

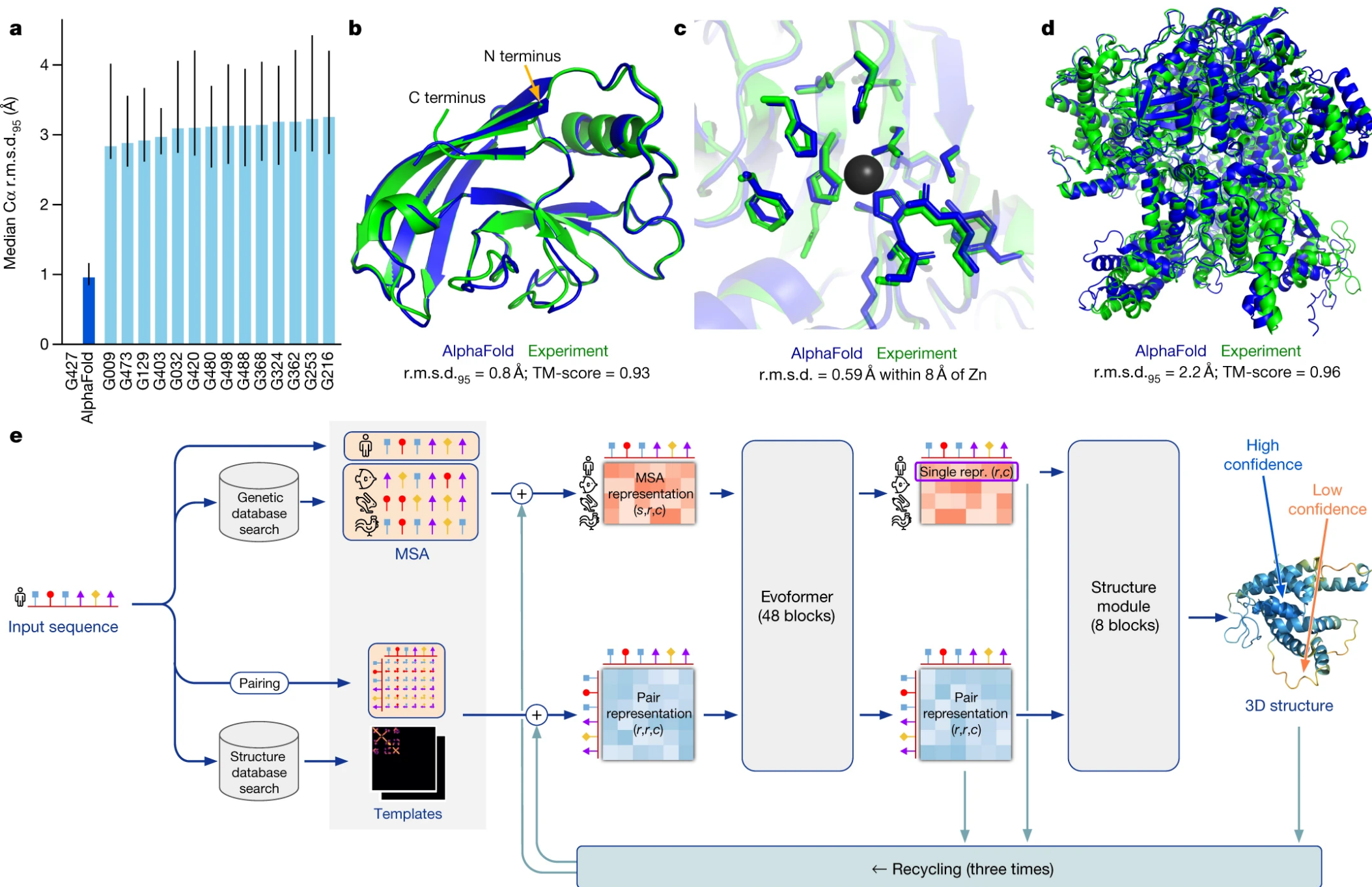
IDEAL OBJECTS

AI, ABSTRACTION, AND THE NATURE OF CULTURE

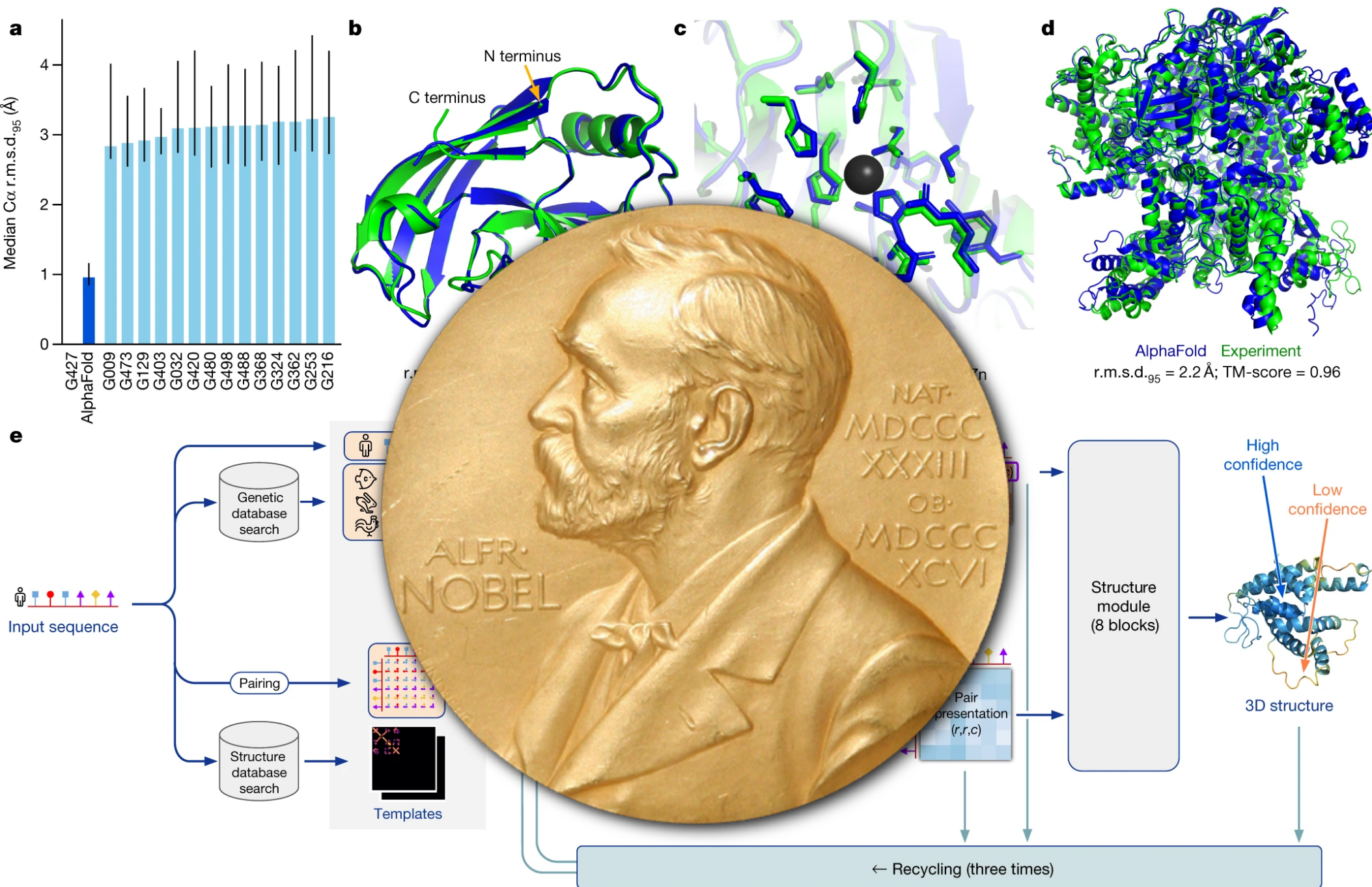


from *Planetary*

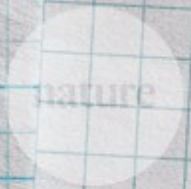
Jacob G. Foster, Indiana University
External Professor, Santa Fe Institute



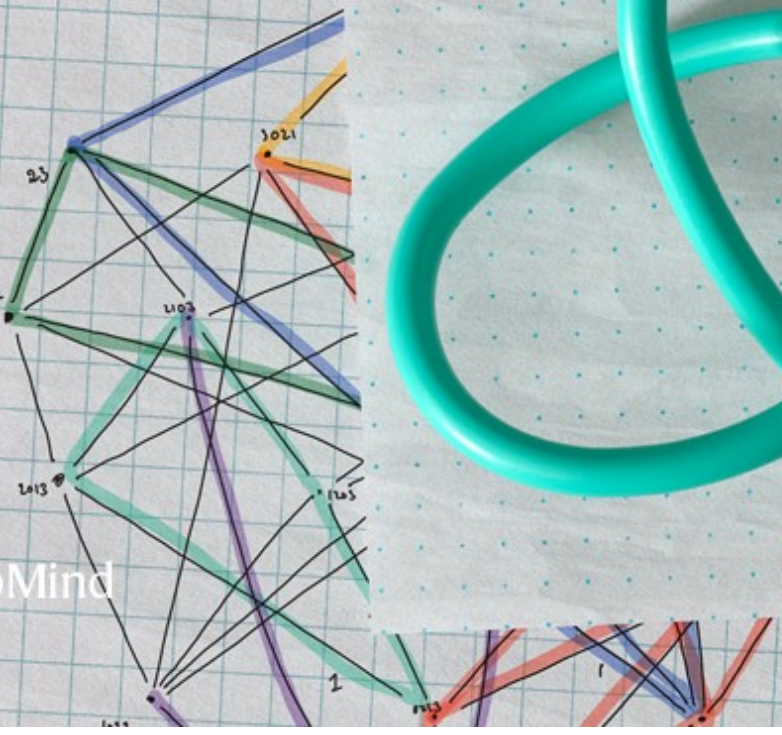
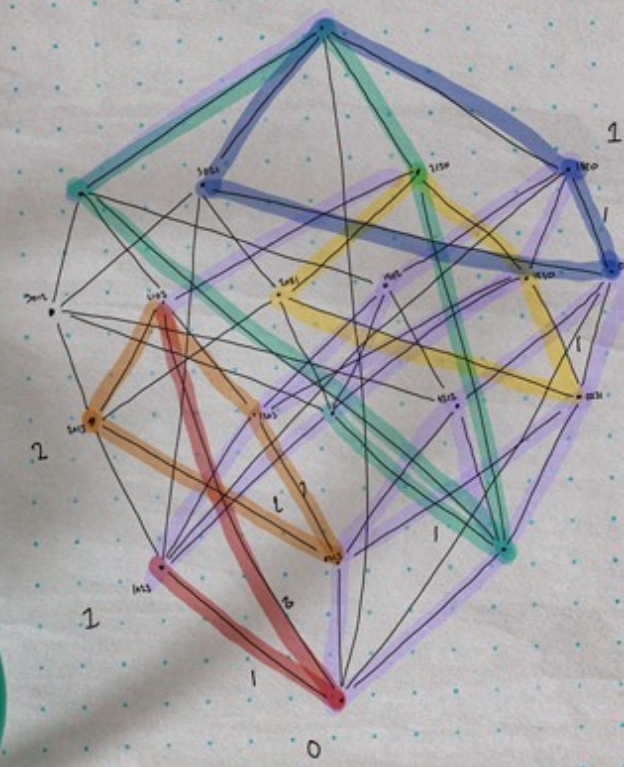
Jumper et al., 2021



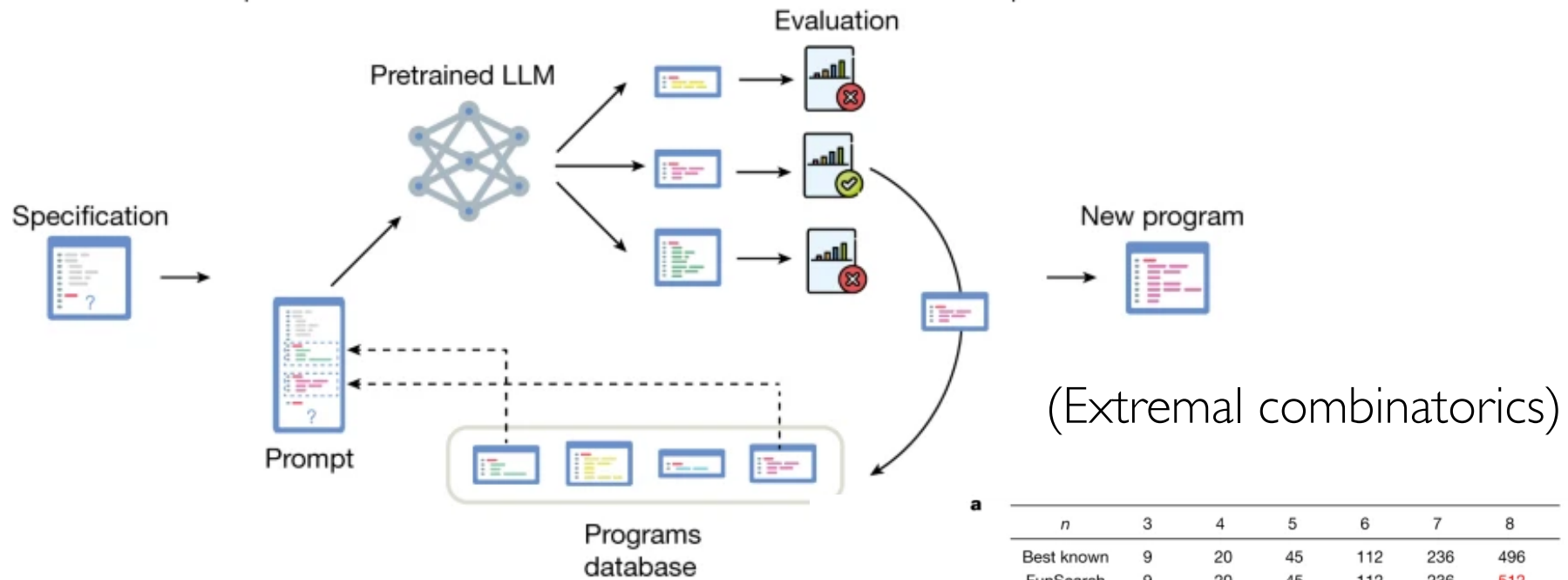
Jumper et al., 2021



DeepMind



FunSearch



a

| n | 3 | 4 | 5 | 6 | 7 | 8 |
|------------|---|----|----|-----|-----|-----|
| Best known | 9 | 20 | 45 | 112 | 236 | 496 |
| FunSearch | 9 | 20 | 45 | 112 | 236 | 512 |

b

```
def priority(el: tuple[int, ...],
            n: int) -> float:
    score = n
    in_el = 0
    el_count = el.count(0)

    if el_count == 0:
        score += n*2
        if el[1] == el[-1]:
            score *= 1.5
        if el[2] == el[-2]:
            score *= 1.5
        if el[3] == el[-3]:
            score *= 1.5
    else:
        if el[1] == el[-1]:
            score *= 0.5
        if el[2] == el[-2]:
            score *= 0.5

    for e in el:
        if e == 0:
            if in_el == 0:
                score *= n * 0.5
            elif in_el == el_count - 1:
                score *= 0.5
            else:
                score *= n * 0.5 ** in_el
            in_el += 1
        else:
            score += 1

    if el[1] == el[-1]:
        score *= 1.5
    if el[2] == el[-2]:
        score *= 1.5

    return score
```

c

```
def build_512_cap() -> list[tuple[int, ...]]:
    """Returns a cap set of size 512 in 'n=8' dimensions."""
    n = 8
    V = np.array(list(itertools.product(range(3), repeat=n)), dtype=np.int32)
    support = lambda v: tuple(i for i in range(n) if v[i] != 0)
    reflections = lambda v: sum(1 for i in range(1, n//2) if v[i] == v[-i])

    # Add all 128 weight-8 vectors that have >= 2 reflections.
    weight8_vectors = [v for v in V
                       if np.count_nonzero(v) == 8 # Weight is 8.
                       and reflections(v) >= 2] # At least 2 reflections.

    # Add all 128 weight-4 vectors that have specific support.
    supports_16 = [(0, 1, 2, 3), (0, 1, 2, 5), (0, 3, 6, 7), (0, 5, 6, 7),
                  (1, 3, 4, 6), (1, 4, 5, 6), (2, 3, 4, 7), (2, 4, 5, 7)]
    weight4_vectors = [v for v in V
                       if support(v) in supports_16]

    # Add all 128 weight-4 vectors with specific support and 1 reflection.
    supports_8 = [(0, 1, 2, 7), (0, 1, 2, 6), (0, 1, 3, 7), (0, 1, 6, 7),
                  (0, 1, 5, 7), (0, 2, 3, 6), (0, 2, 6, 7), (0, 2, 5, 6),
                  (1, 2, 4, 7), (1, 2, 4, 6), (1, 3, 4, 7), (1, 4, 6, 7),
                  (1, 4, 5, 7), (2, 3, 4, 6), (2, 4, 6, 7), (2, 4, 5, 6)]
    weight4_vectors_2 = [v for v in V
                        if support(v) in supports_8
                        and reflections(v) == 1] # Exactly 1 reflection.

    # Add 128 weight-5 vectors with <= 1 reflections and one more condition.
    allowed_zeros = [(0, 4, 7), (0, 2, 4), (0, 1, 4), (0, 4, 6),
                    (1, 2, 6), (2, 6, 7), (1, 2, 7), (1, 6, 7)]
    weight5_vectors = [
        v for v in V
        if tuple(i for i in range(n) if v[i] == 0) in allowed_zeros
        and reflections(v) <= 1 # At most 1 reflection.
        and (v[1] * v[7] % 3 != 1 and (v[2] * v[6] % 3 != 1)]

    return weight8_vectors + weight4_vectors + weight4_vectors_2 +
        weight5_vectors
```

Romera-Paredes et al., 2023



Different kinds of creativity

Different kinds of creativity

Margaret Boden



Different kinds of creativity

- Exploratory
- Combinatorial
- Transformational

Margaret Boden



Different kinds of creativity

- **Exploratory**
- Combinatorial
- Transformational

Margaret Boden





Different kinds of creativity

- Exploratory
- **Combinatorial**
- Transformational

Margaret Boden





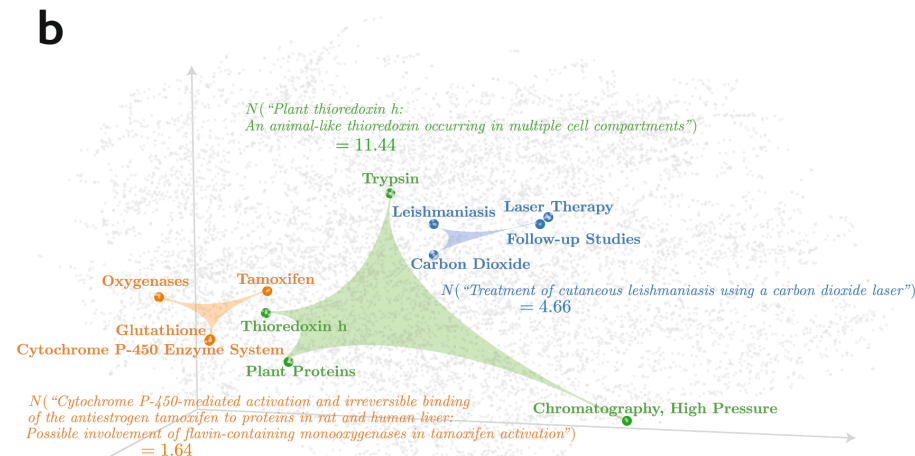
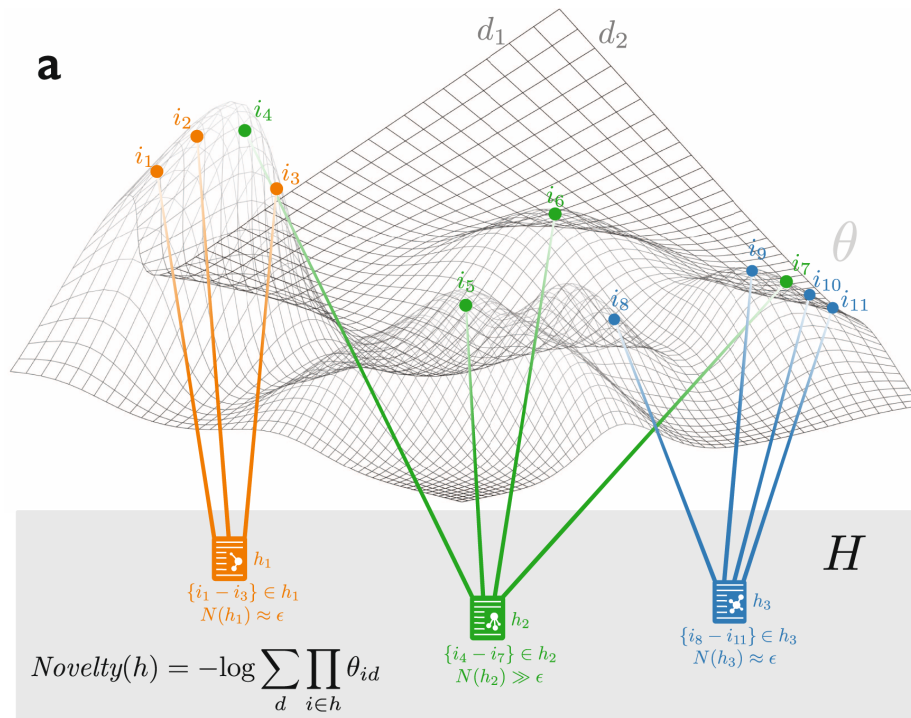
Tradition



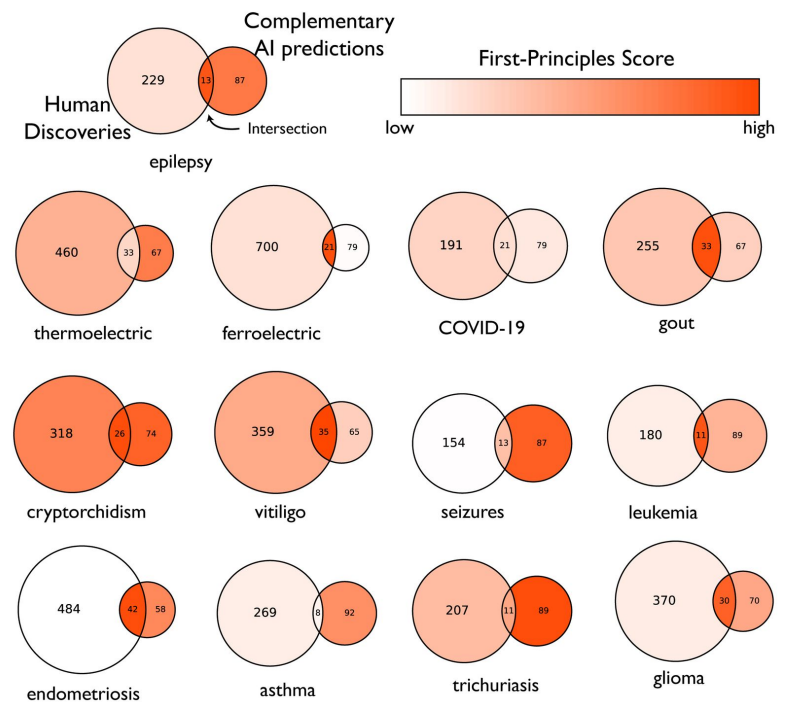
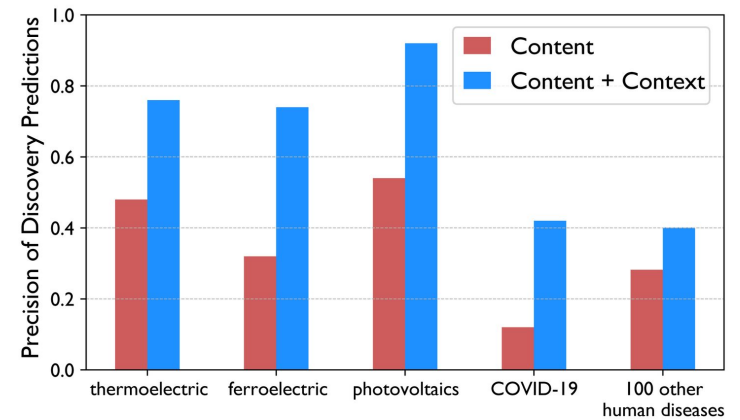
Innovation



