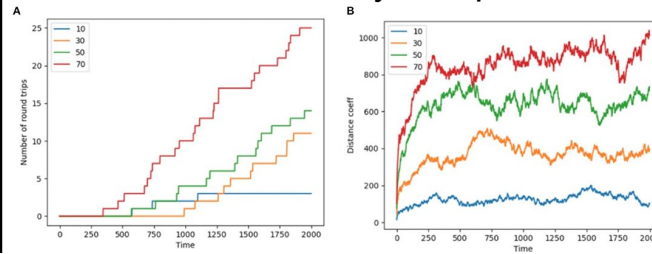
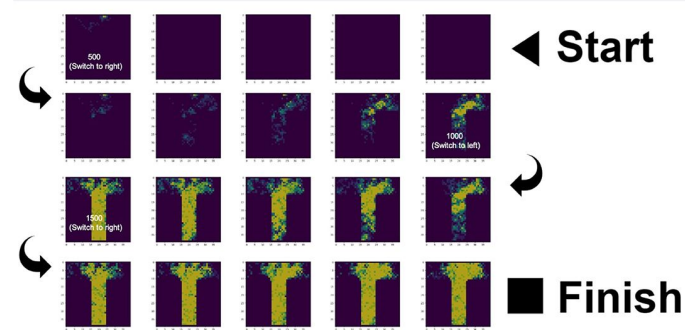
Daniel Ari Friedman<sup>1,2</sup>, Alec Tschantz<sup>1,4</sup>, Maxwell J. D. Ramstead<sup>1,4,5</sup>, Karl Friston<sup>2</sup>, Axel Constant<sup>1\*</sup>

## Active Inference: An Active Inference Framework for Ant Colony Behavior <https://www.frontiersin.org/articles/10.3389/fnbeh.2021.647732/full>

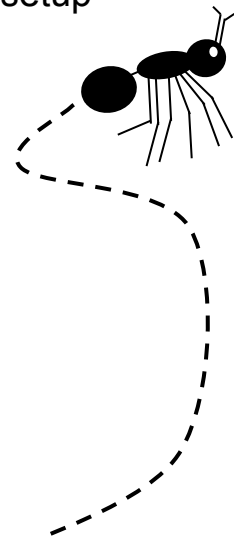
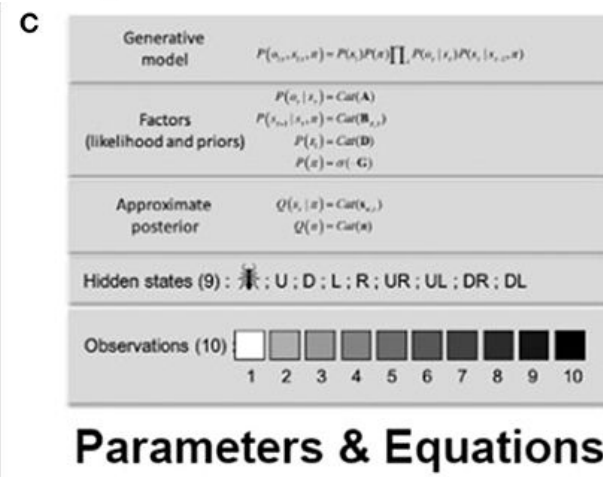
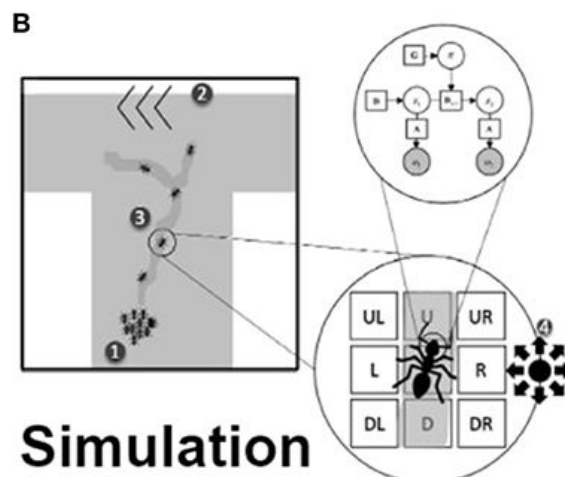
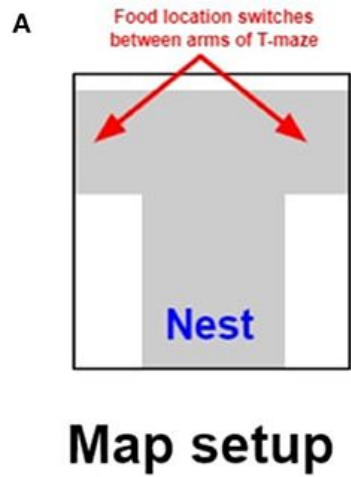
Daniel Ari Friedman, Alec Tschantz, Maxwell J. D. Ramstead, Karl Friston, Axel Constant  
*Front. Behav. Neurosci.*