Science is predictable

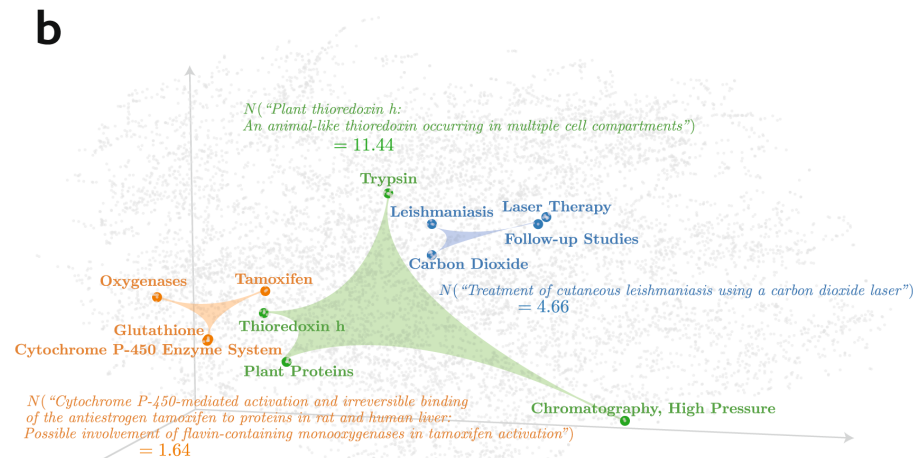
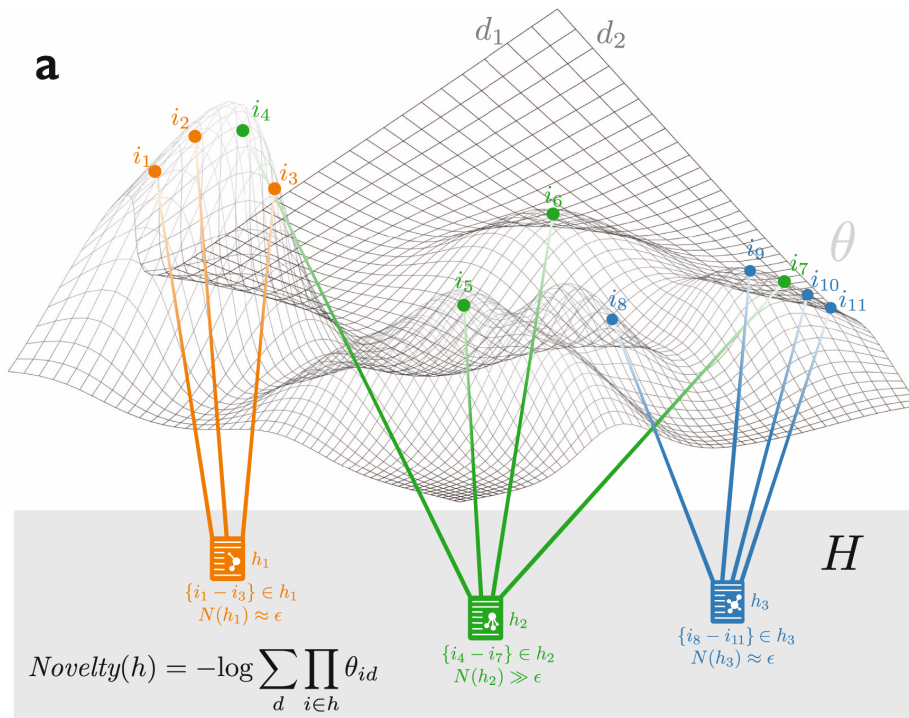


Shi & Evans 2023

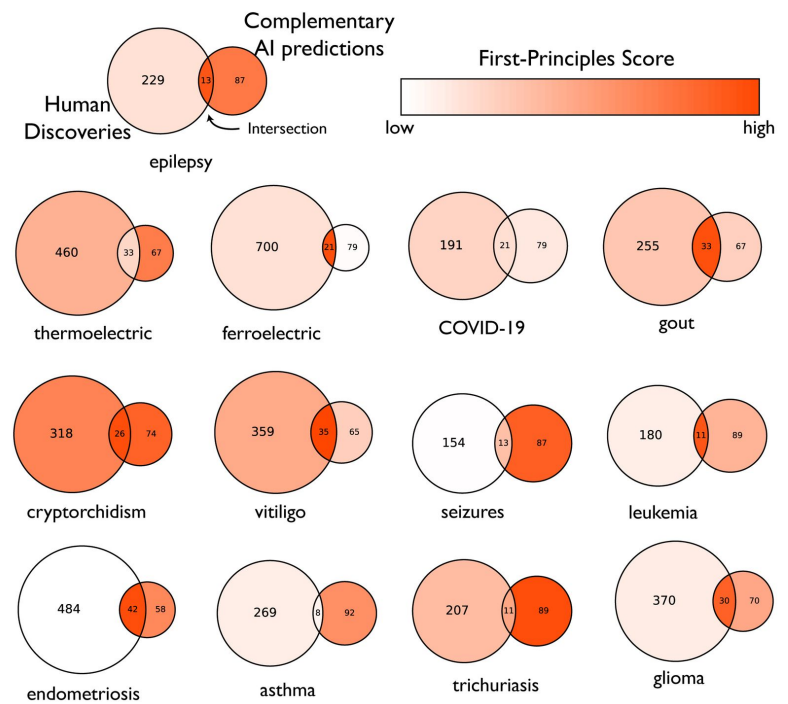
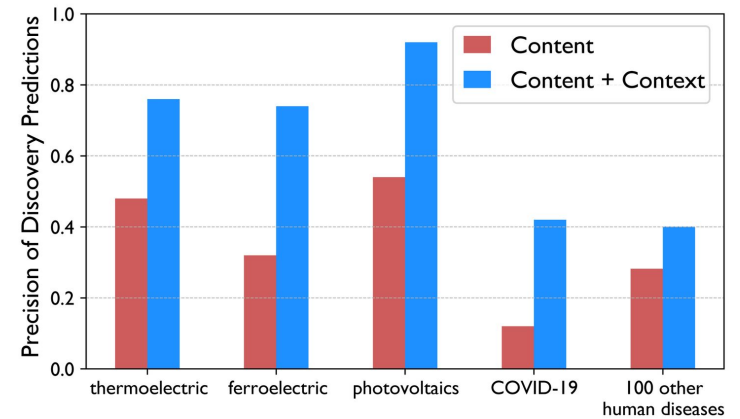


Sourati, Belikov & Evans 2022

AI can exploit this to speed up search



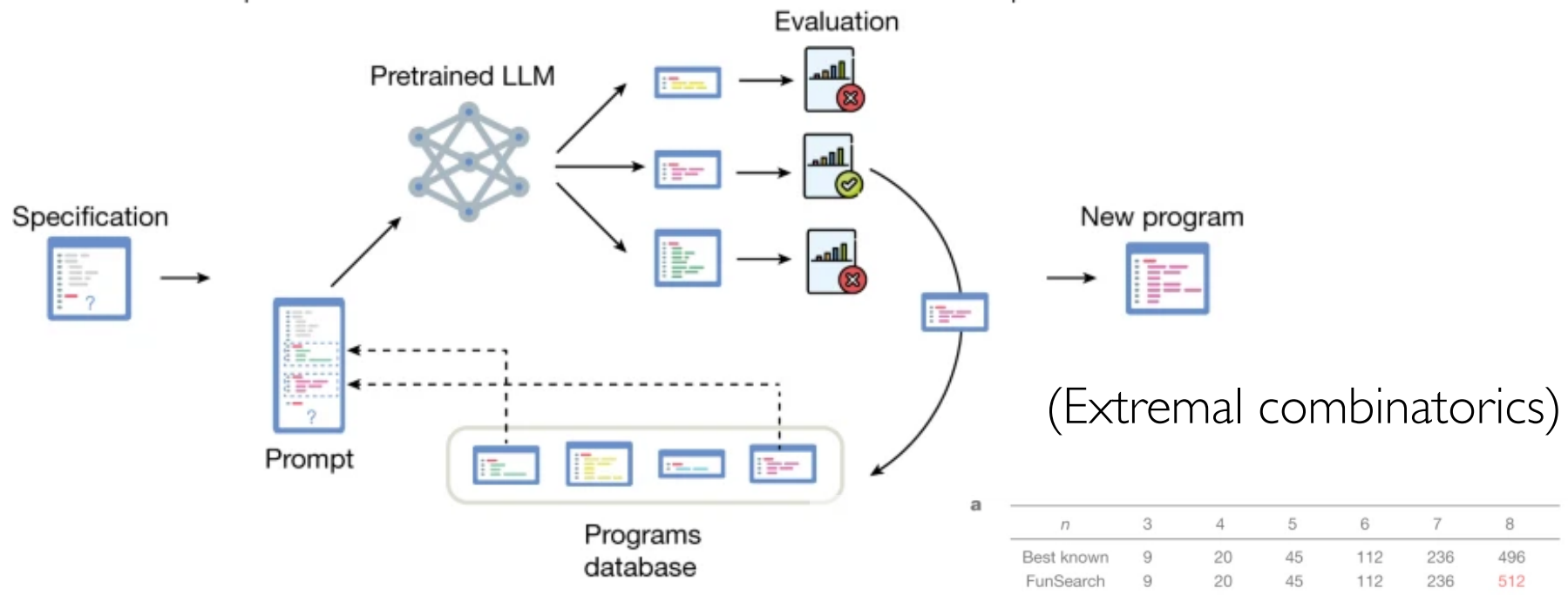
Shi & Evans 2023



Sourati, Belikov & Evans 2022



FunSearch



b

```
def priority(el: tuple[int, ...],
            n: int) -> float:
    score = n
    in_el = 0
    el_count = el.count(0)

    if el_count == 0:
        score += n*2
        if el[1] == el[-1]:
            score *= 1.5
        if el[2] == el[-2]:
            score *= 1.5
        if el[3] == el[-3]:
            score *= 1.5
    else:
        if el[1] == el[-1]:
            score *= 0.5
        if el[2] == el[-2]:
            score *= 0.5
    for e in el:
        if e == 0:
            if in_el == 0:
                score *= n * 0.5
            elif in_el == el_count - 1:
                score *= 0.5
            else:
                score *= n * 0.5 ** in_el
        else:
            score += 1

    if el[1] == el[-1]:
        score *= 1.5
    if el[2] == el[-2]:
        score *= 1.5

    return score
```

c

```
def build_512_cap() -> list[tuple[int, ...]]:
    """Returns a cap set of size 512 in 'n=8' dimensions."""
    n = 8
    V = np.array(list(itertools.product(range(3), repeat=n)), dtype=np.int32)
    support = lambda v: tuple(i for i in range(n) if v[i] != 0)
    reflections = lambda v: sum(1 for i in range(1, n//2) if v[i] == v[-i])

    # Add all 128 weight-8 vectors that have >= 2 reflections.
    weight8_vectors = [v for v in V
                       if np.count_nonzero(v) == 8 # Weight is 8.
                       and reflections(v) >= 2] # At least 2 reflections.

    # Add all 128 weight-4 vectors that have specific support.
    supports_16 = [(1, 2, 3), (0, 1, 2, 5), (0, 3, 6, 7), (0, 5, 6, 7),
                   (1, 3, 4, 6), (1, 4, 5, 6), (2, 3, 4, 6), (2, 4, 5, 7)]
    weight4_vectors_1 = [v for v in V
                        if support(v) in supports_16]

    # Add all 128 weight-4 vectors that have specific support.
    supports_8 = [(1, 5, 7), (0, 1, 7), (0, 2, 7), (0, 3, 7), (0, 4, 7),
                  (1, 2, 4, 7), (2, 3, 4, 6), (1, 3, 4, 7), (1, 4, 6, 7),
                  (1, 4, 5, 7), (2, 3, 4, 6), (2, 4, 6, 7), (2, 4, 5, 6)]
    weight4_vectors_2 = [v for v in V
                        if support(v) in supports_8
                        and reflections(v) == 1] # Exactly 1 reflection.

    # Add 128 weight-5 vectors with <= 1 reflections and one more condition.
    allowed_zeros = [(0, 4, 7), (0, 2, 4), (0, 1, 4), (0, 4, 6),
                     (1, 2, 6), (2, 6, 7), (1, 2, 7), (1, 6, 7)]
    weight5_vectors = [
        v for v in V
        if tuple(i for i in range(n) if v[i] == 0) in allowed_zeros
        and reflections(v) <= 1 # At most 1 reflection.
        and (v[1] * v[7] % 3 != 1 and (v[2] * v[6] % 3 != 1)]

    return weight8_vectors + weight4_vectors + weight4_vectors_2 +
        weight5_vectors
```

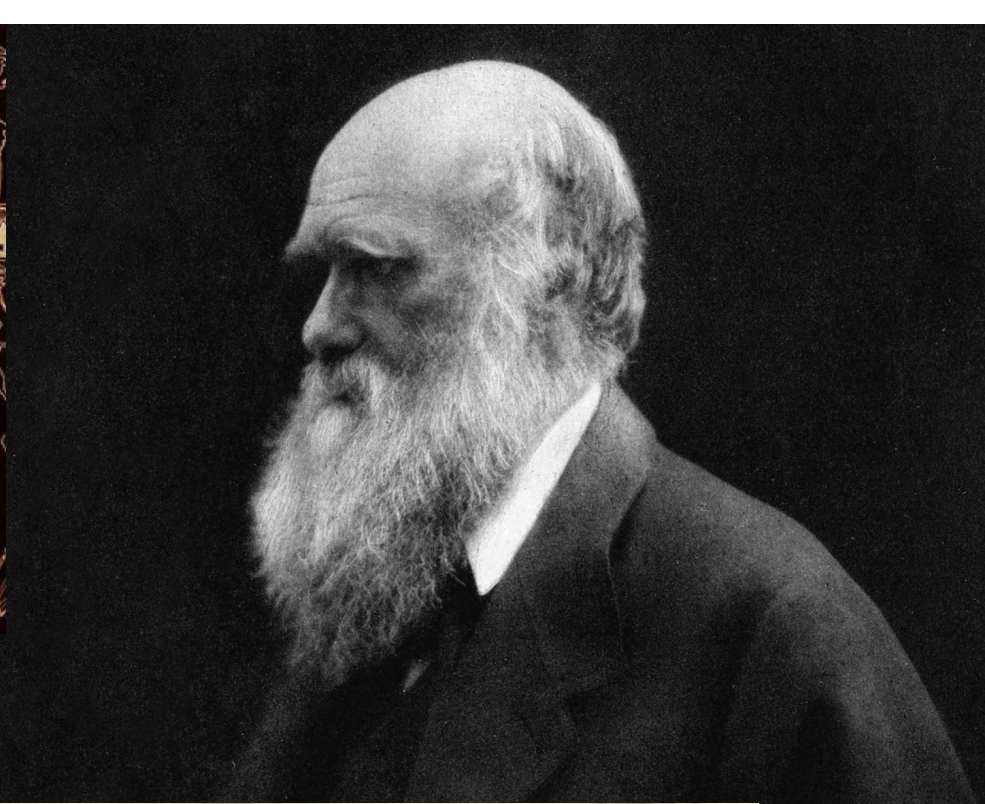
Little illumination

Different kinds of creativity

- Exploratory
- Combinatorial
- **Transformational**

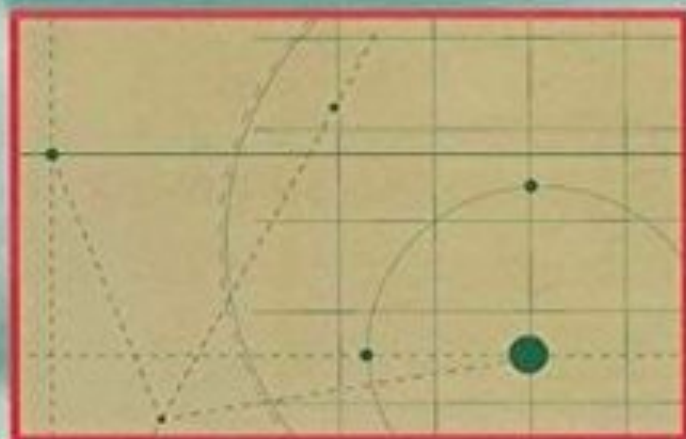
Margaret Boden







Lichtung = *clearing*



Indiscrete

Thoughts

G i a n - C a r l o R o t a

Springer Science+Business Media, LLC



Stan Ulam

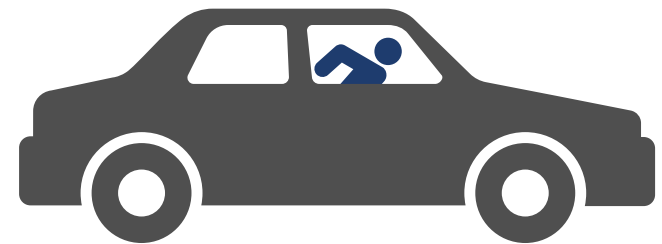
The Barrier of Meaning

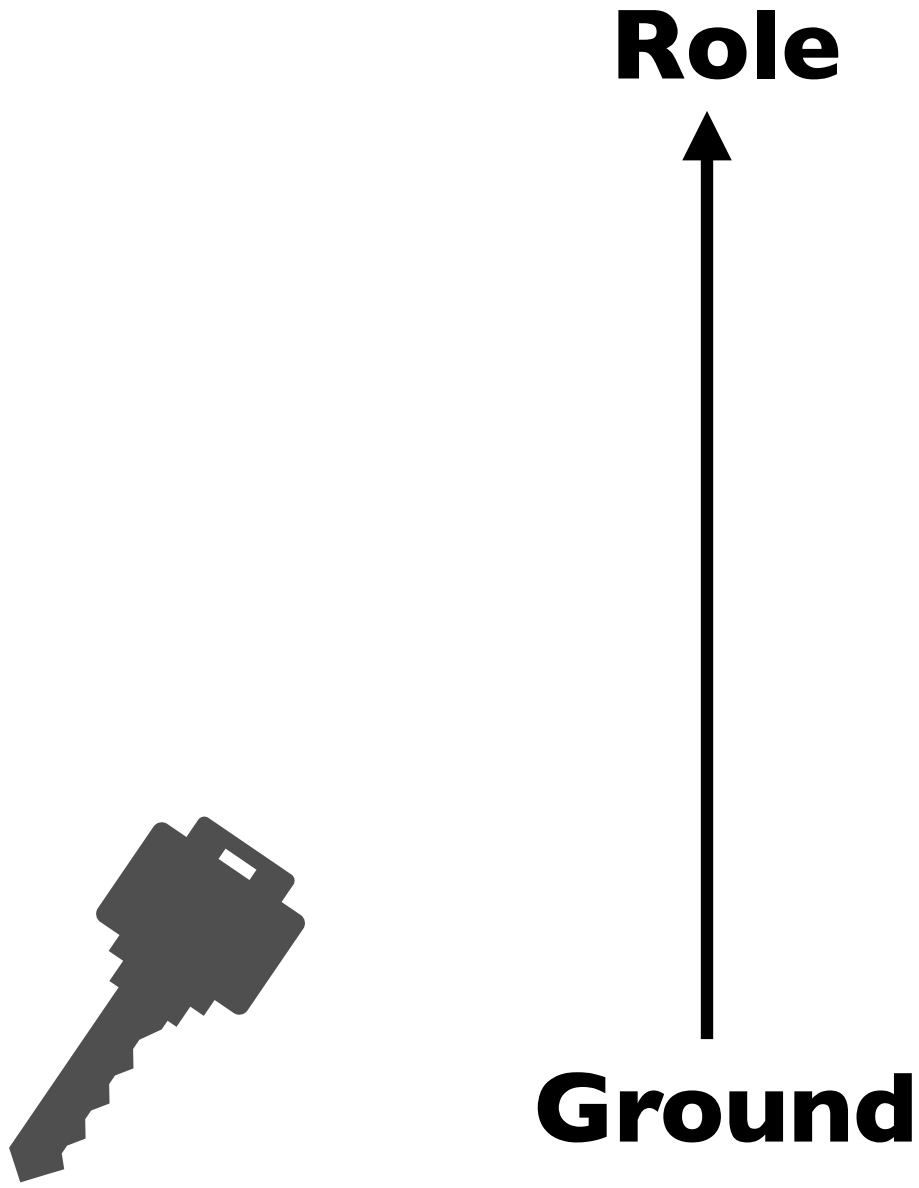


"When you perceive intelligently, as you sometimes do, you always perceive a function, never an object in the set-theoretic or physical sense."

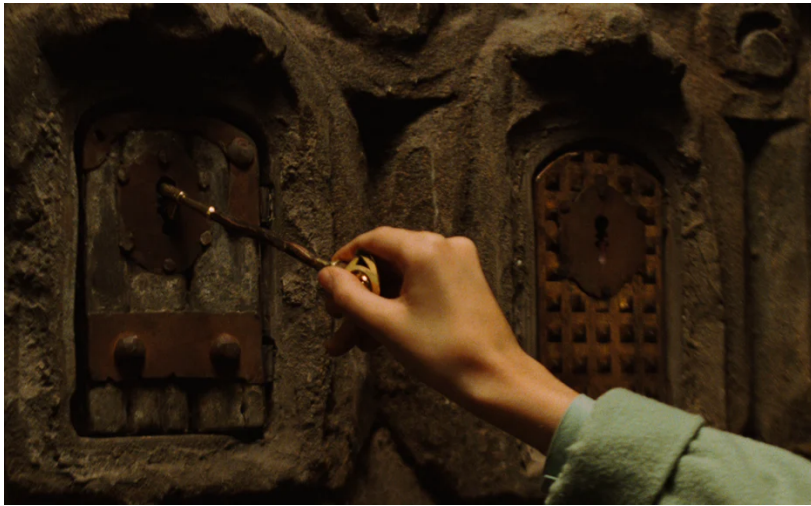
The Barrier of Meaning

“Logic formalizes only very few of the processes by which we think. The time has come to enrich formal logic by adding some other fundamental notions to it. What is it that you see when you see? You see an object as a key, you see a man in a car as a passenger, you see some sheets of paper as a book. **It is the word 'as' that must be mathematically formalized, on a par with the connectives 'and,' 'or,' 'implies,' and 'not' that have already been accepted into a formal logic.** Until you do that, you will not get very far with your A.I. problem.”





G.C. Rota, "Fundierung as a logical concept," *The Monist*, 1989



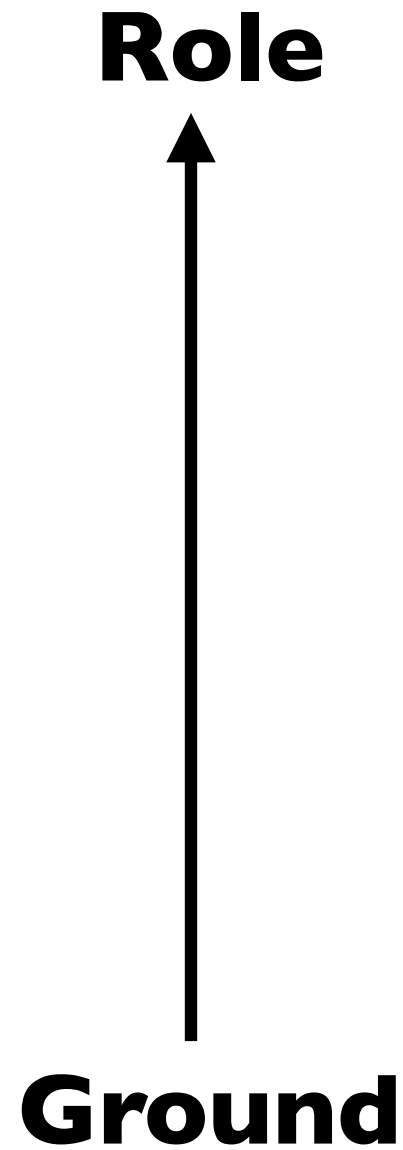
Role



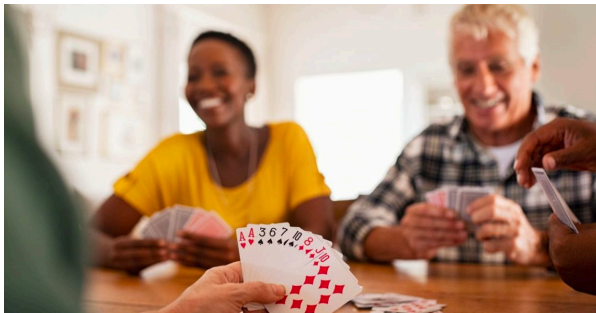
Ground



G.C. Rota, "Fundierung as a logical concept," *The Monist*, 1989



G.C. Rota, "Fundierung as a logical concept," *The Monist*, 1989



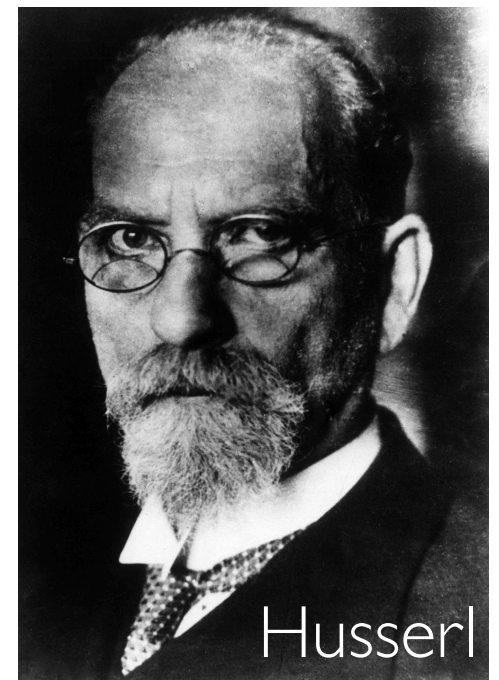
Role (in a “world”)



Ground



**Function/
Role**



Fundierung



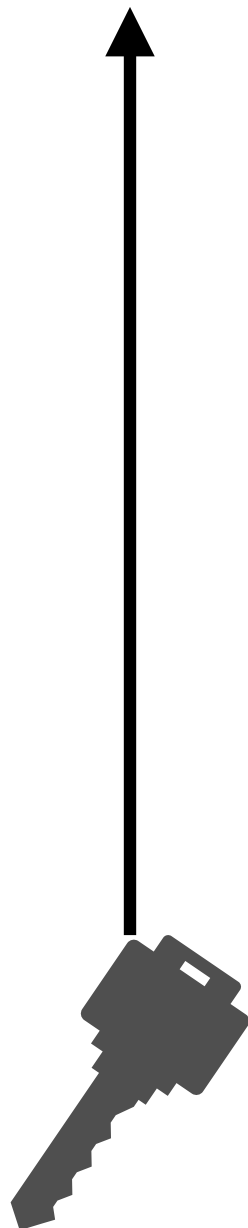
**Facticity/
Ground**

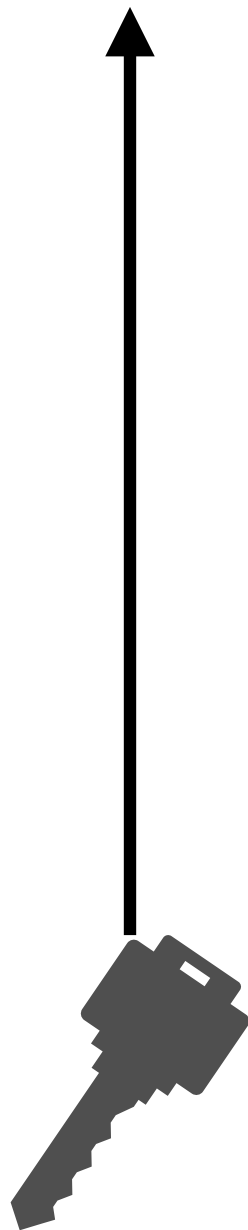
{Roles}

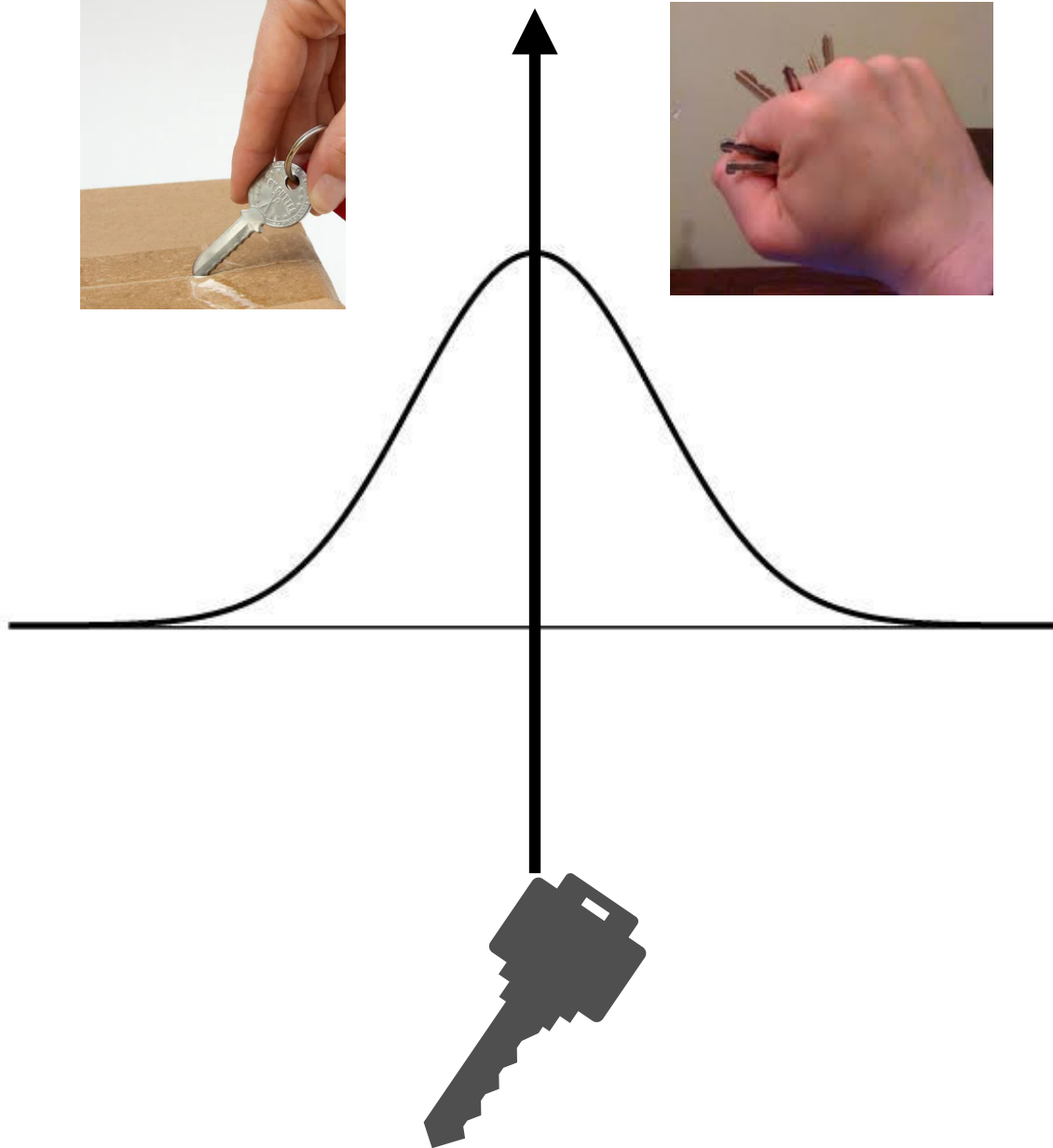


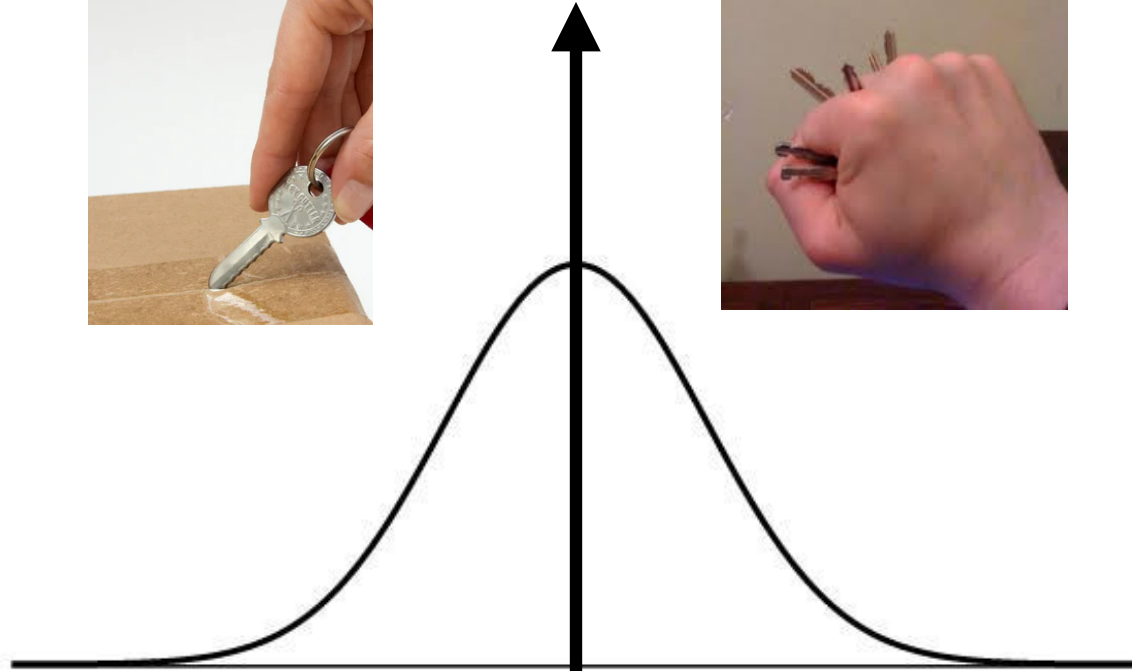
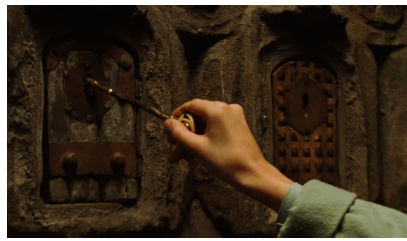
Ground











Affordances

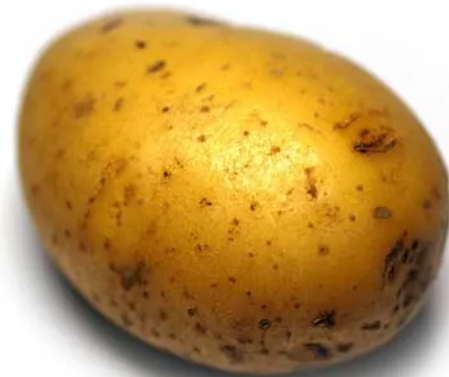


Formalizing the “**as**” relation

Foster, in prep

Formalizing the “**as**” relation

Ground

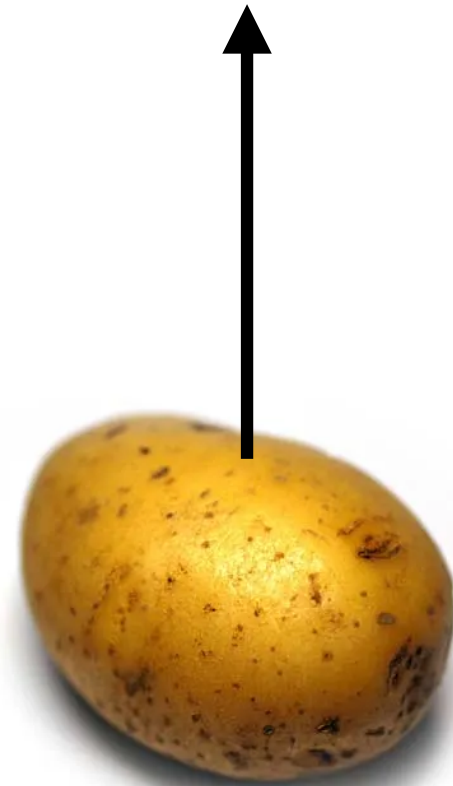


Formalizing the “**as**” relation

Role

(in a “world”, a context)

Ground

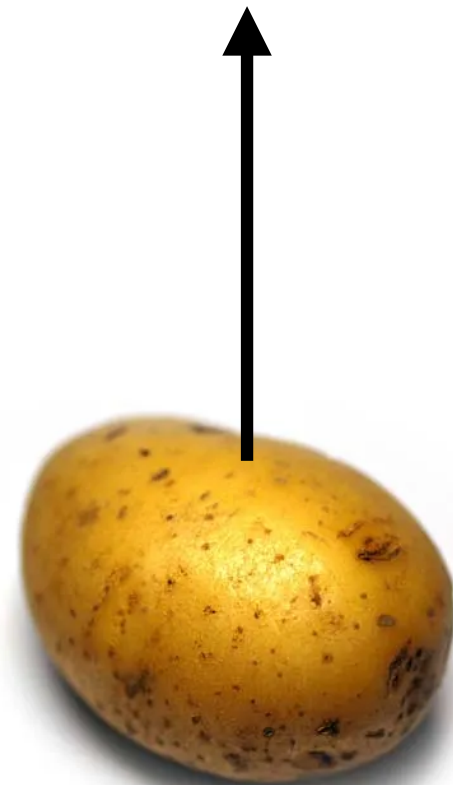


Formalizing the “**as**” relation

Role

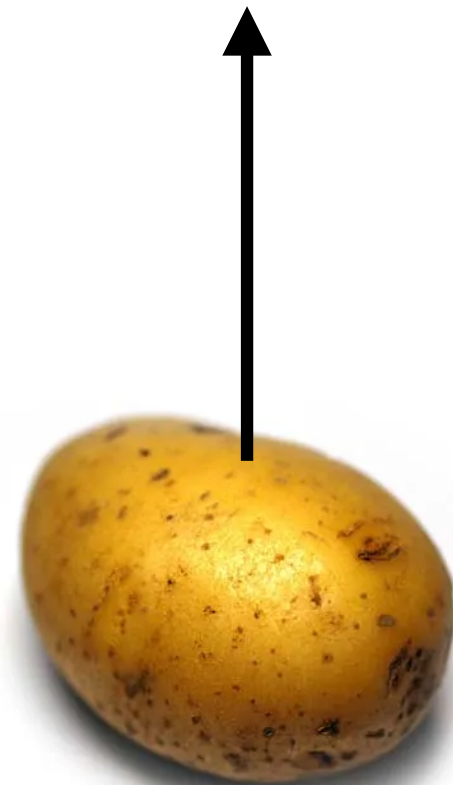
Mashable

Ground



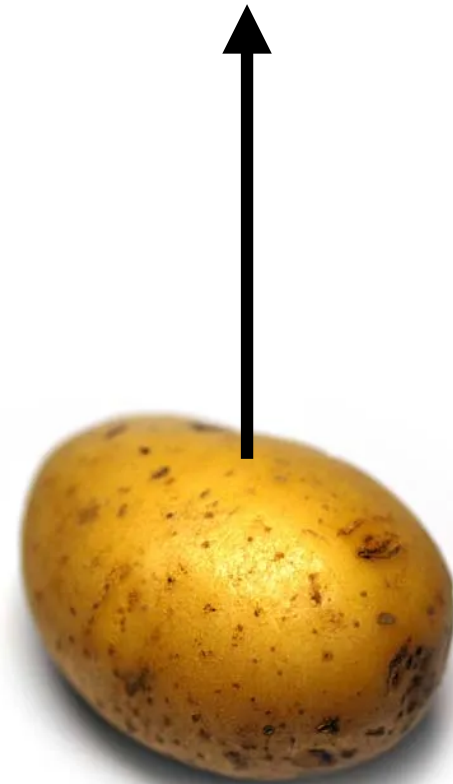
Formalizing the “**as**” relation

Mashable



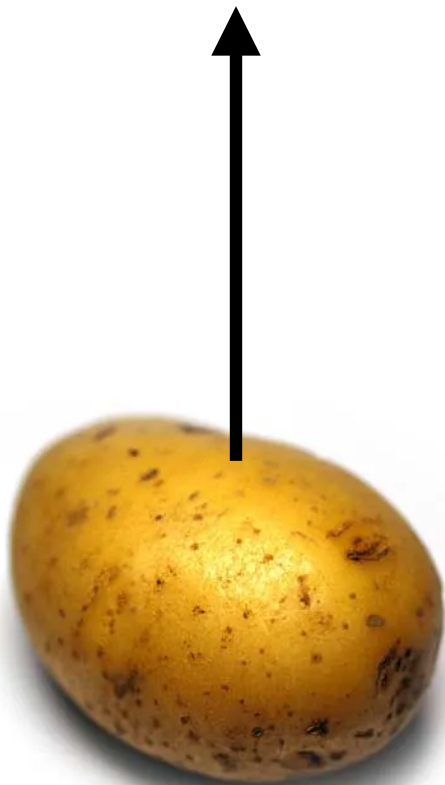
Formalizing the “**as**” relation

Masher $\xrightarrow{\textit{Mash}}$ **Mashable**

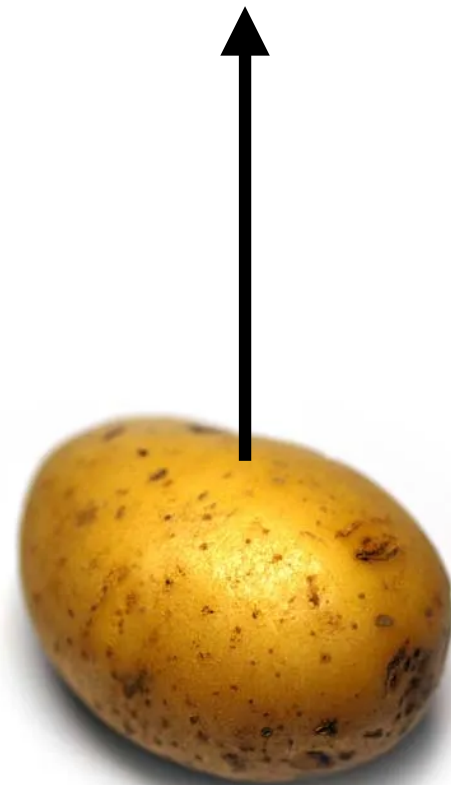


Formalizing the “**as**” relation

Masher $\xrightarrow{\text{Mash}}$ **Mashable**

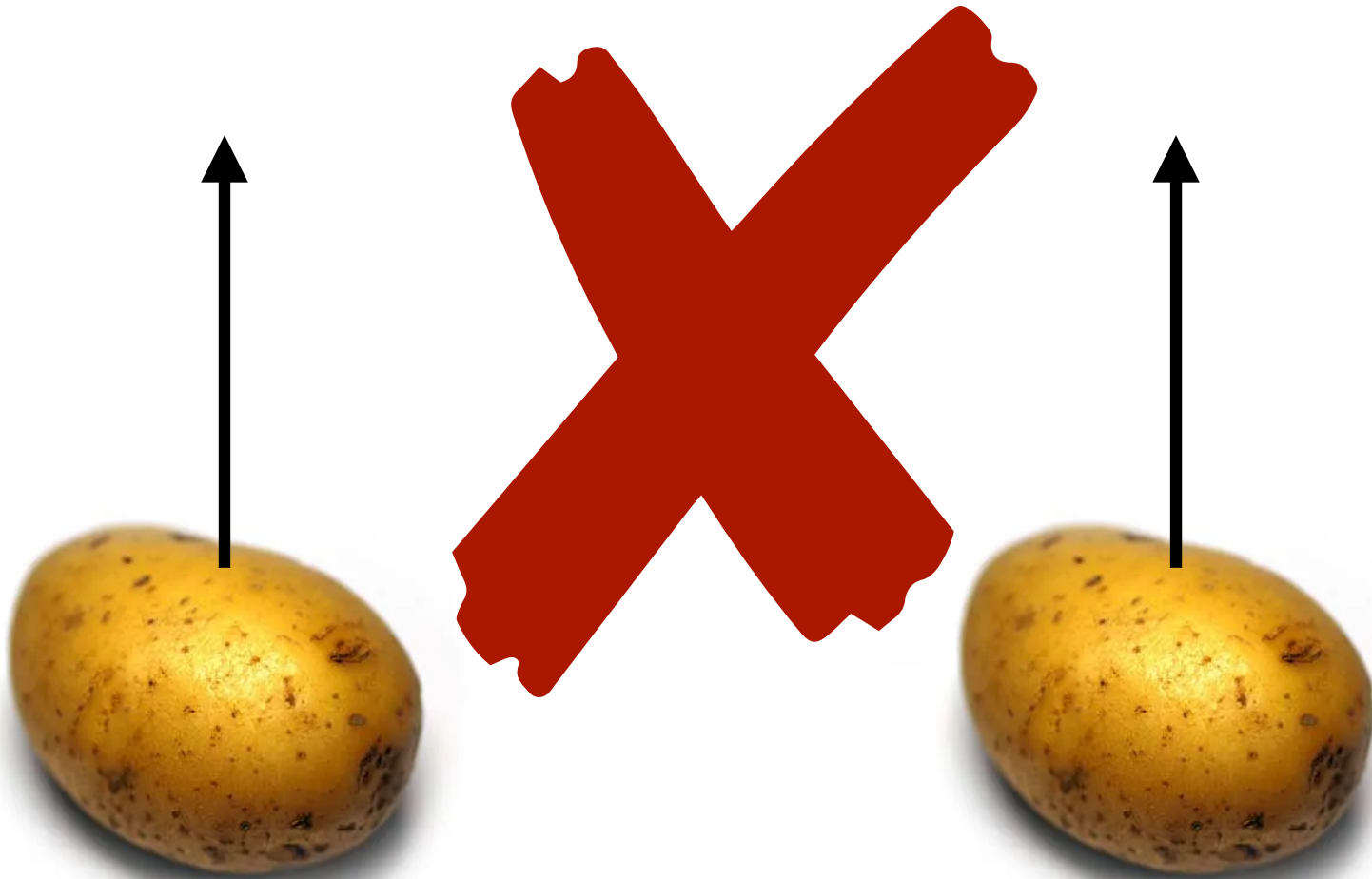


?????



Formalizing the “**as**” relation

Masher $\xrightarrow{\text{Mash}}$ **Mashable**

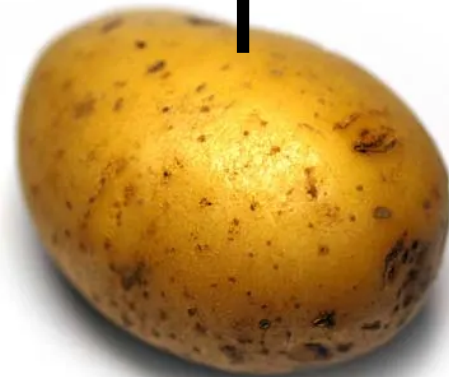


Formalizing the “**as**” relation

Masher $\xrightarrow{\text{Mash}}$ **Mashable**

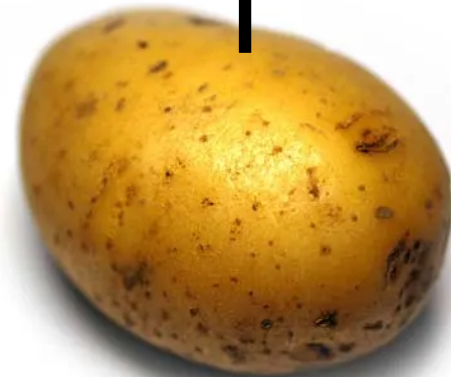


?????