2021

- First Active Inference model of stigmergic collective behavior
- Sets up extensible framework for studying the diversity of Ant behaviors; foraging and beyond
- Early pre-pymdp collaboration that could already be updated



- Above – Pheromone dynamics
- Left – Collective phenotypes
- Bottom – Generative model and T-maze simulation setup

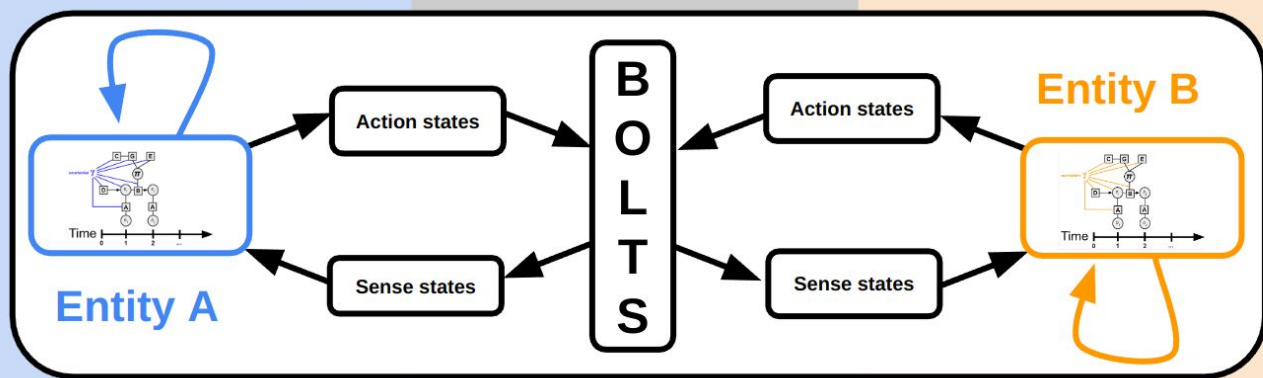
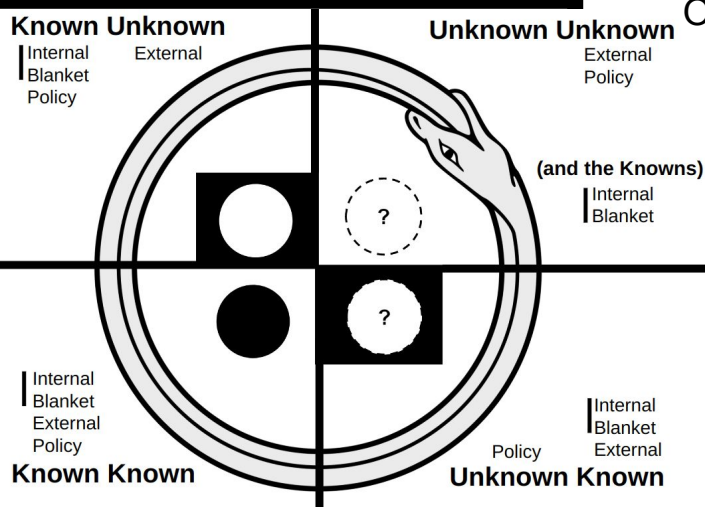