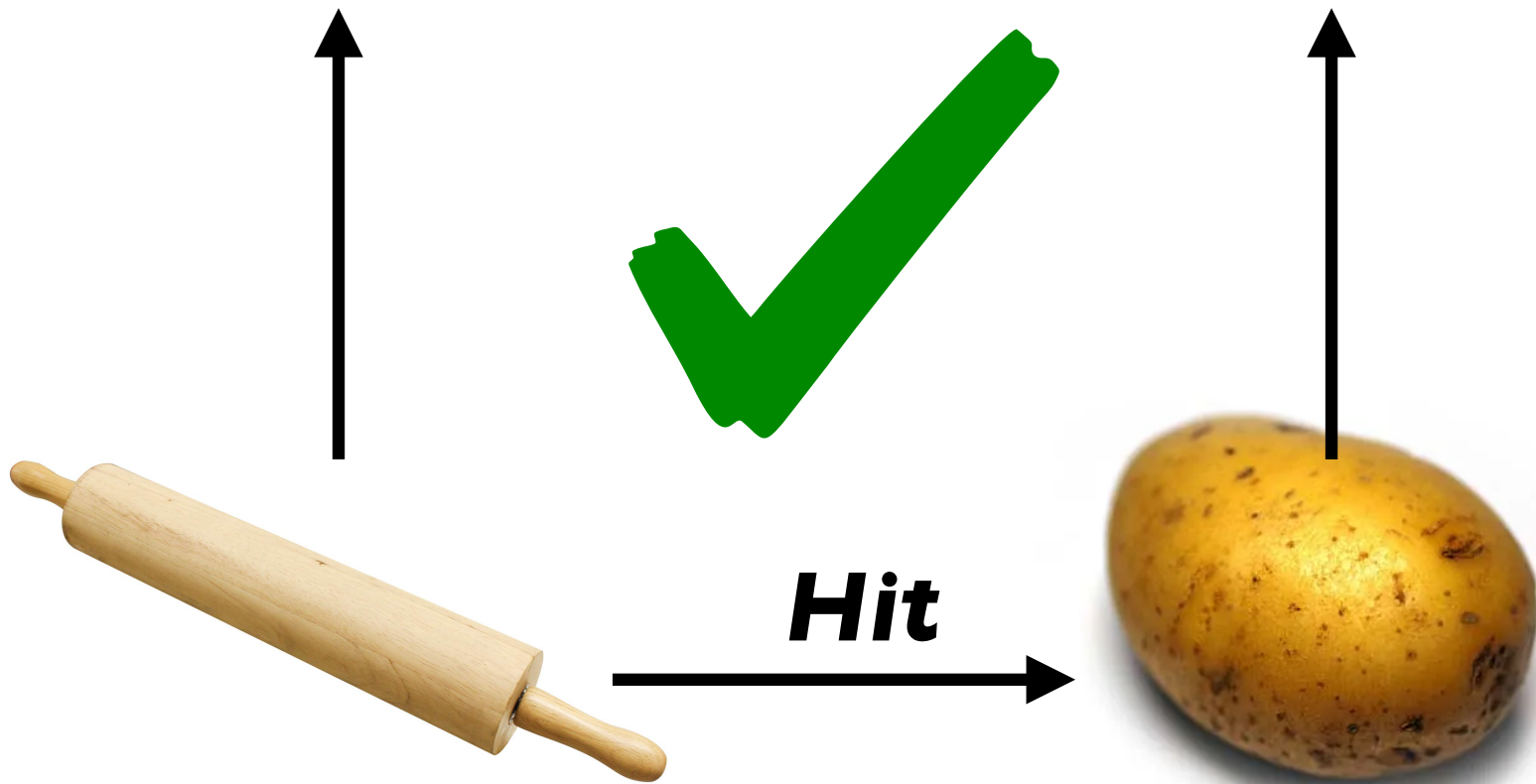
Formalizing the “**as**” relation

Masher $\xrightarrow{\text{Mash}}$ **Mashable**



Formalizing the “**as**” relation

Masher $\xrightarrow{\text{Mash}}$ **Mashable**



MY TAKE AWAY?

Meaning is about **imagination**.

It is about *seeing* what is **as** what could be

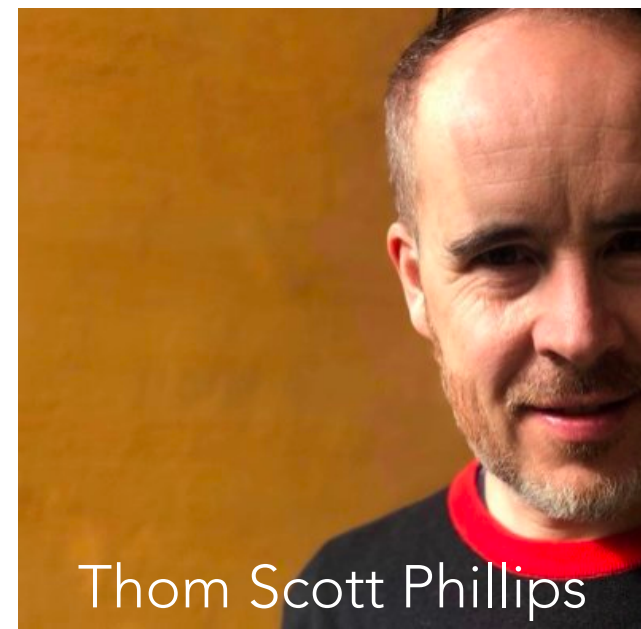
“as” relation
in **language**

Linguistic Code

11 ~~Google~~ Code

~~Language Code~~

Language as Creativity



Thom Scott Phillips

Ostension + Inference



Dan Sperber

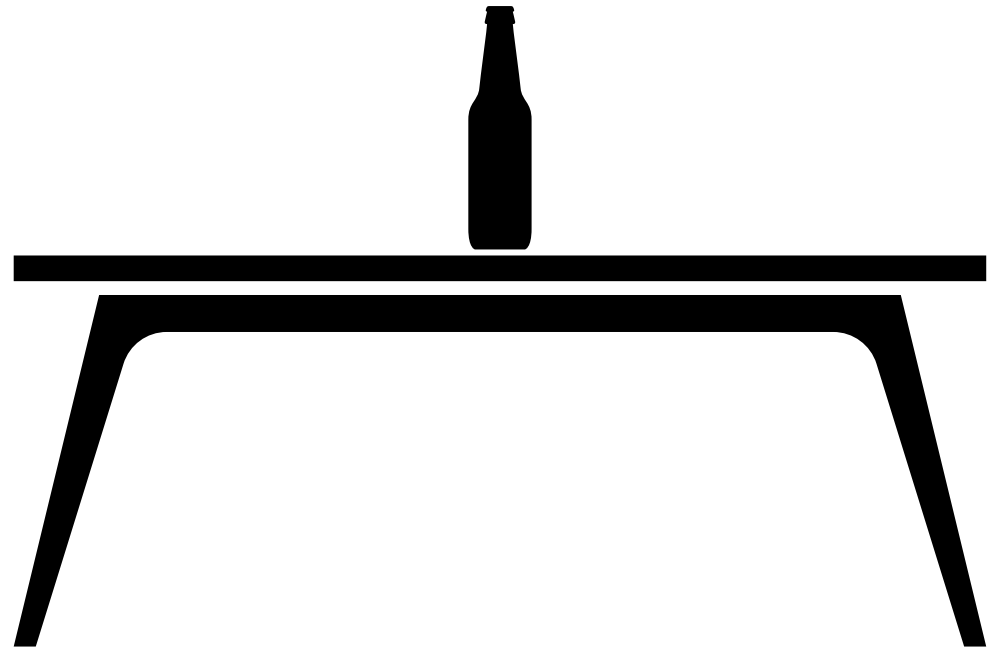


Deirdre Wilson

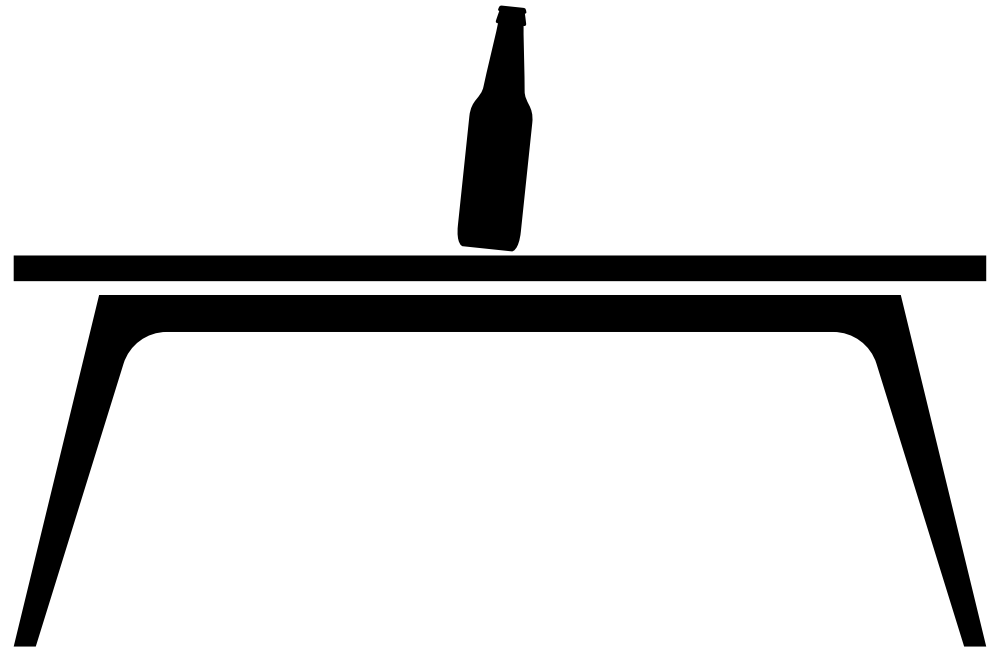
Ostension + Inference

“signalling signalhood”

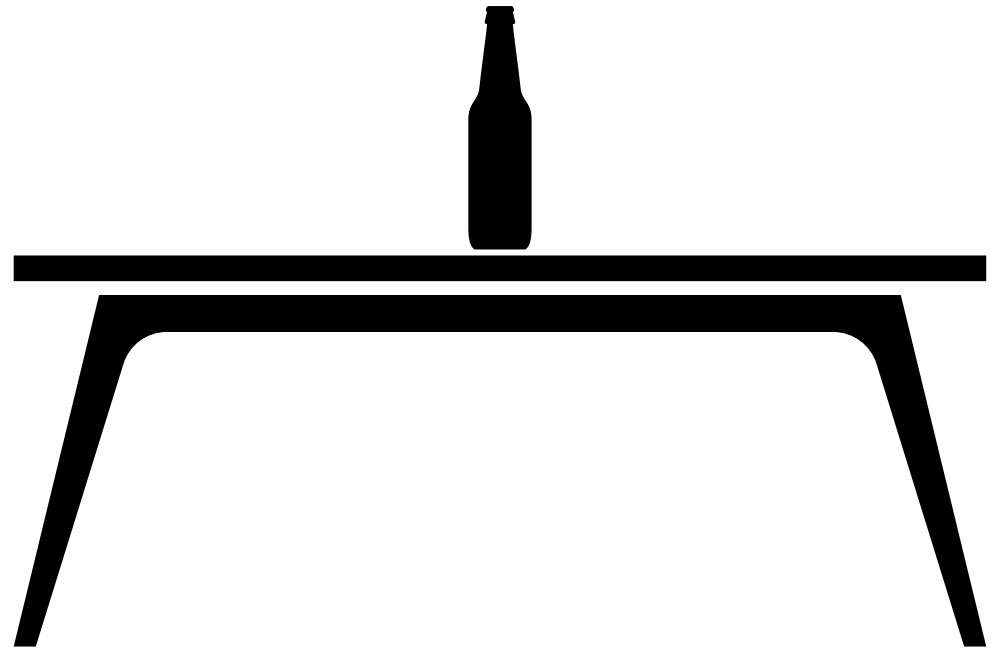
Ostension + Inference



Ostension + Inference



Ostension + Inference



Ostension + Inference

Ostension + Inference





as

Communicative
Act



as

Communicative
Act

as

Greeting

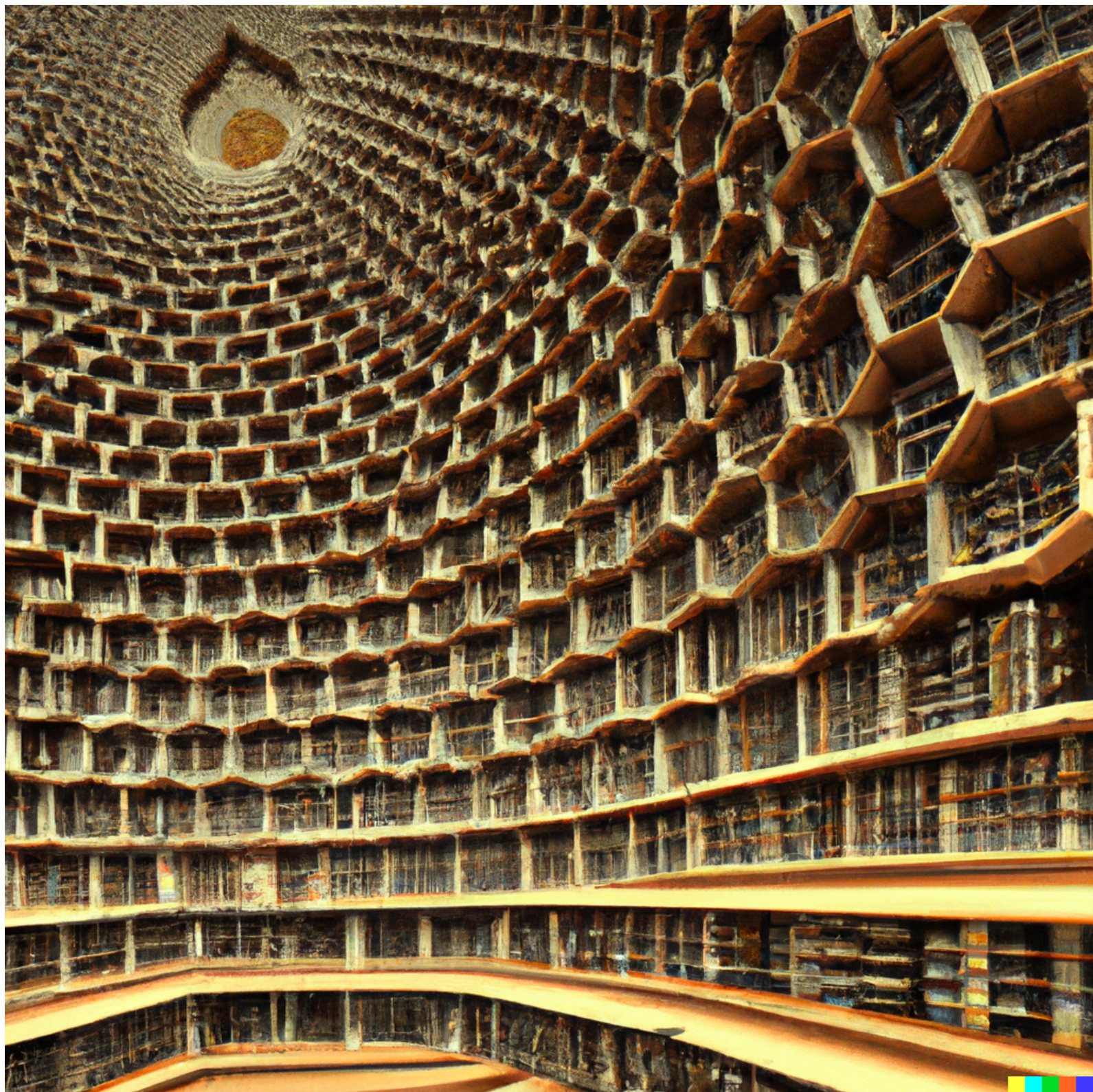


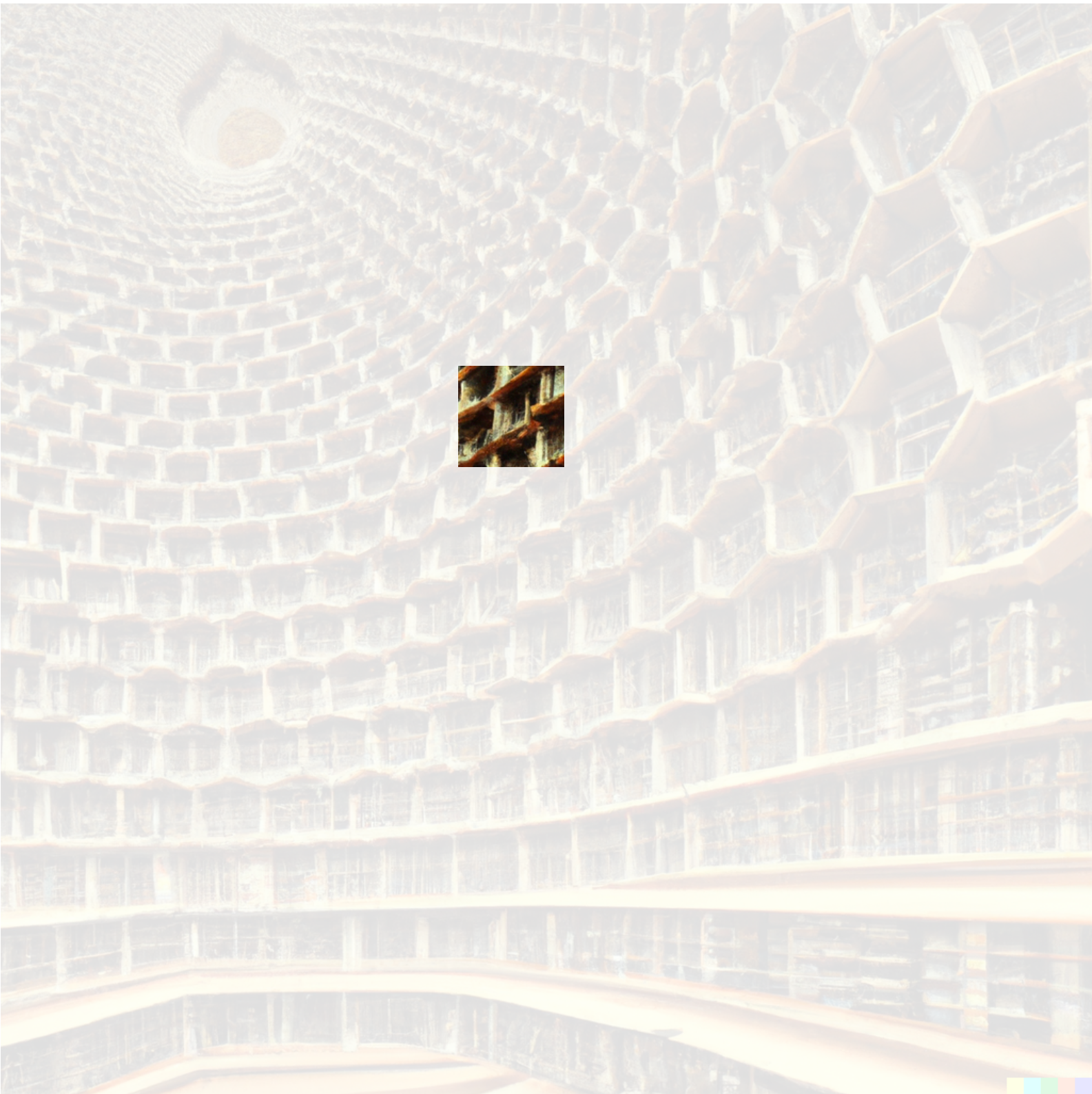
as


Communicative
Act

as

Threat





The background of the slide is a photograph of a modern building's facade, characterized by a complex, honeycomb-like structure of hexagonal and pentagonal openings. The building is viewed from a low angle, looking up, and the image is faded to serve as a background for the text.

Physical Form (e.g., iconicity)

Physical Context (e.g., deixis)

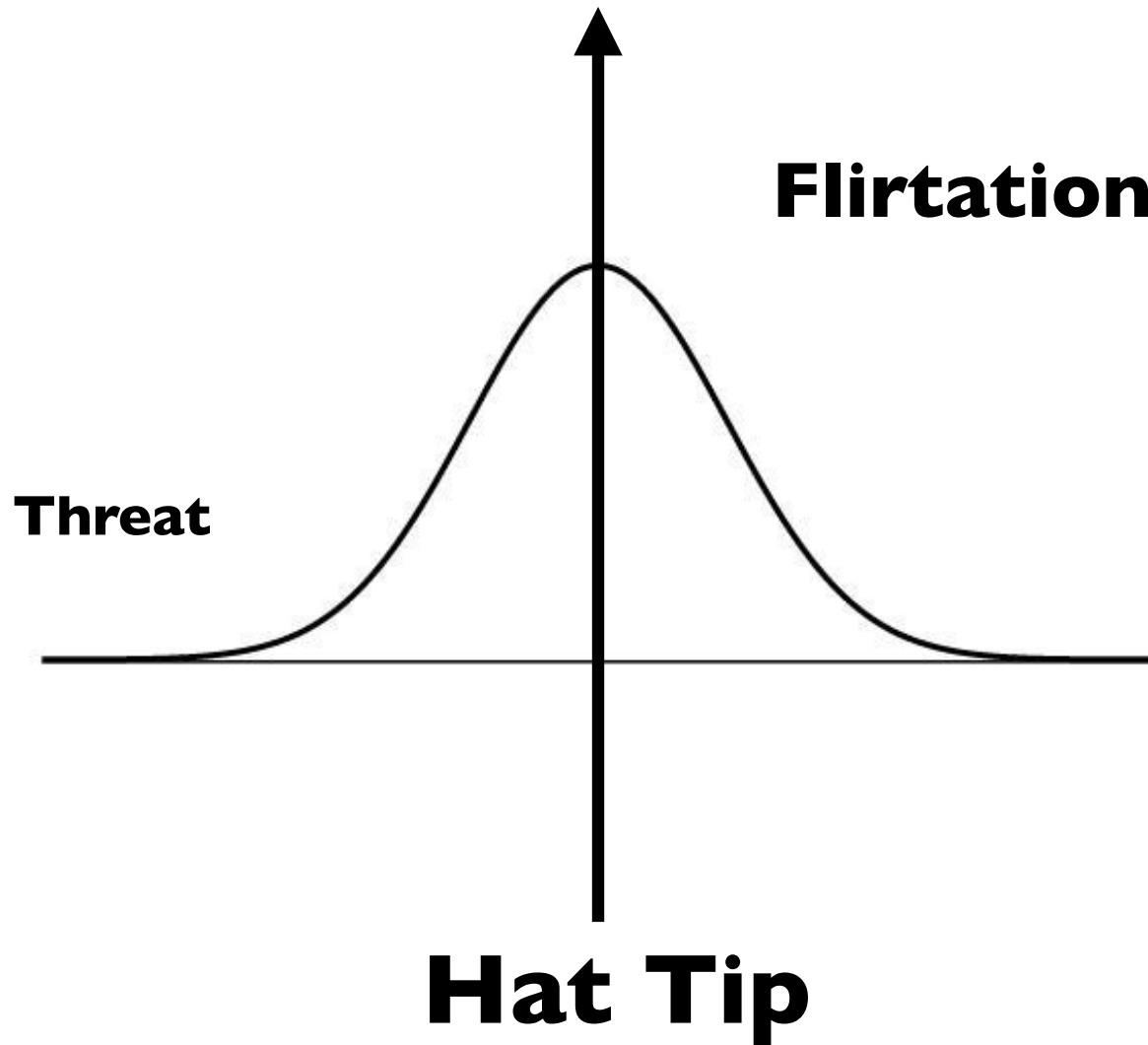
Joint Activity

Shared History

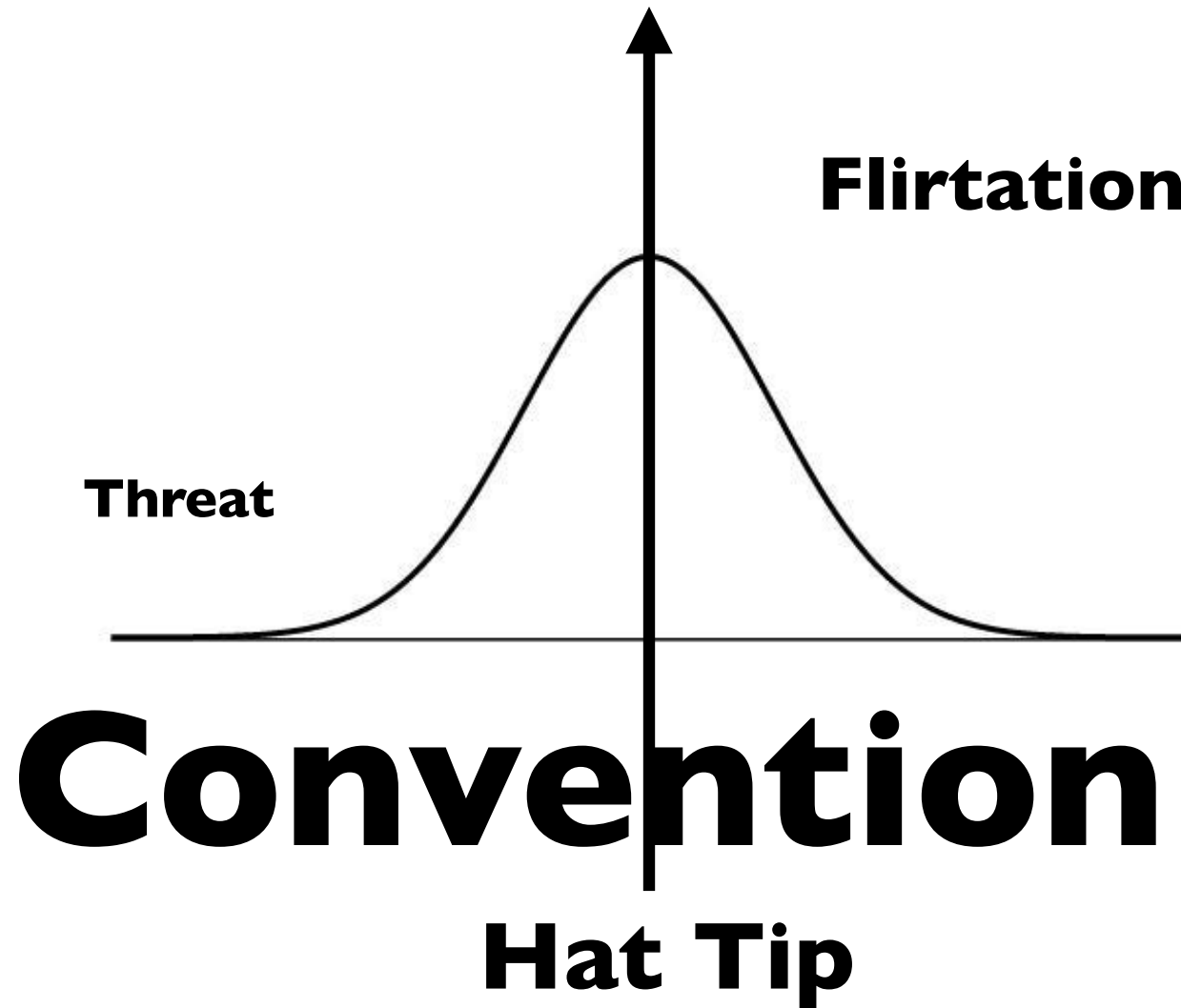
Linguistic Code

Foster & Cartmill 2018

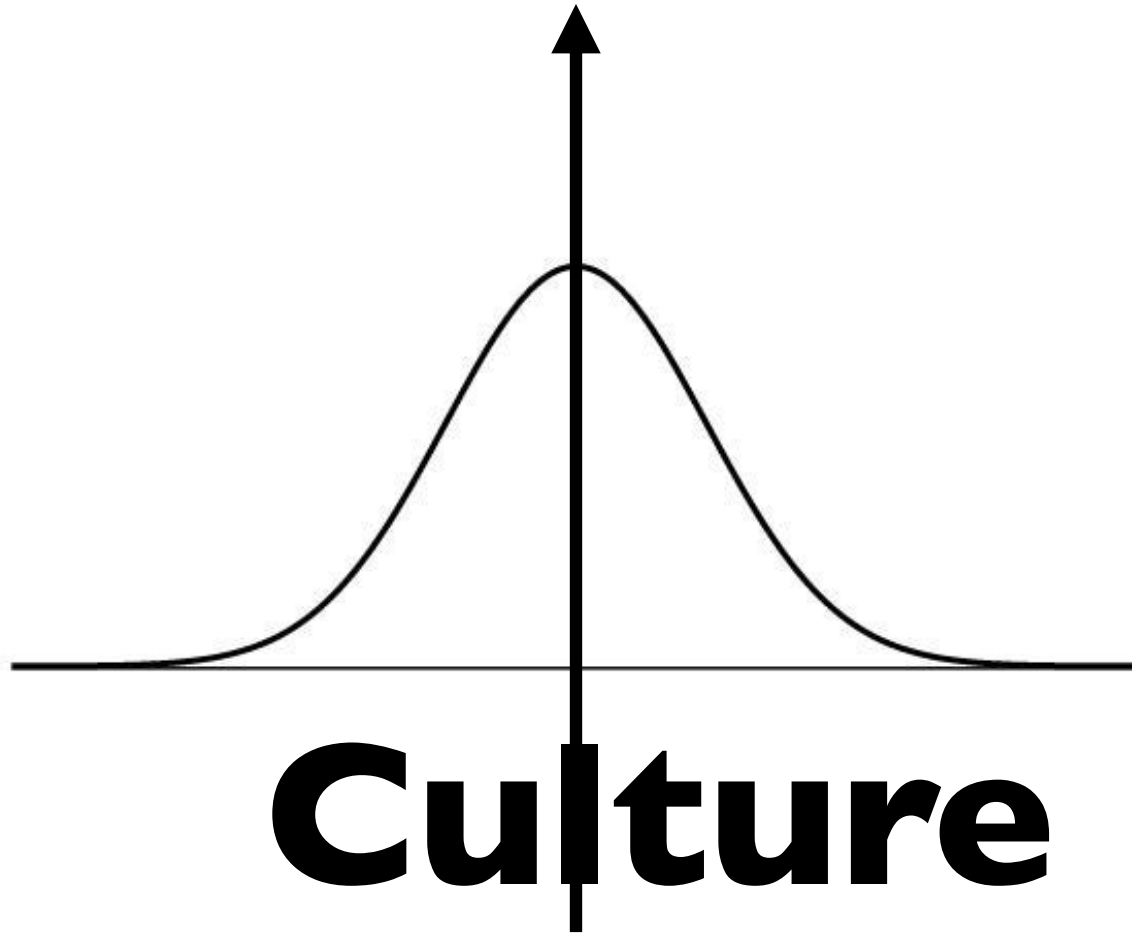
Greeting



Greeting

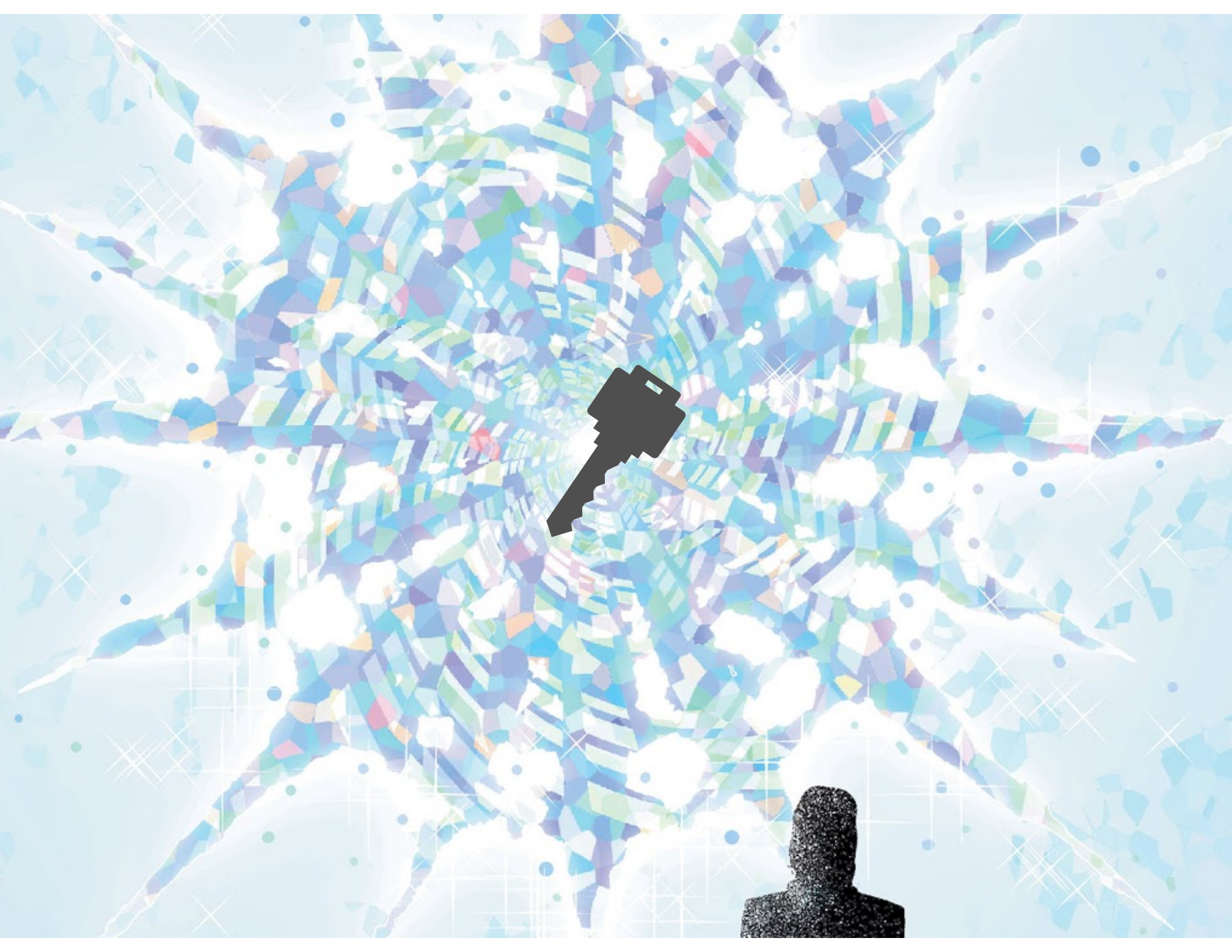


{Roles}

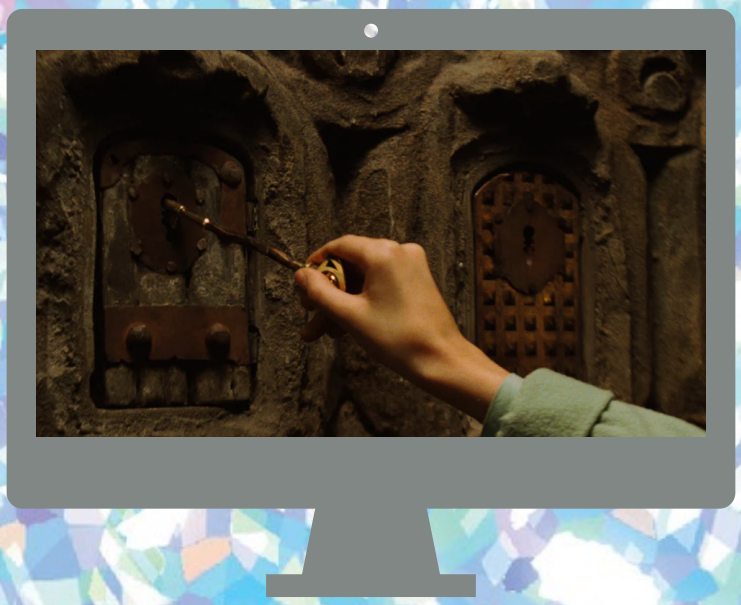
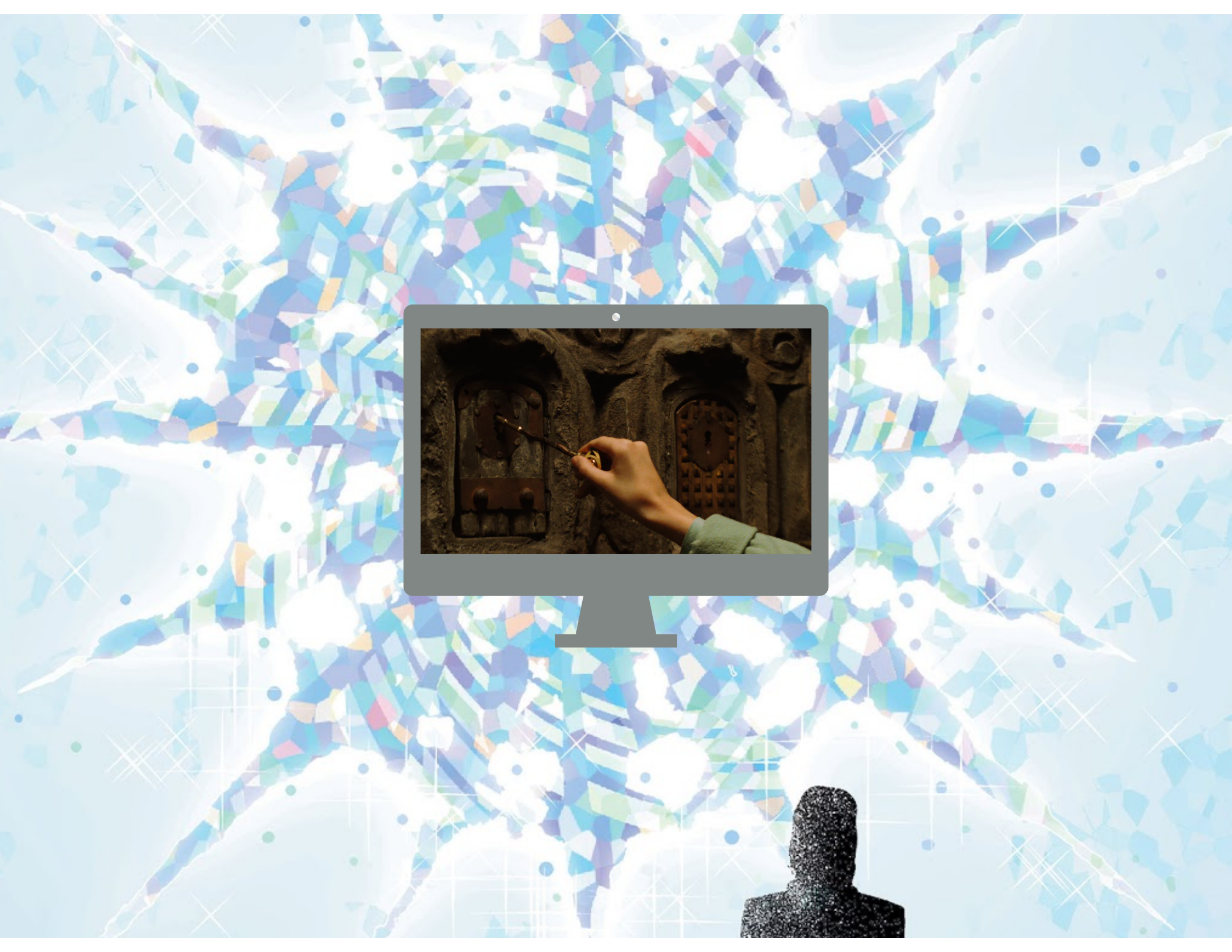


Culture

Ground



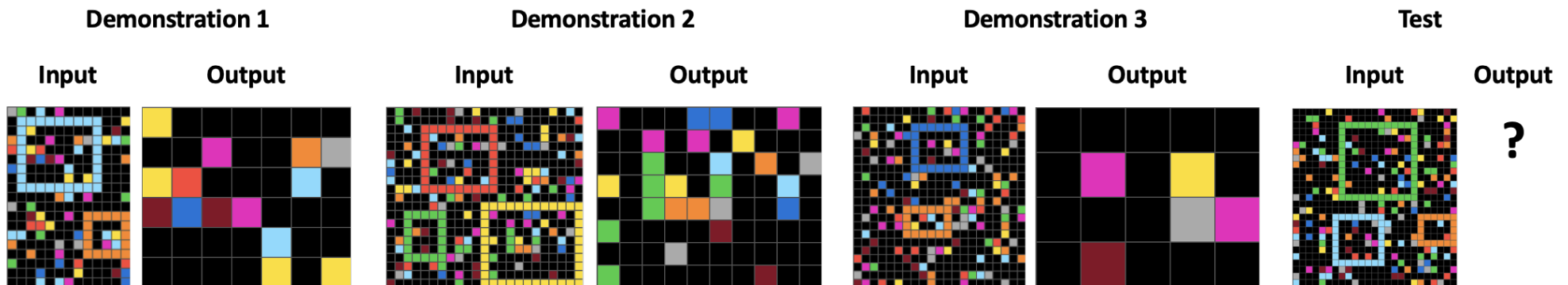






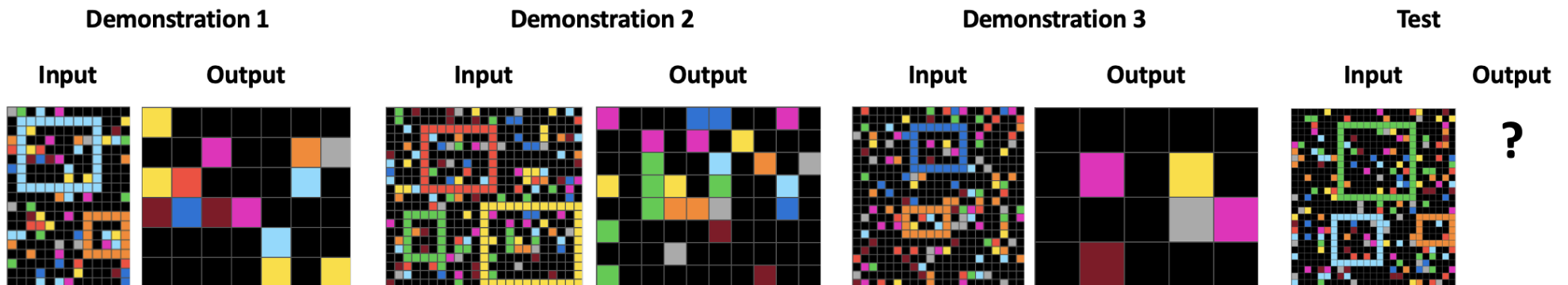
Key

Abstraction & Reasoning Corpus (ARC) -Chollet 2019



Mitchell, Foster, Beger, Yi, Fu, Denton, Palmarini, R&R at *PNAS*

Abstraction & Reasoning Corpus (ARC)



Extract the sub-grid enclosed by the largest hollow rectangle

Abstraction & Reasoning Corpus (ARC)



Extract the sub-grid enclosed by the largest hollow rectangle

Abstraction & Reasoning Corpus (ARC)



Not so fast...

Where can we look for principles of LLM evaluation?

Position: Principles of Animal Cognition to Improve LLM Evaluations

Sunayana Rane^{*1} Cyrus F. Kirkman^{*2} Graham Todd^{*3} Amanda Royka^{*4} Ryan M. C. Law^{*5}
Erica A. Cartmill⁺⁶ Jacob G. Foster^{+7 8}

ICML 2025 (oral)

Baby steps in evaluating the capacities of large language models. [\[PDF\]](#) [\[DOI\]](#) [\[BibTeX\]](#)

M. C. Frank. (2023). *Nature Reviews Psychology*. doi:10.1038/s44159-023-00211-x.

How to evaluate the cognitive abilities of LLMs

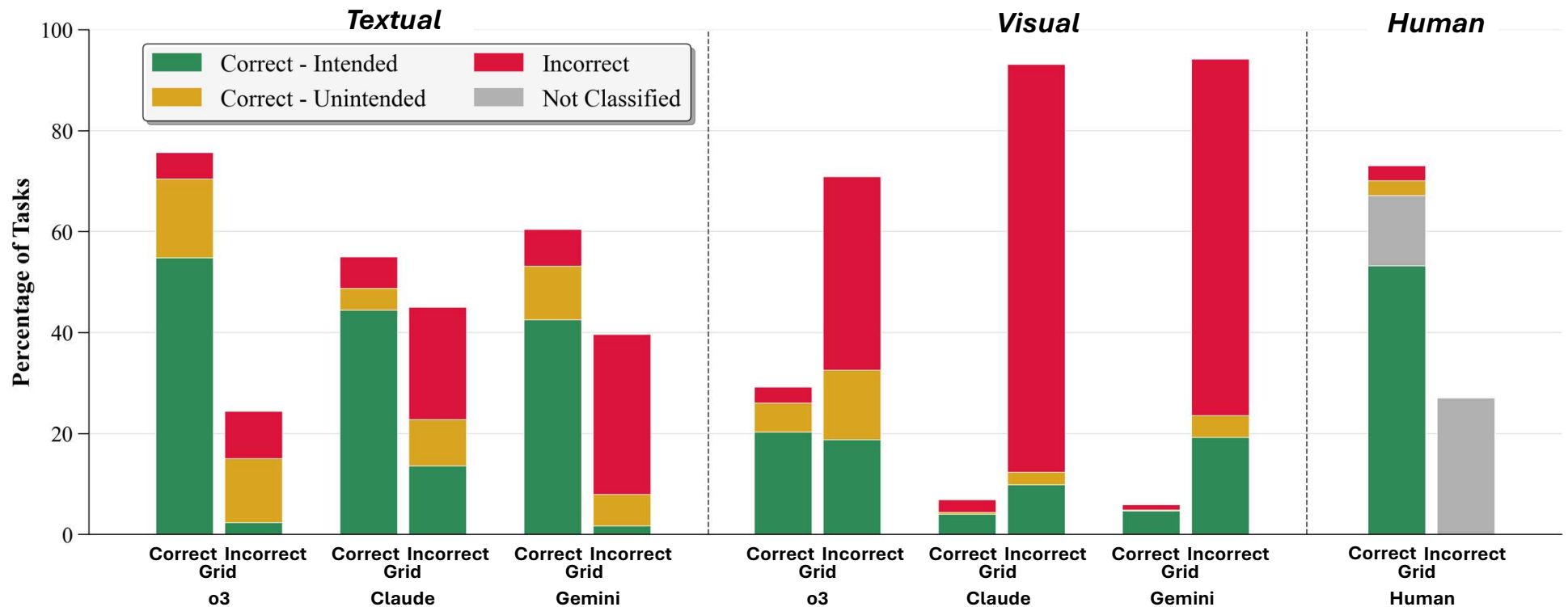
[Anna A. Ivanova](#) (2025) [Nature Human Behaviour](#)
volume 9, pages 230–233 (2025)

Abstraction & Reasoning Corpus (ARC)



Drumroll

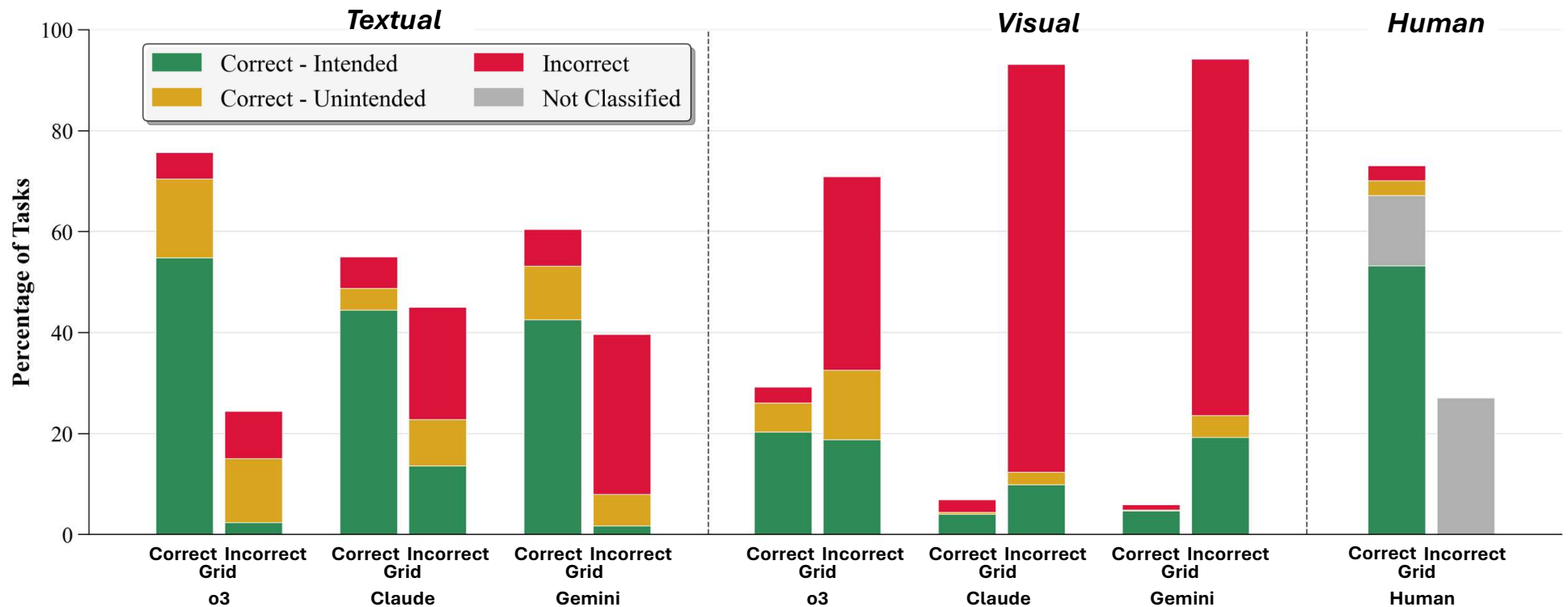
Often get it “right”
for **wrong** reasons