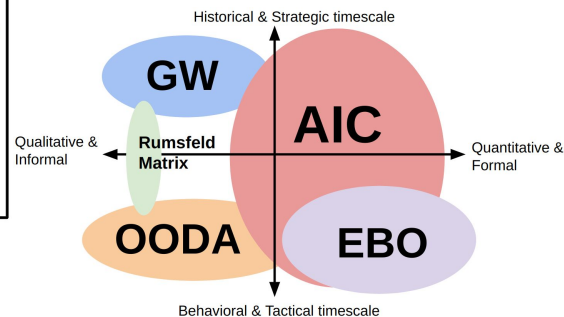
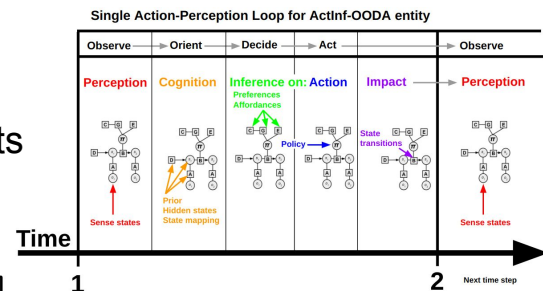
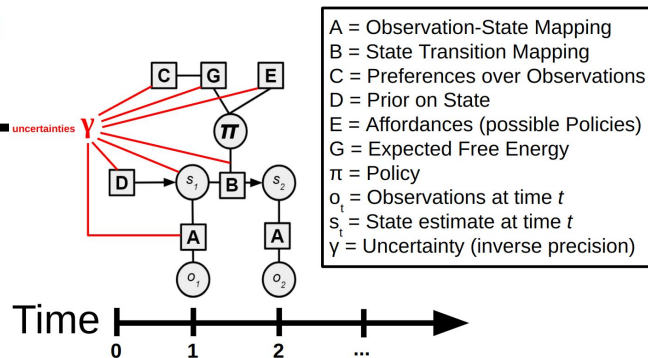
<https://zenodo.org/record/5759807>

Scott David, Richard J. Cordes, Daniel A. Friedman  
*Zenodo*

# 2021



- Application of Active Inference to multiscale conflict/cooperation settings
- Foundation of further work on CogSec, OODA, (inter)organizational developments
  - BOLTS (Business, Operational, Legal, Technical, and Social)



# The Active Inference Institute and Active Inference Ecosystem

Active Inference Institute; Aguirre, Ander; Boik, John; Burian, Libor; Brown, Matthew; Cordes, RJ; David, Scott; Douglass, David S; Fernandez-Maqueira, Pablo; Friedman, Daniel A; Grimm, Holly; Guénin–Carlut, Avel; Iennaco, Maria Luiza; Knight, V Bleu; Mikhailova, Alexandra; Rahmjoo, Ali; Razi, Adeel; Smékal, Jakub; Tamari, Ronen; Tickle, Dean; Vyatkin, Alex

This document briefly surveys the current state of the Active Inference Institute and Active Inference Ecosystem, and outlines our future directions. It will be versioned as a living representation (both cyclic and updating) of ecosystems both general and local, describing the past, present, and future actions of the Active Inference Institute.

## The Active Inference Institute and Active Inference Ecosystem (2023)

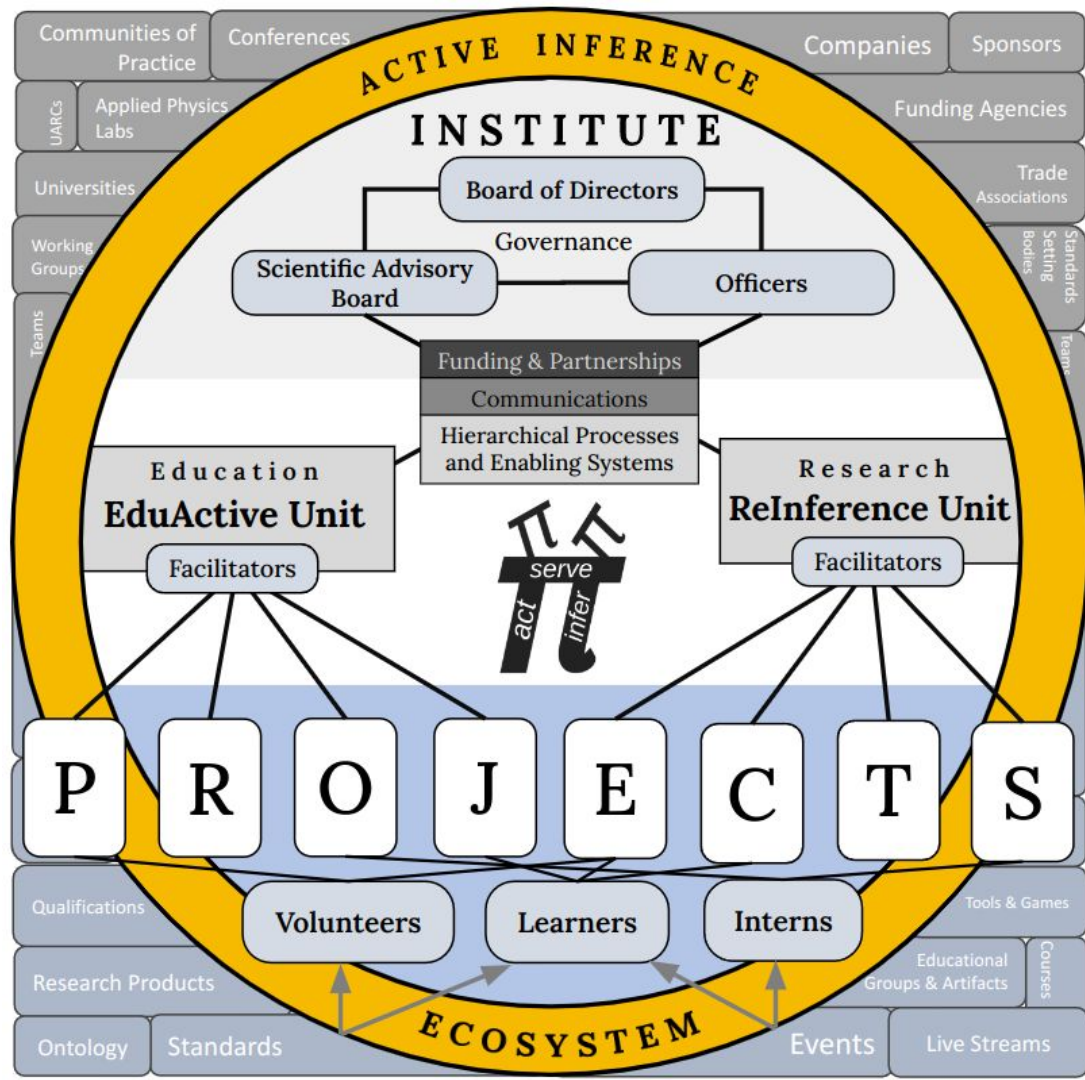
<https://zenodo.org/record/8266281>

Active Inference Institute; Aguirre, Ander; Boik, John; Burian, Libor; Brown, Matthew; Cordes, RJ; David, Scott; Douglass, David S; Fernandez-Maqueira, Pablo; Friedman, Daniel A; Grimm, Holly; Guénin–Carlut, Avel; Iennaco, Maria Luiza; Knight, V Bleu; Mikhailova, Alexandra; Rahmjoo, Ali; Razi, Adeel; Smékal, Jakub; Tamari, Ronen; Tickle, Dean; Vyatkin, Alex

[375+ livestreams on Active Inference](#) 2020-2023 along with transcripts at the [Active Inference Journal](#)

# 2020-2023

~30 Interns, SAB, BoD, and so many other nestmates!