Mitchell, Foster, Beger, Yi, Fu, Denton, Palmarini, R&R at PNAS

adapted from Beger et al., 2025

Very bad at **visual**



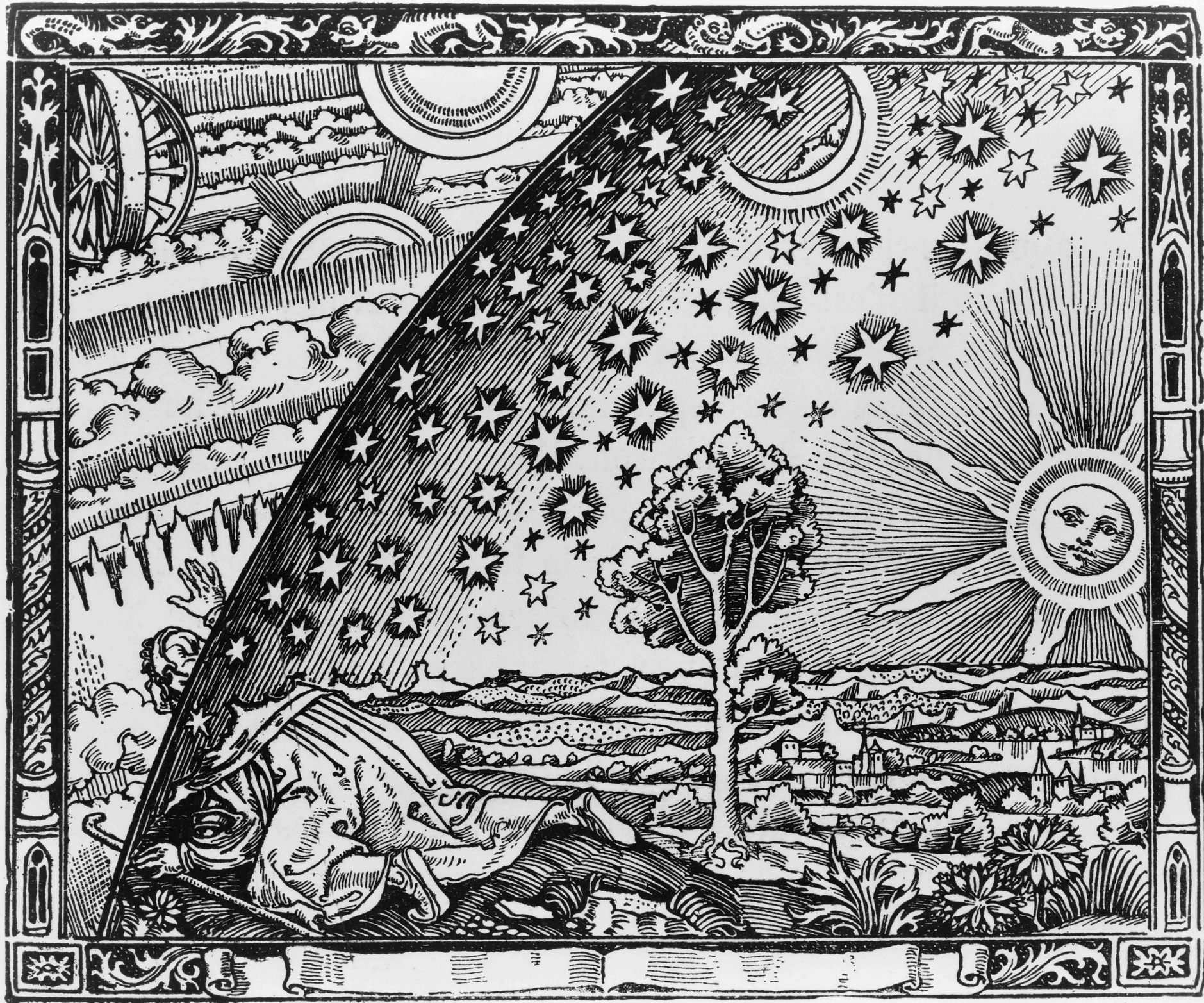
Mitchell, Foster, Beger, Yi, Fu, Denton, Palmarini, R&R at *PNAS*

adapted from Beger et al., 2025

Has the barrier of meaning been crashed?



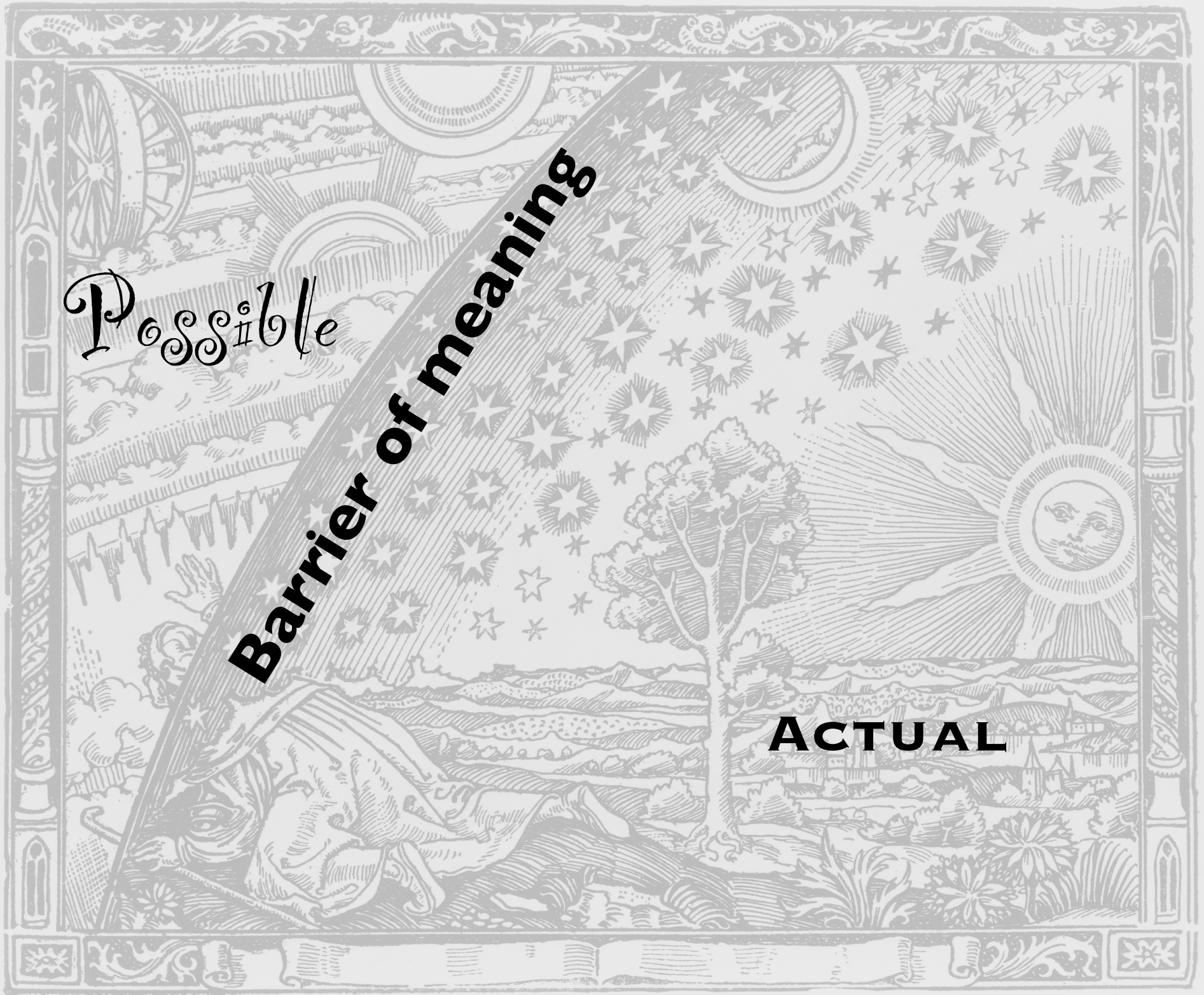




Possible

Barrier of meaning

ACTUAL



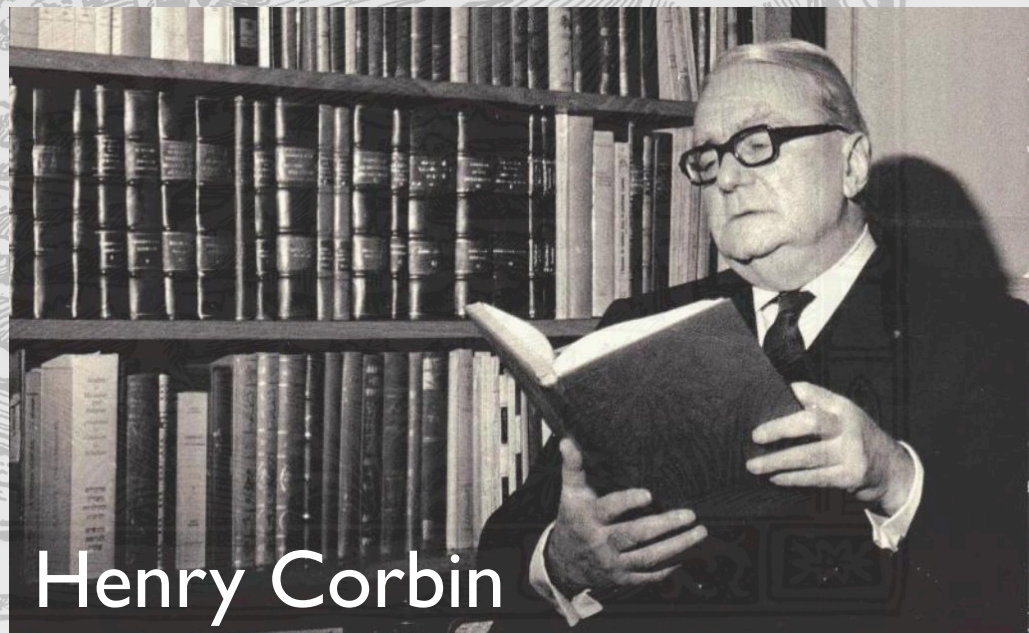
Imaginal

Barrier of meaning





Imaginal



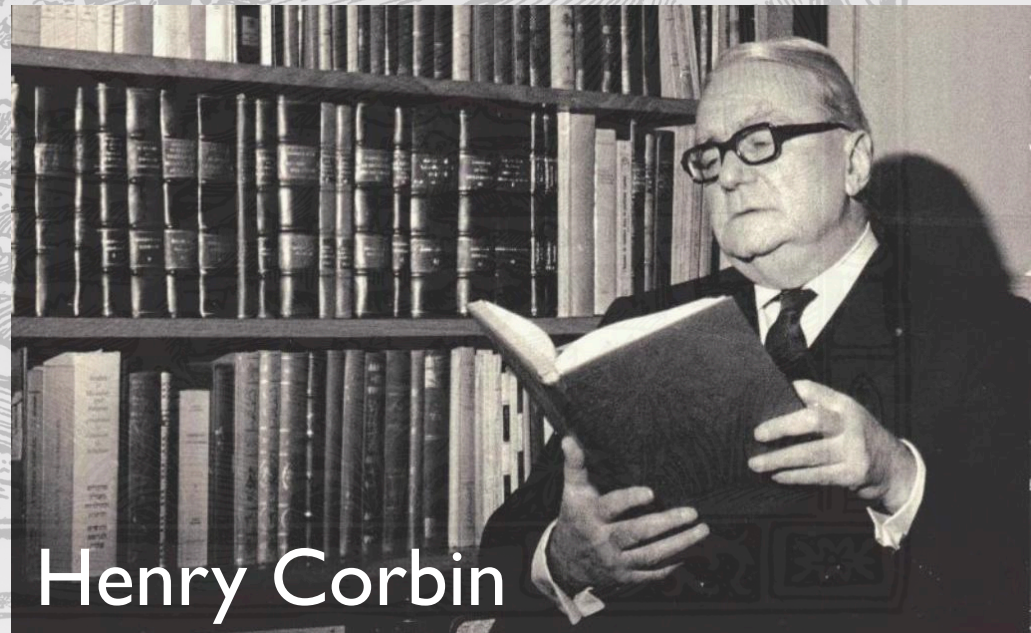
Henry Corbin

Imaginal

Ibn Arabi



Suhrawardī



Henry Corbin

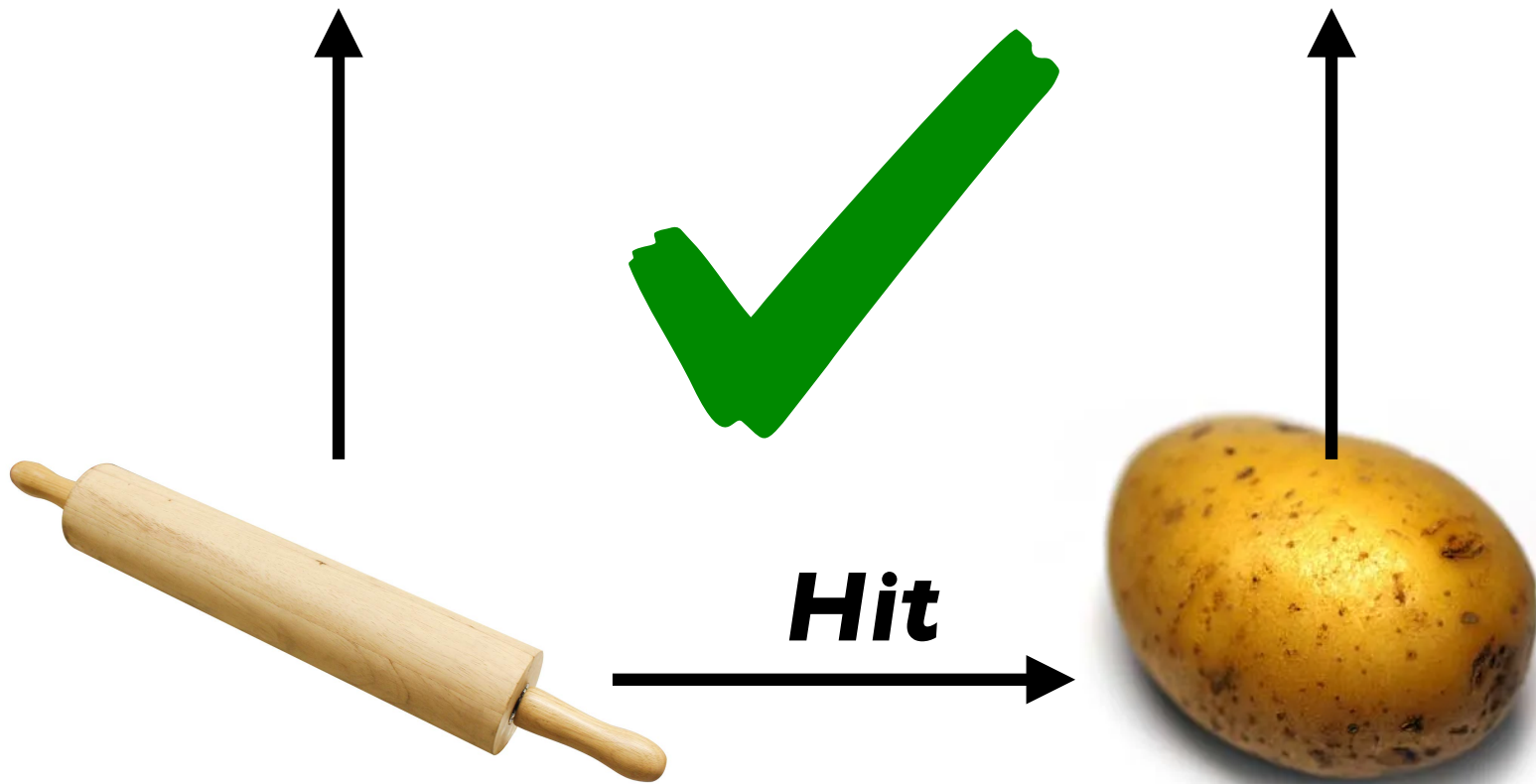


Imaginal

UNDERSTANDING

Is this understanding?