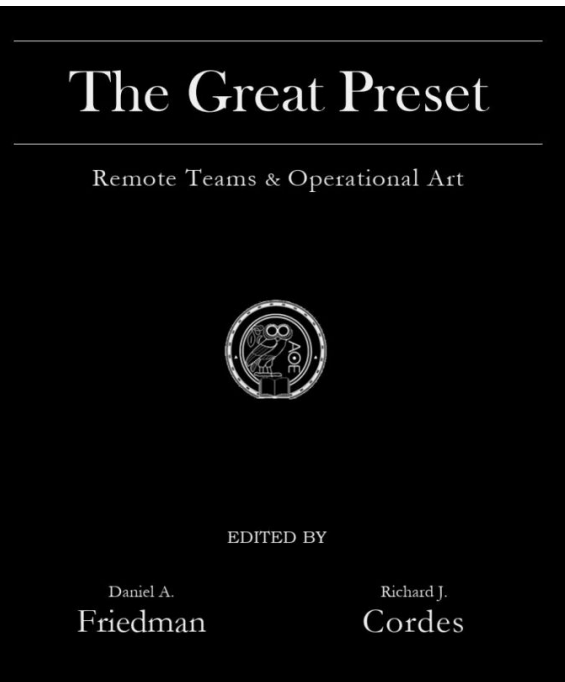




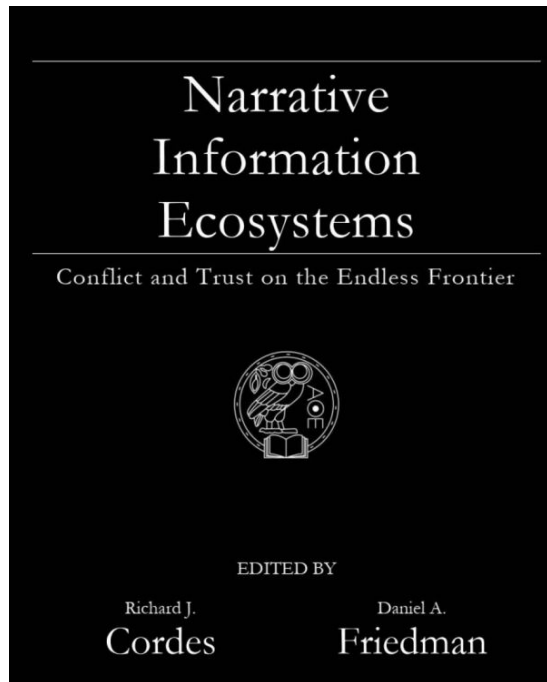
# Cognitive Security



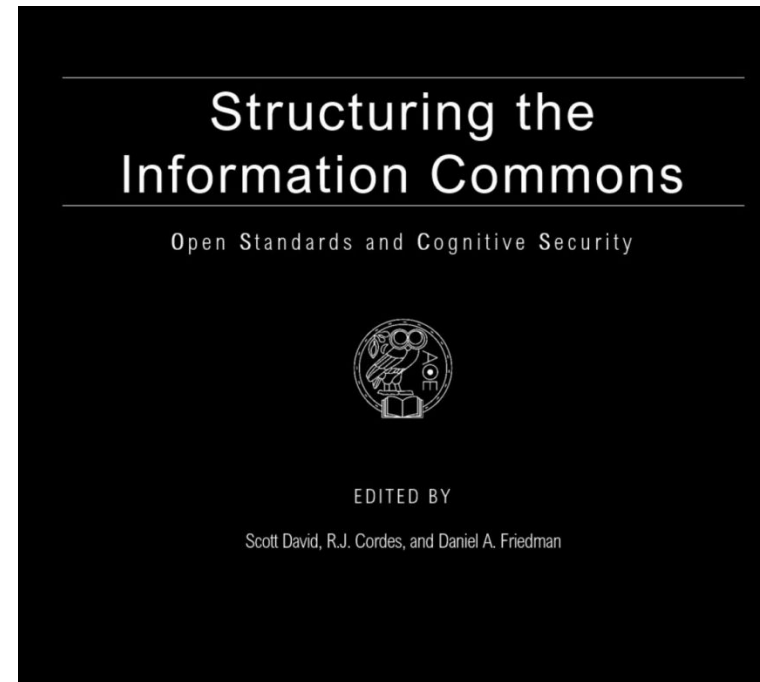
# 2020



# 2021



# 2022



## COGSEC books 2020-2022

[cogsec.org/research-initiatives-3](https://cogsec.org/research-initiatives-3)

Ongoing initiative in 2023: ATLAS



COGNITIVE SECURITY  
& EDUCATION FORUM

**RJ Cordes**

<https://coda.io/@aien/rj-cordes>





2021



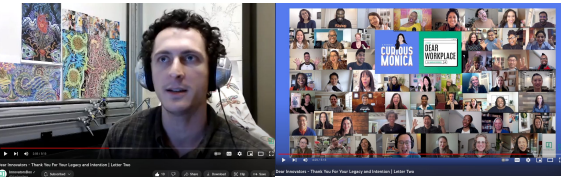
Monica Kang

[innovatorsbox.com](https://innovatorsbox.com)

Rethink Creativity & Rethink Facilitation

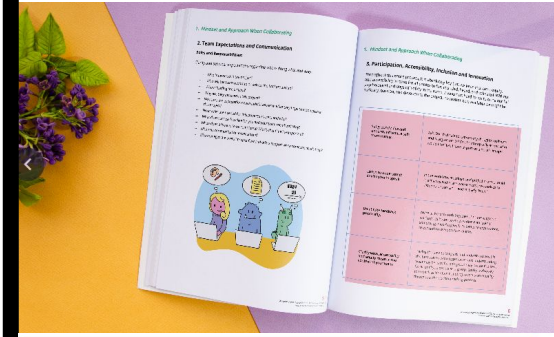


<https://www.youtube.com/watch?v=salltiaml3a3a>



<https://www.youtube.com/watch?v=4f4rrMZ-Wyo>

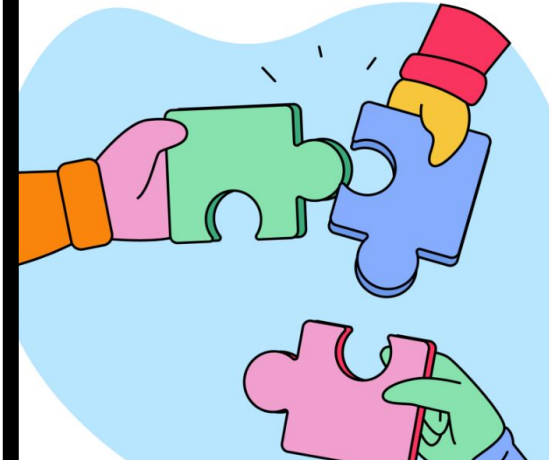
# Innovator's Digital Playbook



## 1. Setting norms and communication expectations as a team

What does success on this project look like to you?  
What is your preferred way of being in touch? Why?  
When would you prefer not to be interrupted?  
When is usually a good time to connect? When isn't?  
What aspects of this project do you feel most confident about? What aspects are you uncertain about?  
How comfortable are you with disagreements and conflicts?  
How do you like to navigate moments of disagreement and clashing opinions?  
Why is it important to reach this deadline and deliver?  
Is there anything else that could help to understand each other's communication style and what we consider our group norm?  
What is the best way to get in touch with you when something is urgent?  
What is your preferred way of getting in touch?

## Worksheets



# Beyond Research





**Exploring Dynamics, Unity and Interactions of Tetrahedrons**  
G. Quaresima, D. Jovanović, S. J. Kim, M. E. H. A.



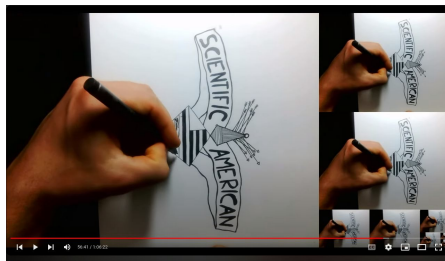
[200+ livestreams on personal channel](#), including [drawings](#), [Synergetics](#), [paper discussion](#) and various other events

Daniel A. Friedman, *YouTube*

# 2023

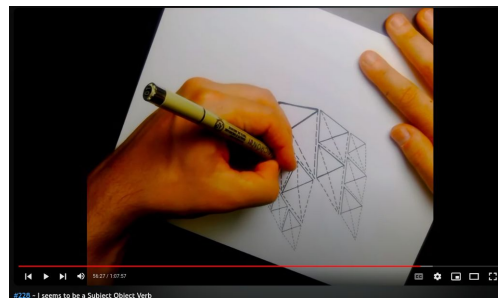
## Context

- Passionate about **Art** (drawing), **Synergetics** (geometry of nature/thinking), **Research**, other areas.

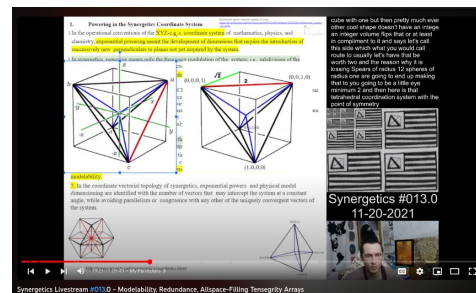


- # Contributions

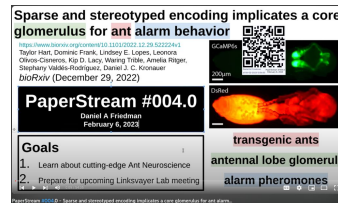
  - 230 total drawing livestreams (~150 during the last 3 years).



- 17 Synergetics streams (all within last 3 years)



- 8 PaperStreams (all within last 3 years)



#225 ~ Department of Expectations and Surprise  
Daniel Ari Friedman • 19 views • Streamed 2 weeks ago



#229 ~ Nothing But Tet  
Daniel Ari Friedman • 24 views • Streamed 1 year ago



#228 ~ I seems to be a Subject Object Verb  
Daniel Ari Friedman • 49 views • Streamed 1 year ago



#227 ~ What Cannot Be Hidden  
Daniel Ari Friedman • 44 views • Streamed 1 year ago



#226 ~ Of Expectations & Preferences  
Daniel Ari Friedman • 37 views • Streamed 1 year ago