Masher $\xrightarrow{\text{Mash}}$ **Mashable**

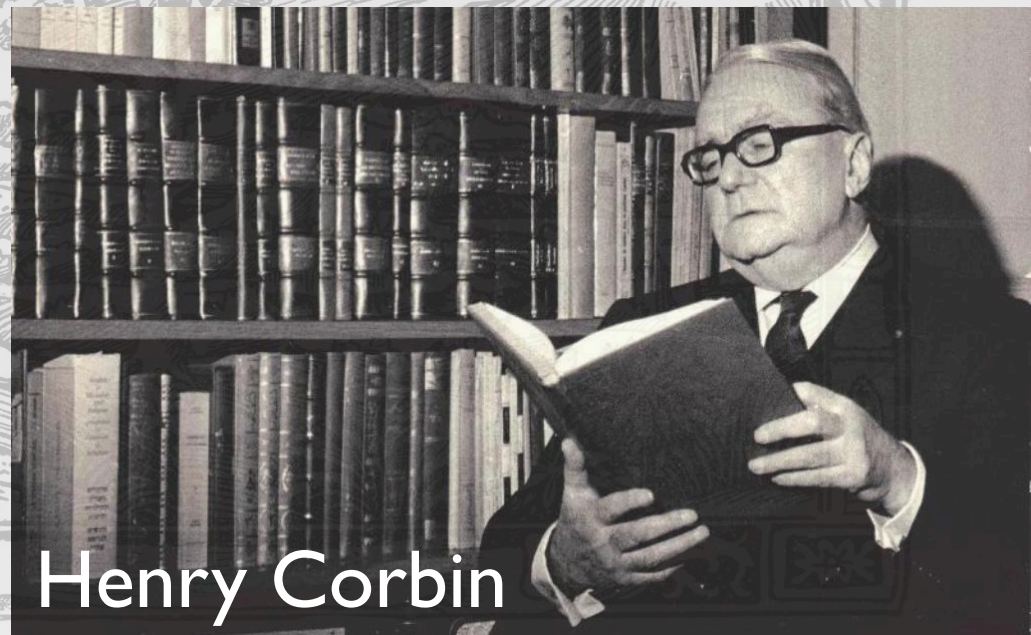


mundus
imaginalis

Ibn Arabi



Suhrawardī



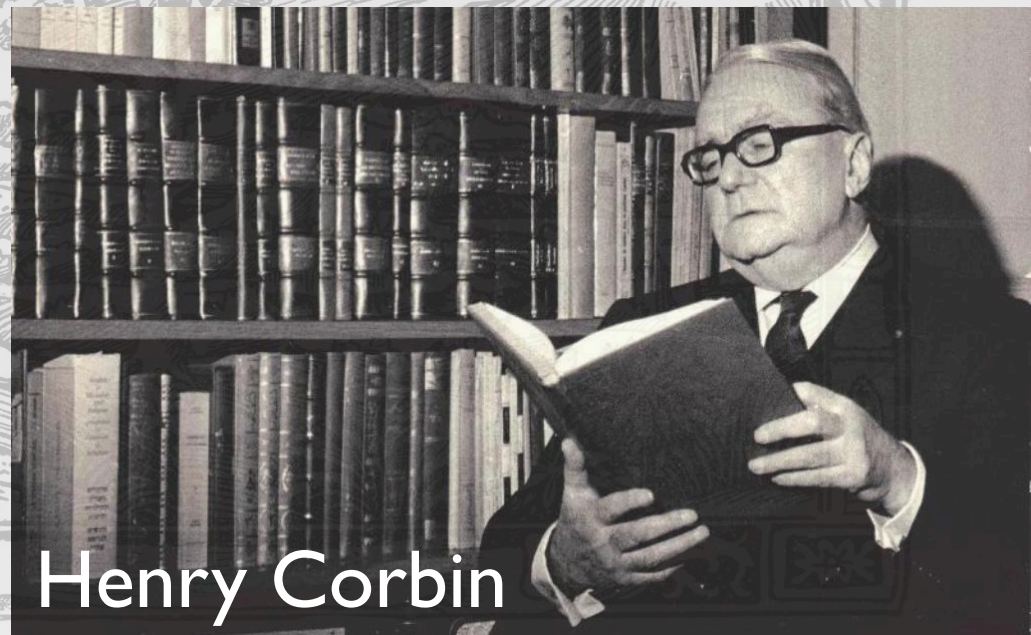
Henry Corbin

‘ālam al-mithāl

Ibn Arabi



Suhrawardī



Henry Corbin

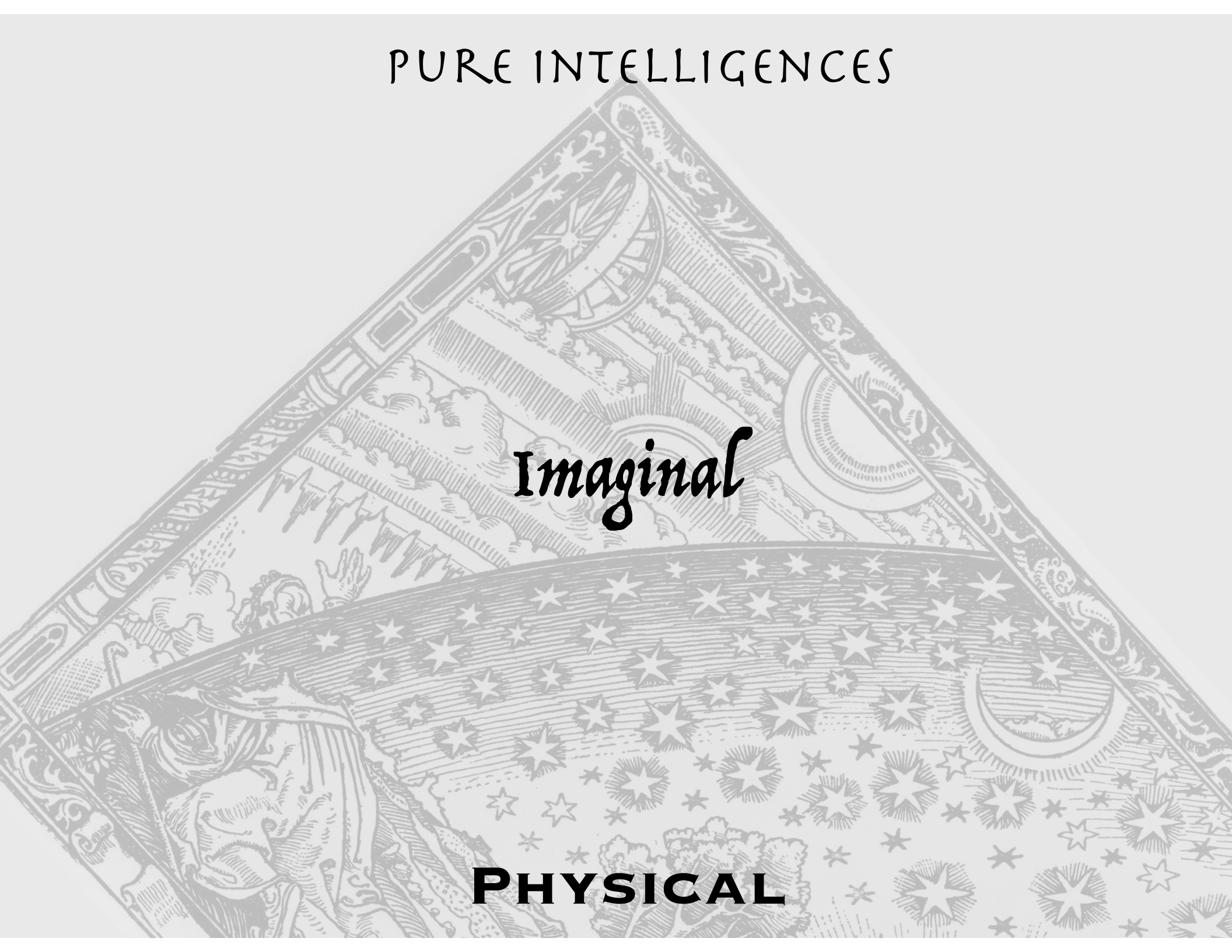


‘ālam al-mithāl

PURE INTELLIGENCES

Imaginal

PHYSICAL



PURE INTELLIGENCES

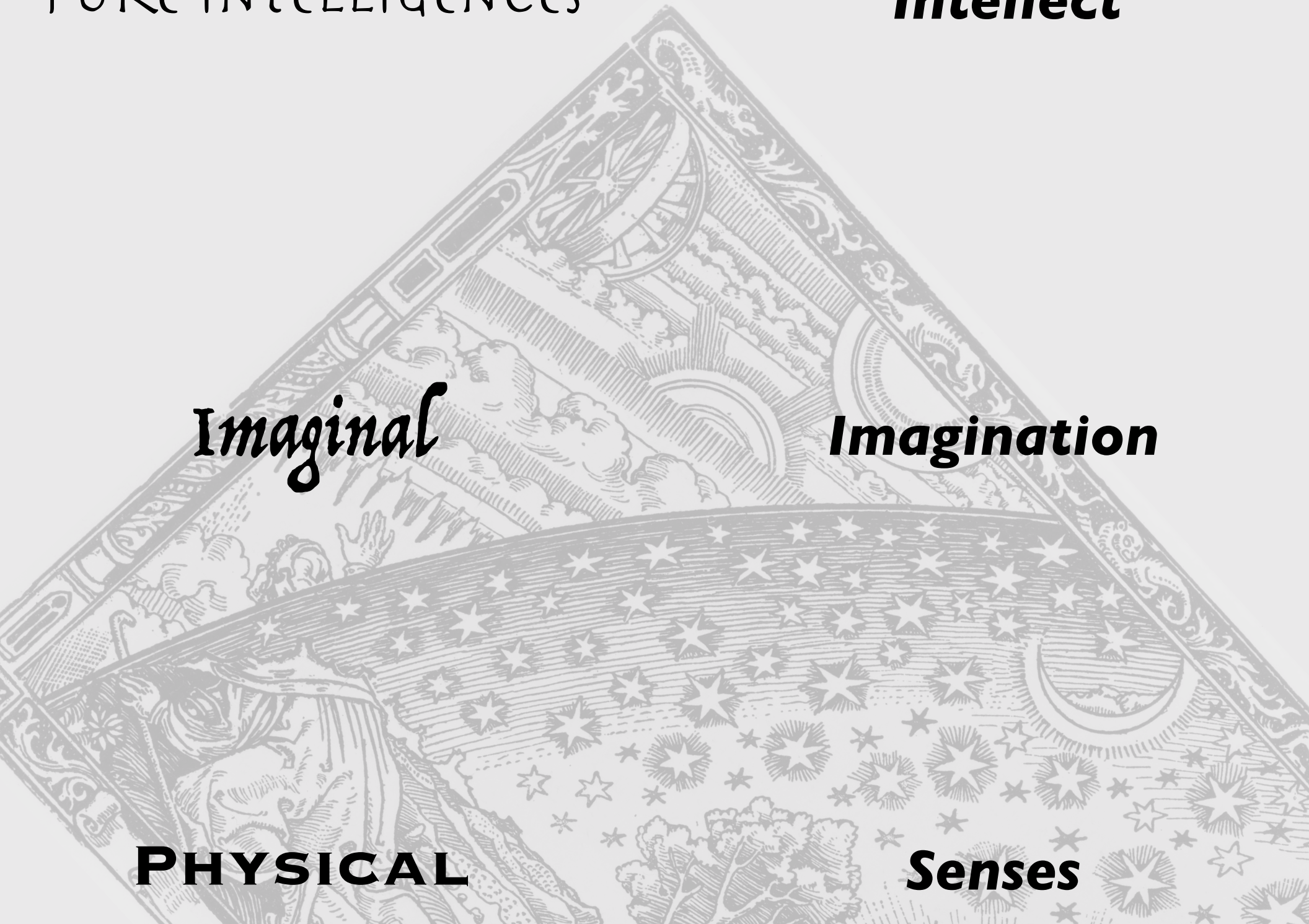
Intellect

Imaginal

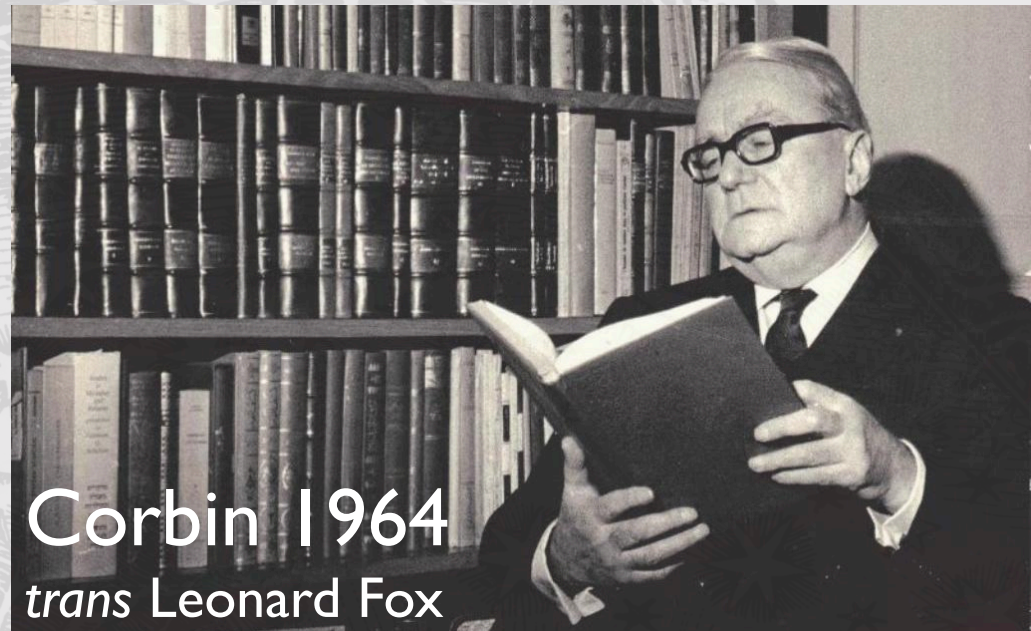
Imagination

PHYSICAL

Senses

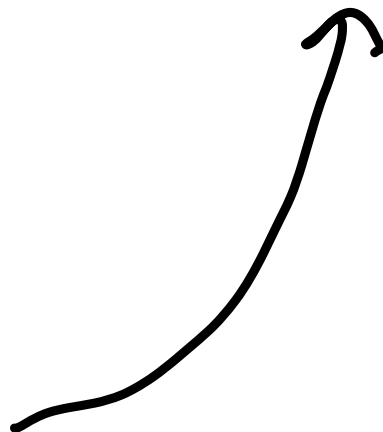
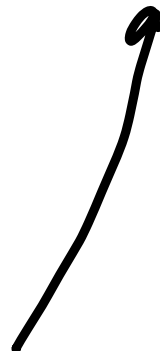
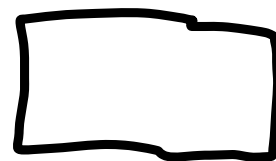
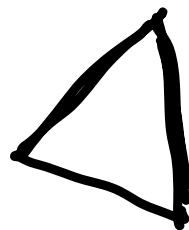
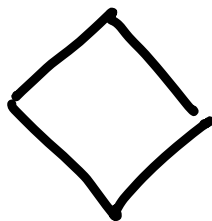
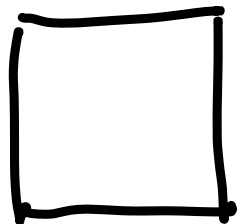


“It is the cognitive function
of the **Imagination** that
permits the establishment of
a rigorous analogical
knowledge.”

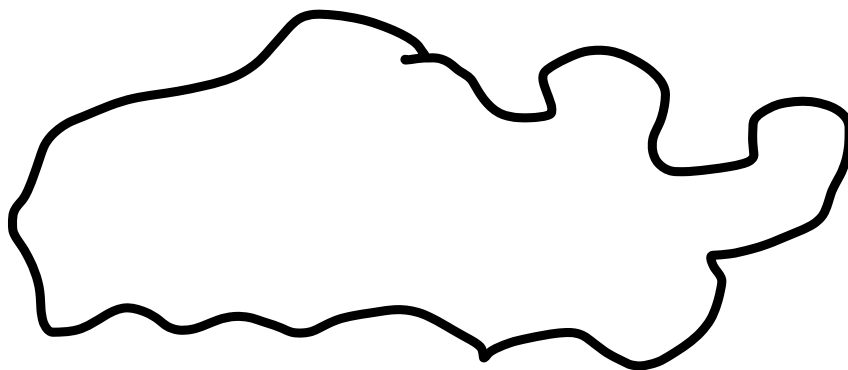


Corbin 1964
trans Leonard Fox

Math
world



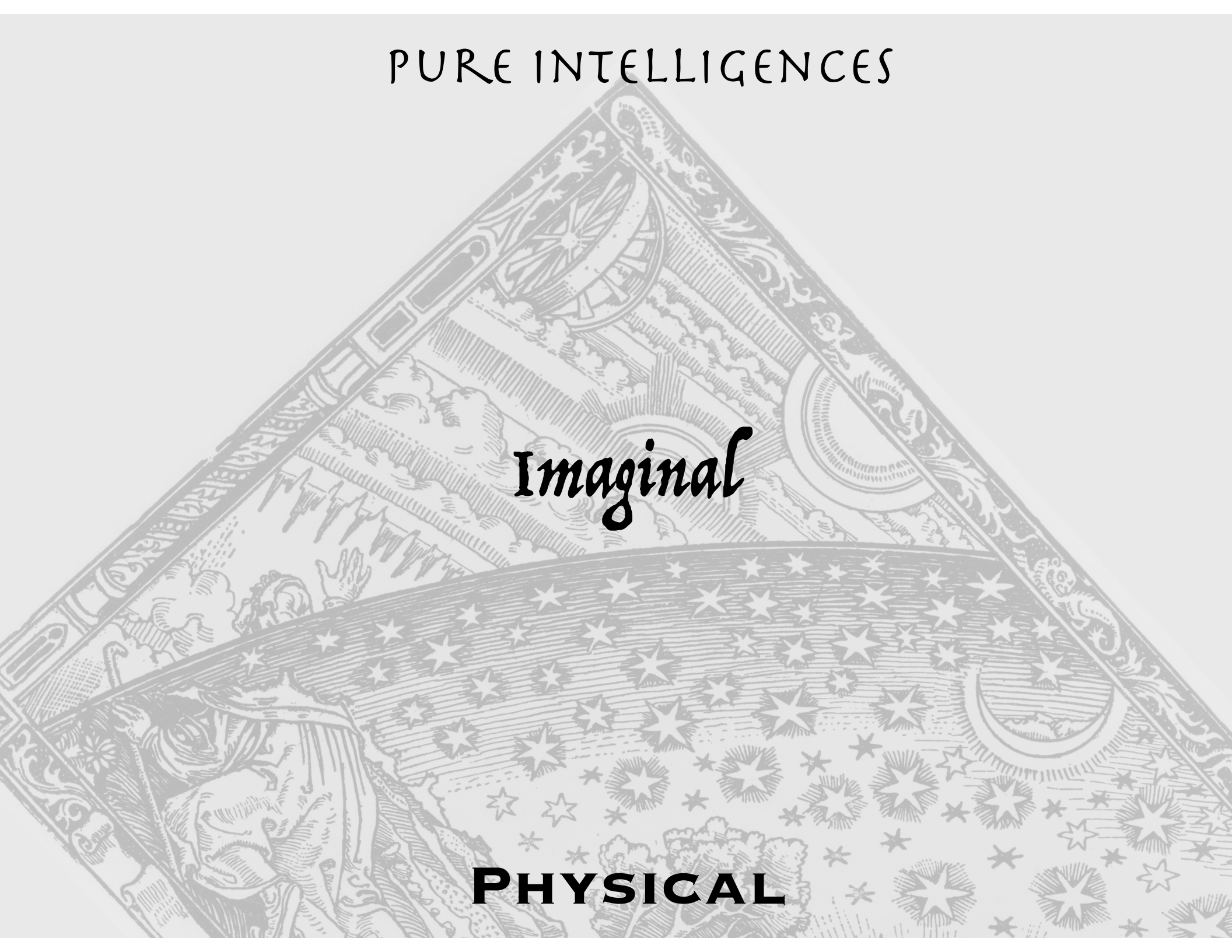
Real
World



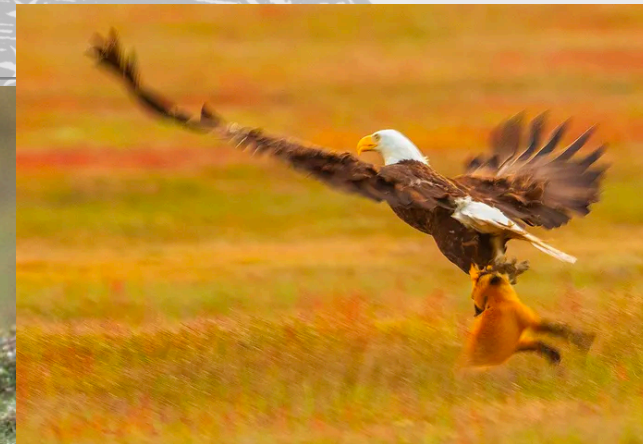
PURE INTELLIGENCES

Imaginal

PHYSICAL

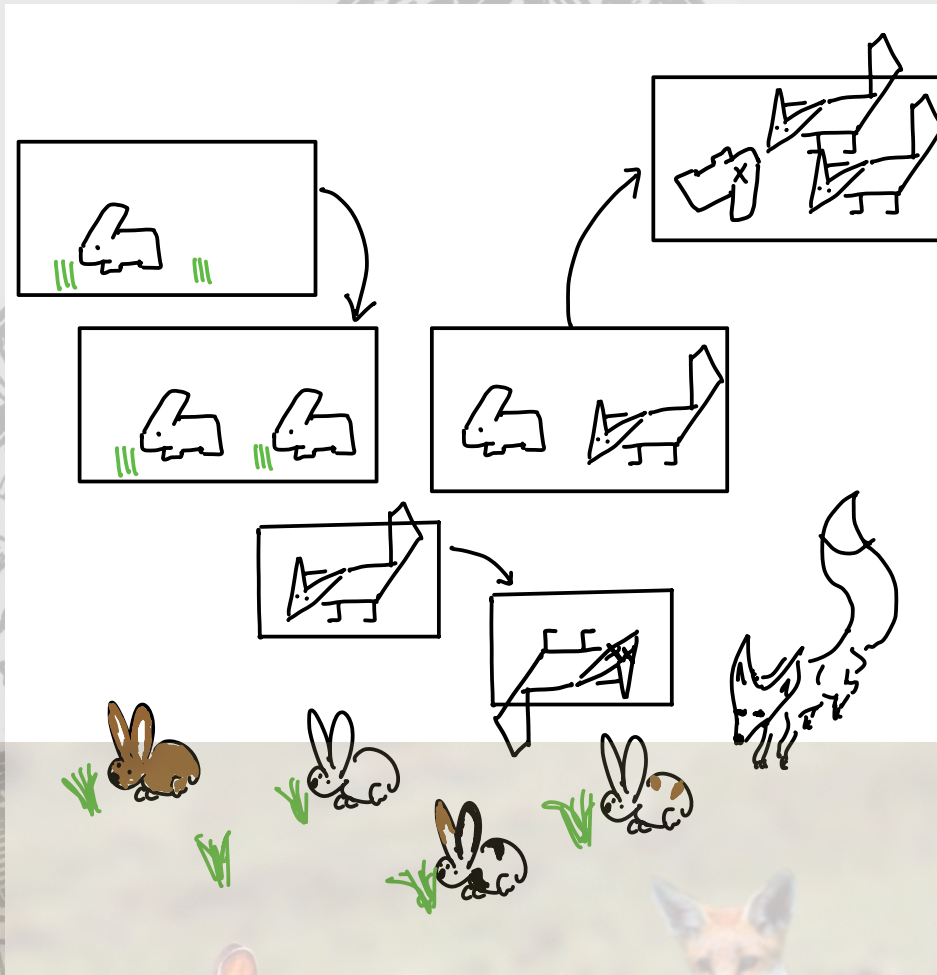






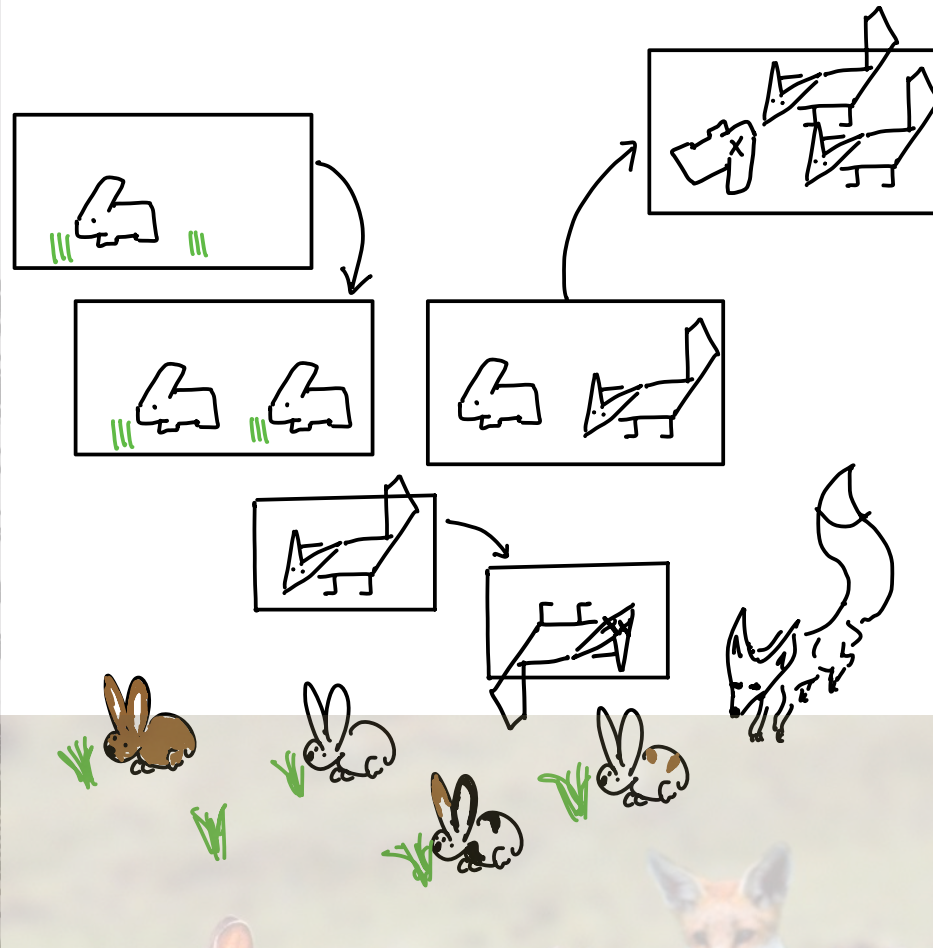






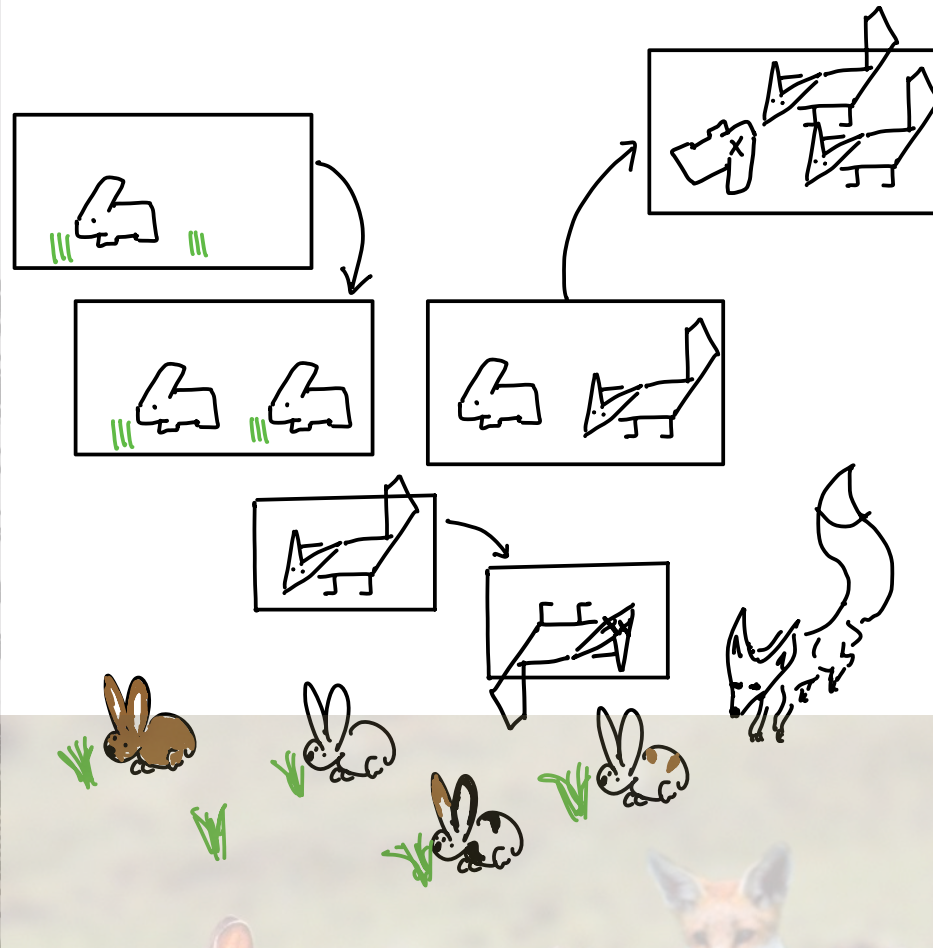
$$\frac{dx}{dt} = \alpha x - \beta xy$$

$$\frac{dy}{dt} = -\gamma y + \delta xy$$



$$\frac{dx}{dt} = \alpha x - \beta xy$$

$$\frac{dy}{dt} = -\gamma y + \delta xy$$



Intellect

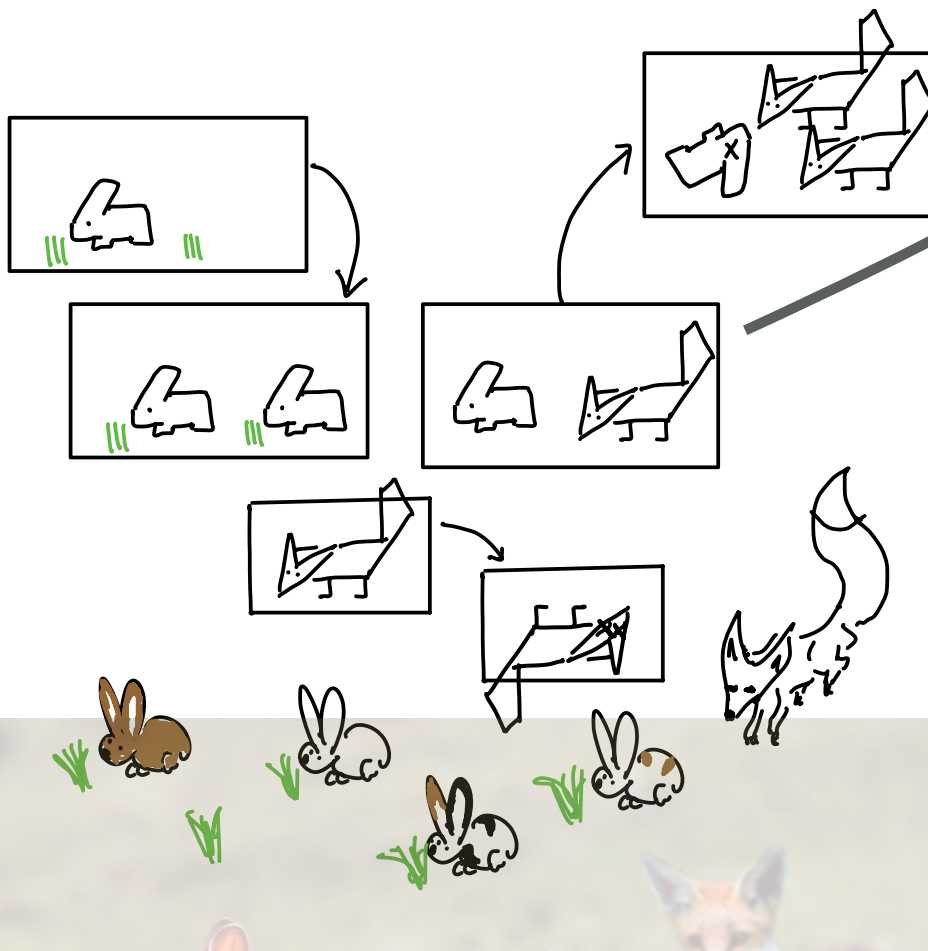
Imagination

Senses

$$\frac{dx}{dt} = \alpha x - \beta xy$$
$$\frac{dy}{dt} = -\gamma y + \delta xy$$