#225 ~ The Untrampled Vintage  
Daniel Ari Friedman • 7 views • Streamed 1 year ago



#224 ~ Good Old Sunday Morning  
Daniel Ari Friedman • 11 views • Streamed 1 year ago



#223 ~ System of Interest  
Daniel Ari Friedman • No views • Streamed 1 year ago



#222 ~ This One is Three Times Two  
Daniel Ari Friedman • 6 views • Streamed 1 year ago



#221 ~The Renormalization Group  
Daniel Ari Friedman • 25 views • Streamed 1 year ago

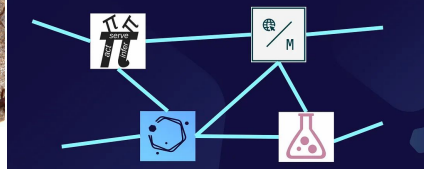


#220 ~ Ten Ten Two Twenty  
Daniel Ari Friedman • 15 views • Streamed 1 year ago





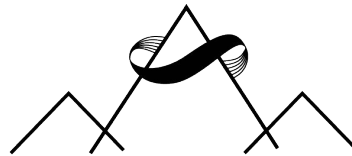
The mostly-unnamed colony



block.  
science/

Kernel Community  
[kernel.community/en/](https://kernel.community/en/)

Thanks  
Jason, Sid,  
and others for  
DeSchool!



[complexityadventures.com/](https://complexityadventures.com/)

**Complexity Adventures**

*Online Community of Practice*



International Society for the Systems Sciences

<https://www.iss.org/home/>

Education  
Knowledge Engineering



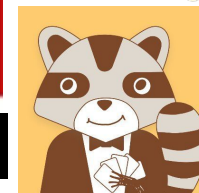
<https://www.aliusresearch.org/>

Interdisciplinary research group  
on the diversity of consciousness

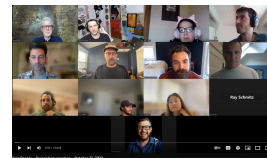
**Remotor Consulting**

**Common  
Sense[makers]**

Ronen, Shahar, William,  
Lauren, Brad, Charles et al.



curio.  
cards



StigPeople

**Apoideas**  
Tucker et al.

 **CYBERNETICS SOCIETY**



**IPA**  
INFORMATION  
PROFESSIONALS  
ASSOCIATION

[Information-  
professionals.org/](https://information-professionals.org/)





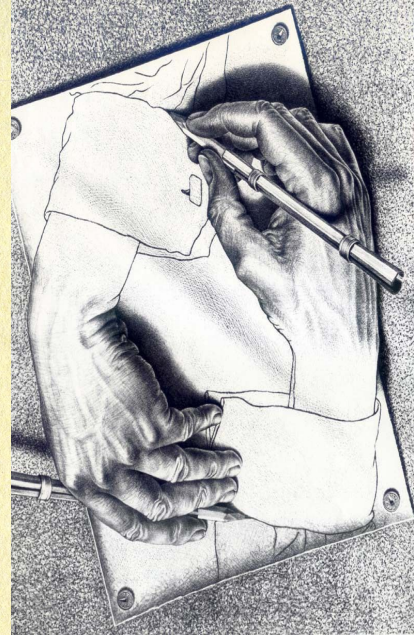
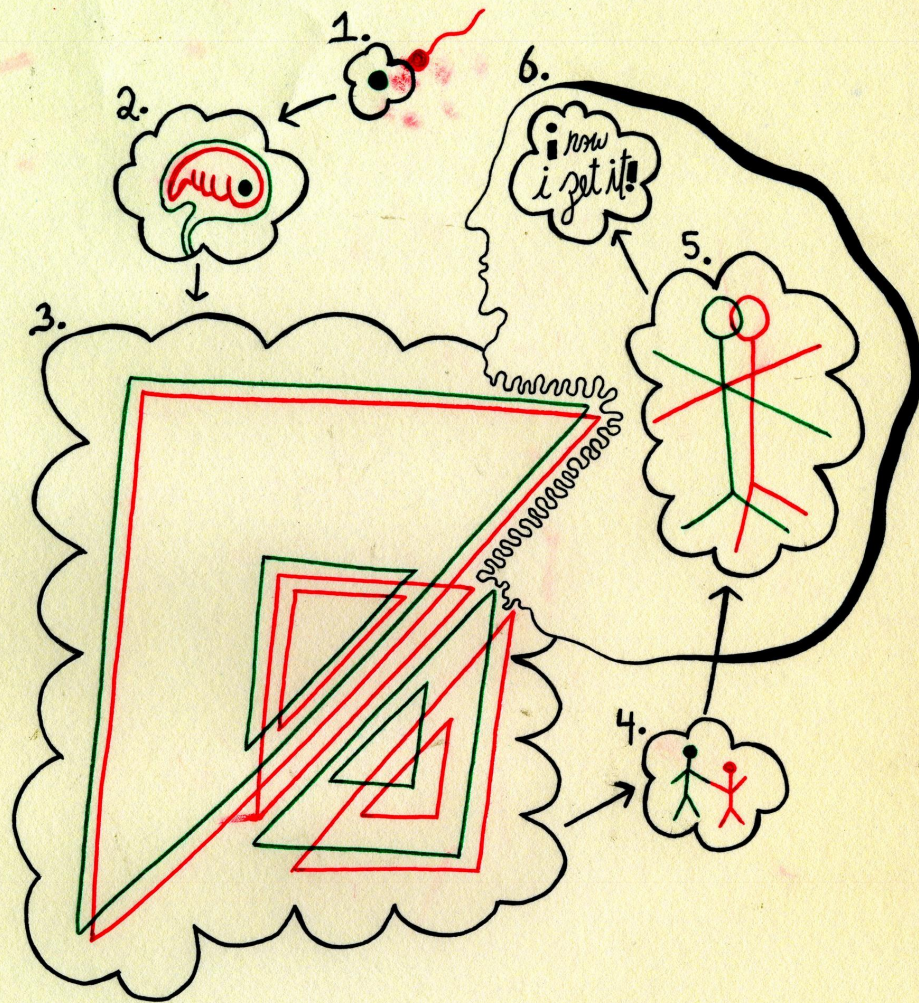
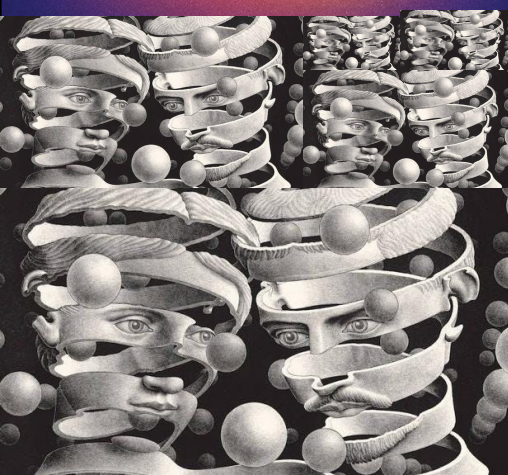
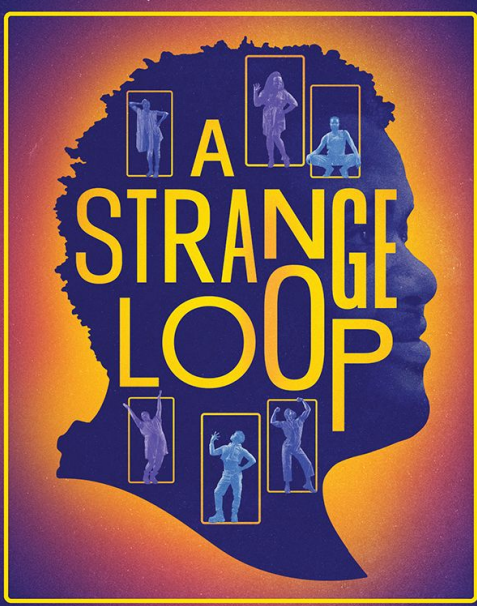
# .2

# Review, Livechats & Onwards

If you are watching live, please add any comments/questions in the livechat & I will try to address everything I can.







STRANGE  
LOOP



DOUGLAS  
HOFSTADTER

AUTHOR OF GÖDEL, ESCHER, BACH





- Continued thanks to Family, Friends, Nestmates, the Niche, and Beyond
- Every day was an opportunity, honor, blessing, and journey.
- I acknowledge contributions of so many over the years.
- I am & will be active in:
  - Research
  - Education
  - Service
- People can get involved with the listed open source projects and communities
- Get in touch with questions, comments, and offers. I expect and prefer to be your advocate, ally, & colleague.
- Read between and among the lines (Quantum Active Inference) && Unity is plural and at minimum two.
- There is much more to come! It is a rising and not a setting sun.



# ***Onwards!***