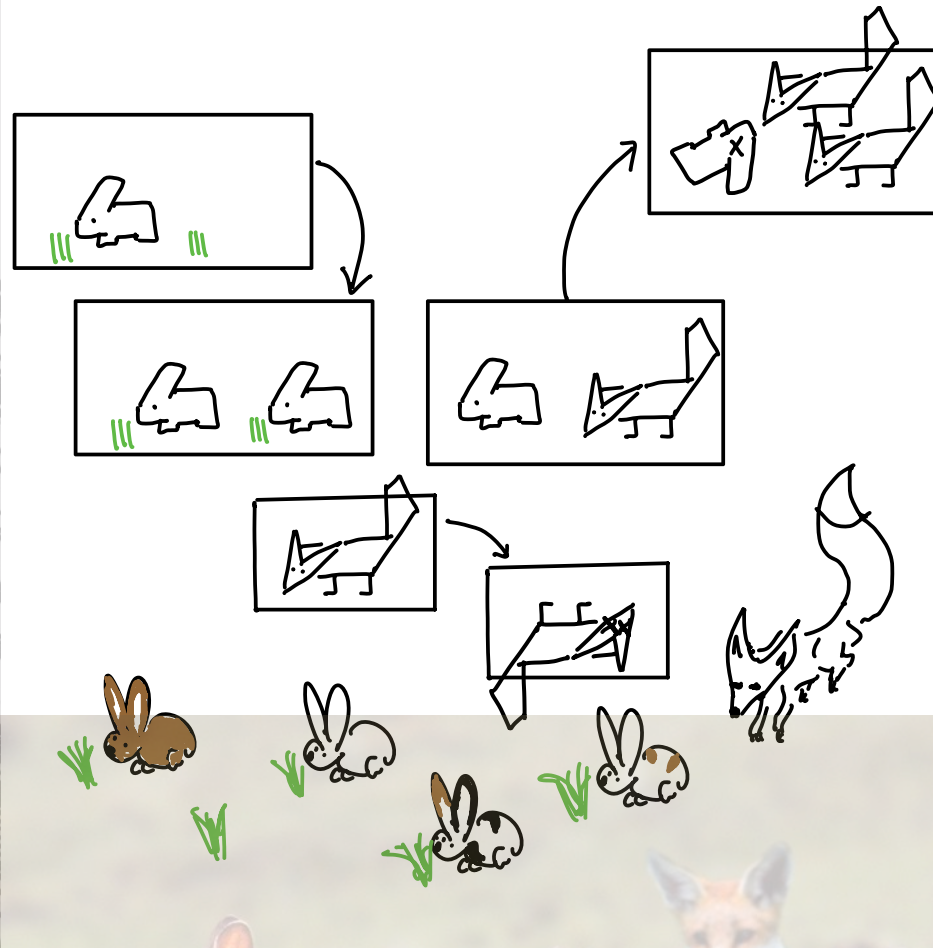
as

as



$$\frac{dx}{dt} = \alpha x - \beta xy$$

$$\frac{dy}{dt} = -\gamma y + \delta xy$$

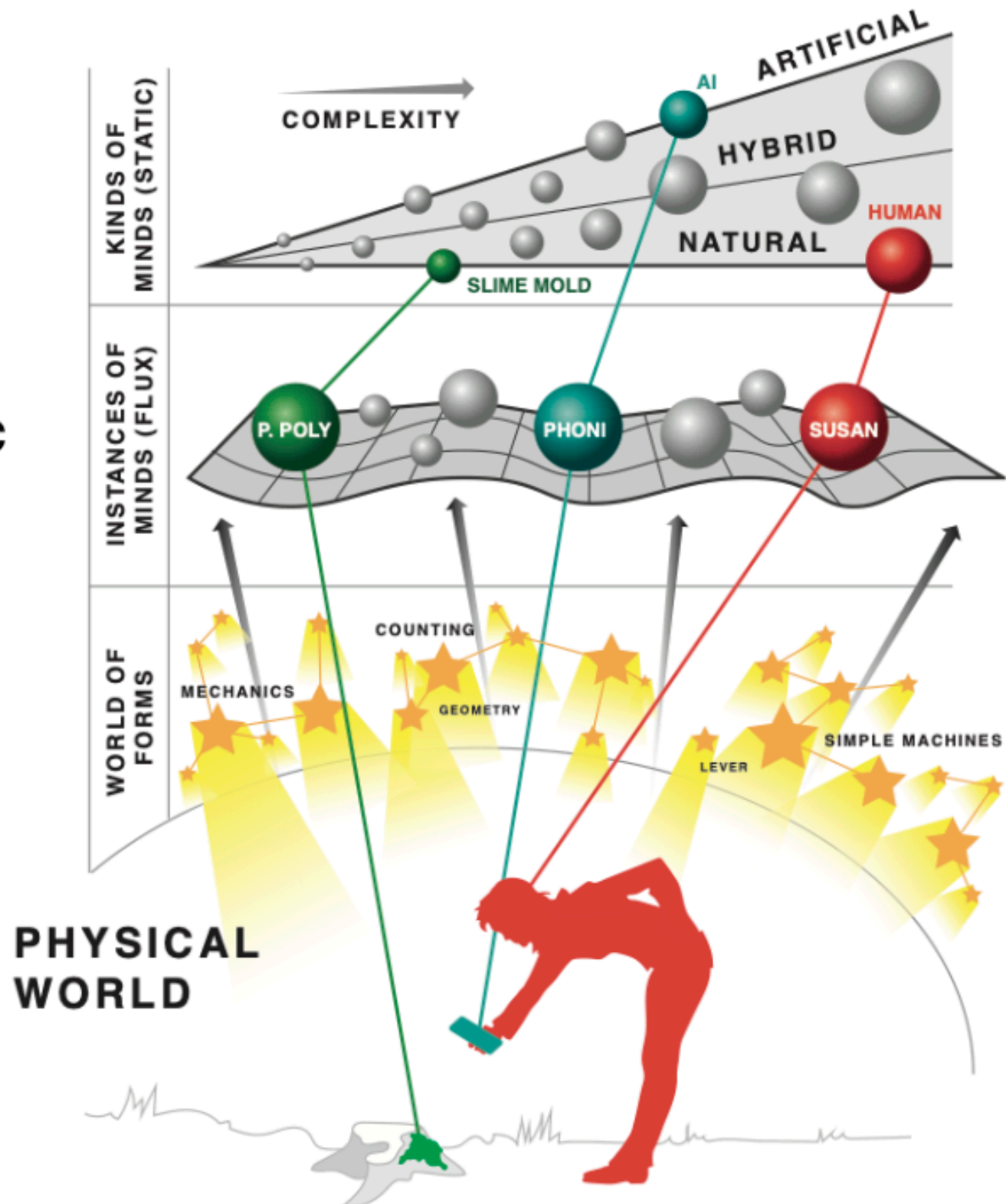


Intellect

Imagination

Senses

Platonic Space



Different kinds of creativity

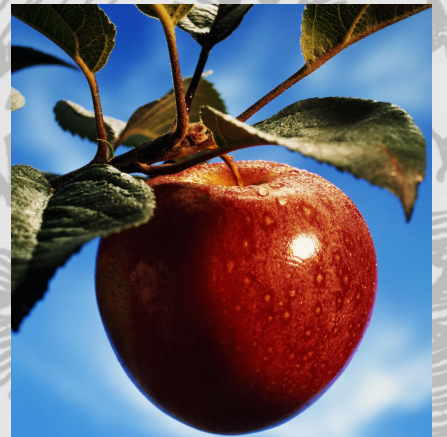
- Exploratory
- Combinatorial
- Transformational

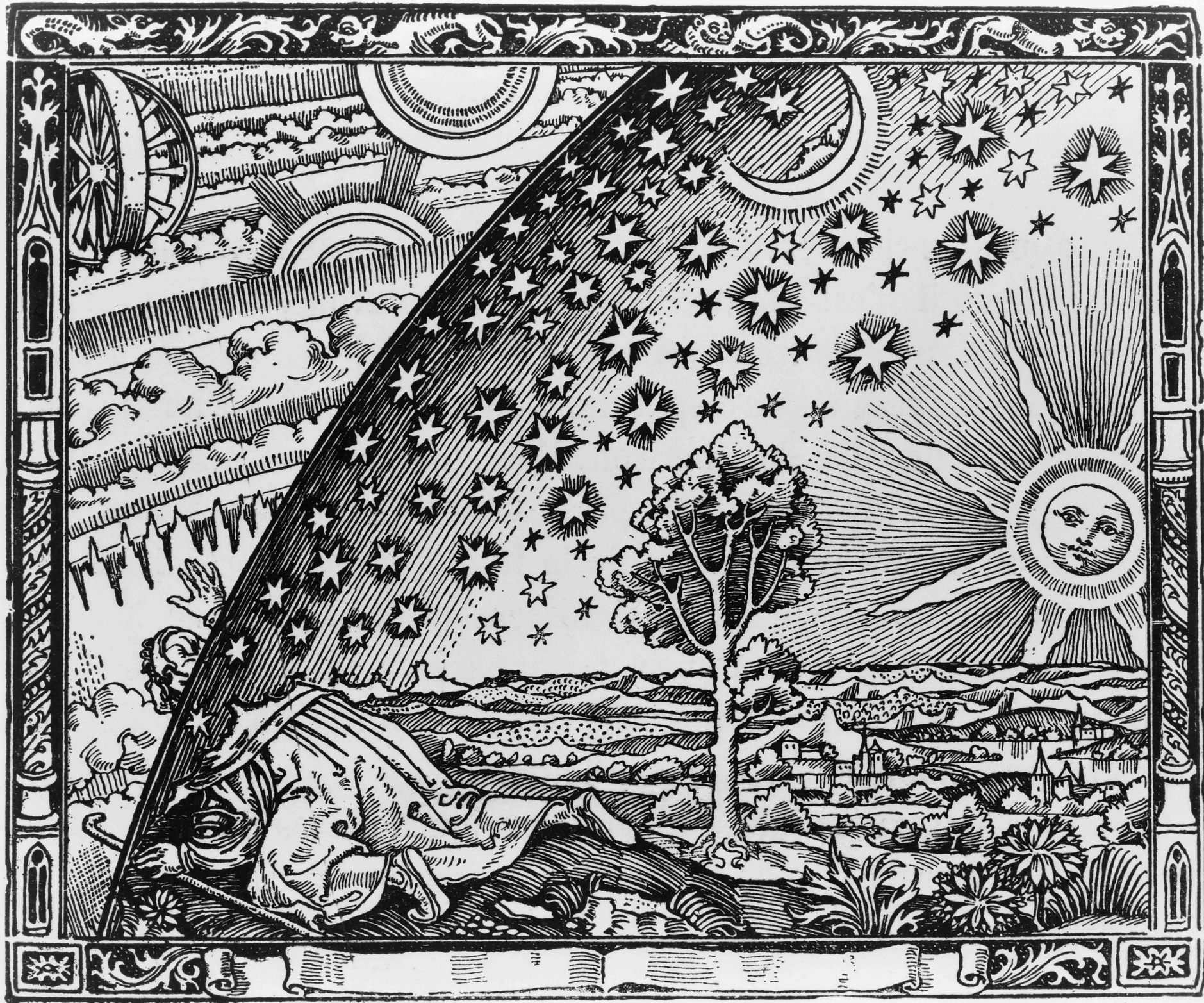
Margaret Boden



Imaginal

Understanding







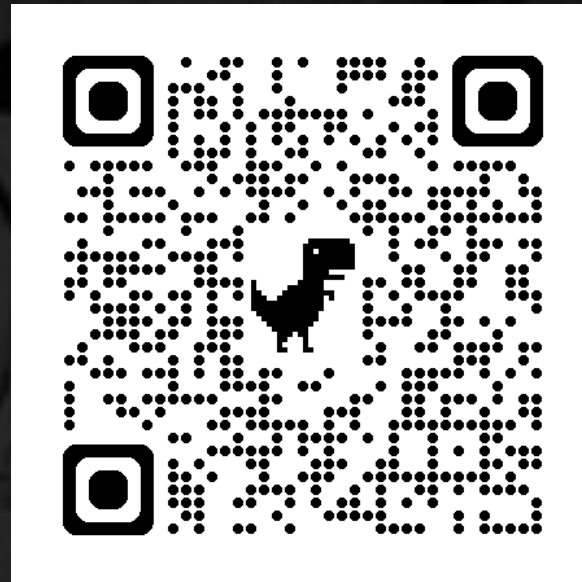
Culture:
shared regularity in the
organization of experience or the
generation of action
acquired through social life.

for the whole megillah, see

CULTURE AND COMPUTATION

Steps to a Probably Approximately Correct Theory of Culture

POETICS 2018



[HTTPS://DOI.ORG/10.1016/J.POETIC.2018.04.007](https://doi.org/10.1016/j.poetic.2018.04.007)

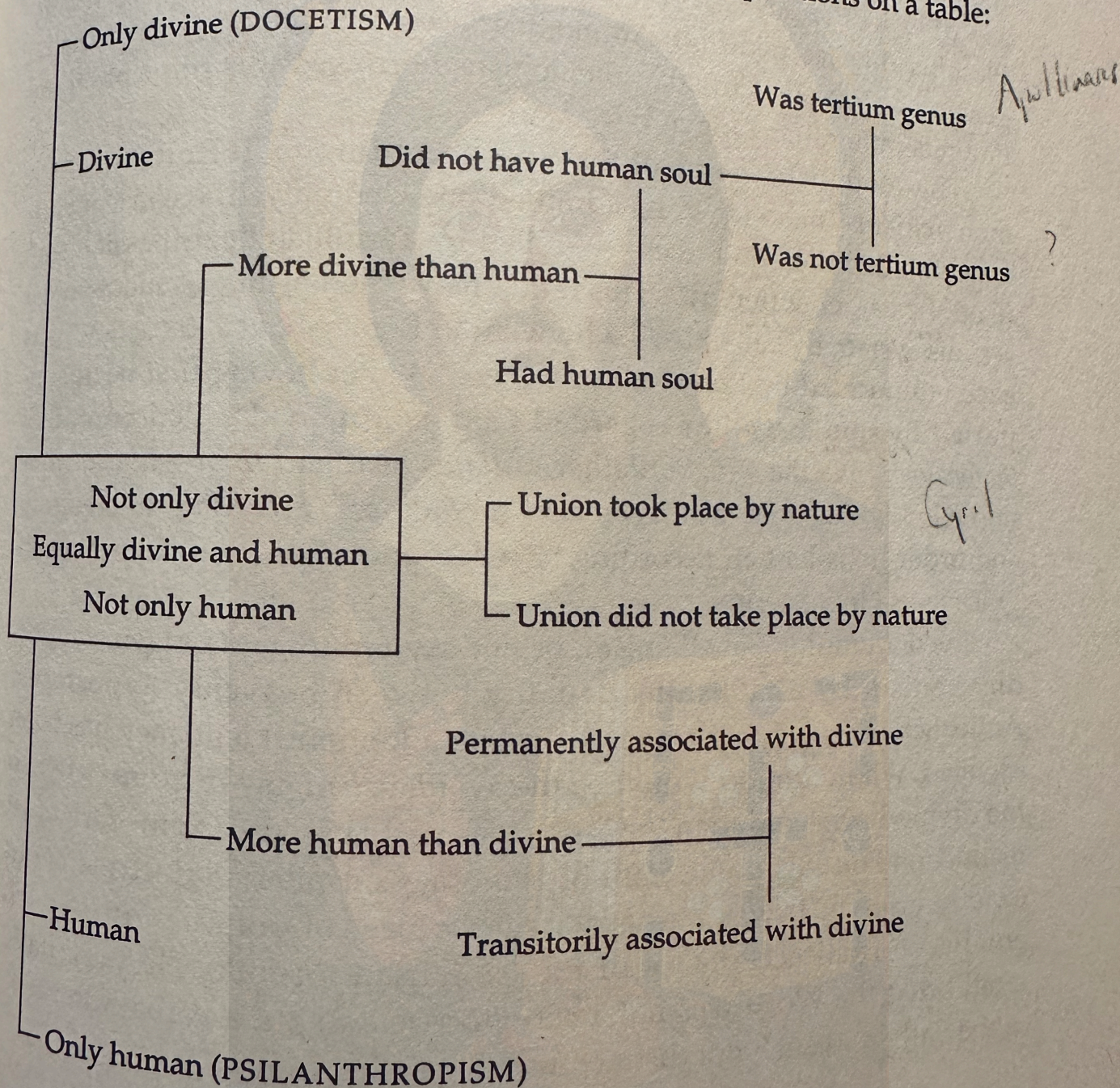
Monophysism

A mosaic of Christ Pantocrator from the 6th century, located in the St. Catherine's Monastery on Mount Sinai. Christ is depicted with long, dark hair and a beard, wearing a dark robe. He has a halo and is holding a book in his left hand, with his right hand raised in a gesture of blessing. The background is a gold leaf mosaic with a blue and gold pattern.

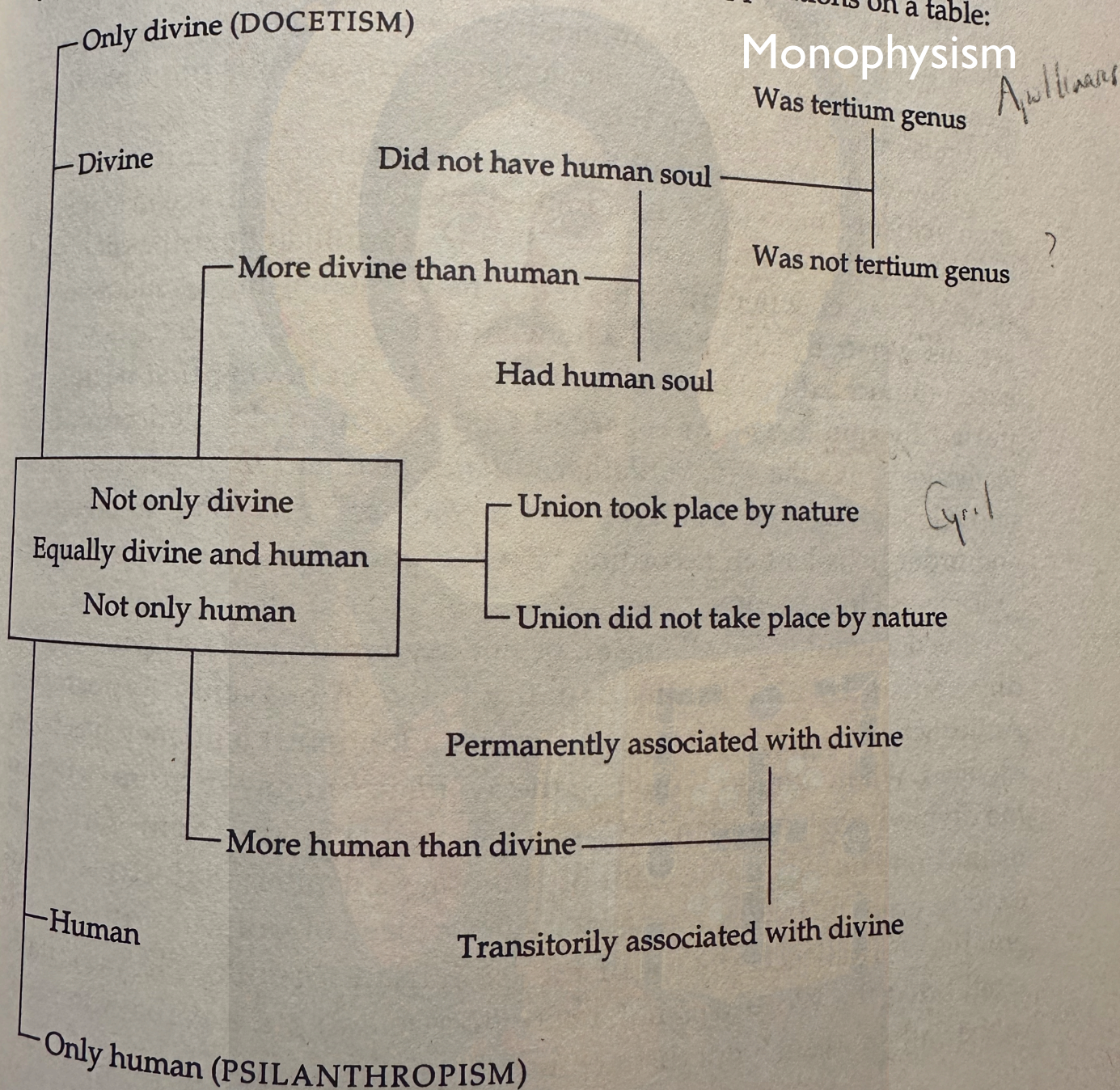
Christology

Christ Pantocrator, Anon., 6th C
St. Catherine's Monastery, Mt. Sinai

These were a few relevant dichotomies according to which the system works. It would be easier to trace the binary oppositions on a table:



These were a few relevant dichotomies according to which the system works. It would be easier to trace the binary oppositions on a table:



Trinitarian? Y/N

Equal? Y/N

Distinct? Y/N

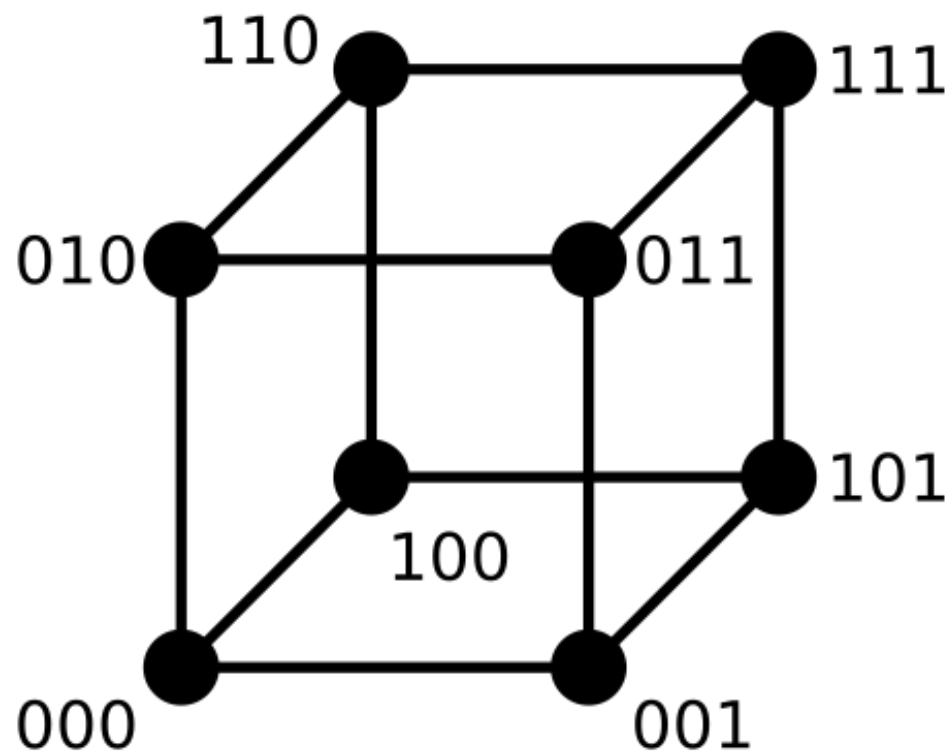


Trinity Sarcophagus
c. 350 CE

Trinitarian? Y/N

Equal? Y/N

Distinct? Y/N



SIHODUSNICEHIAE IIII NUMERUS
SCOR PATR CCCXVIII ET OMNES

SUBSCRIP

SECU

II



HERETICI

ARRIANI

DAMNATI





"A profound study of Western religious dualism: an immensely learned chronicle of Gnosis and the varieties of Gnosticism."
—Harold Bloom, author of *The Book of J*

The Tree of Gnosis

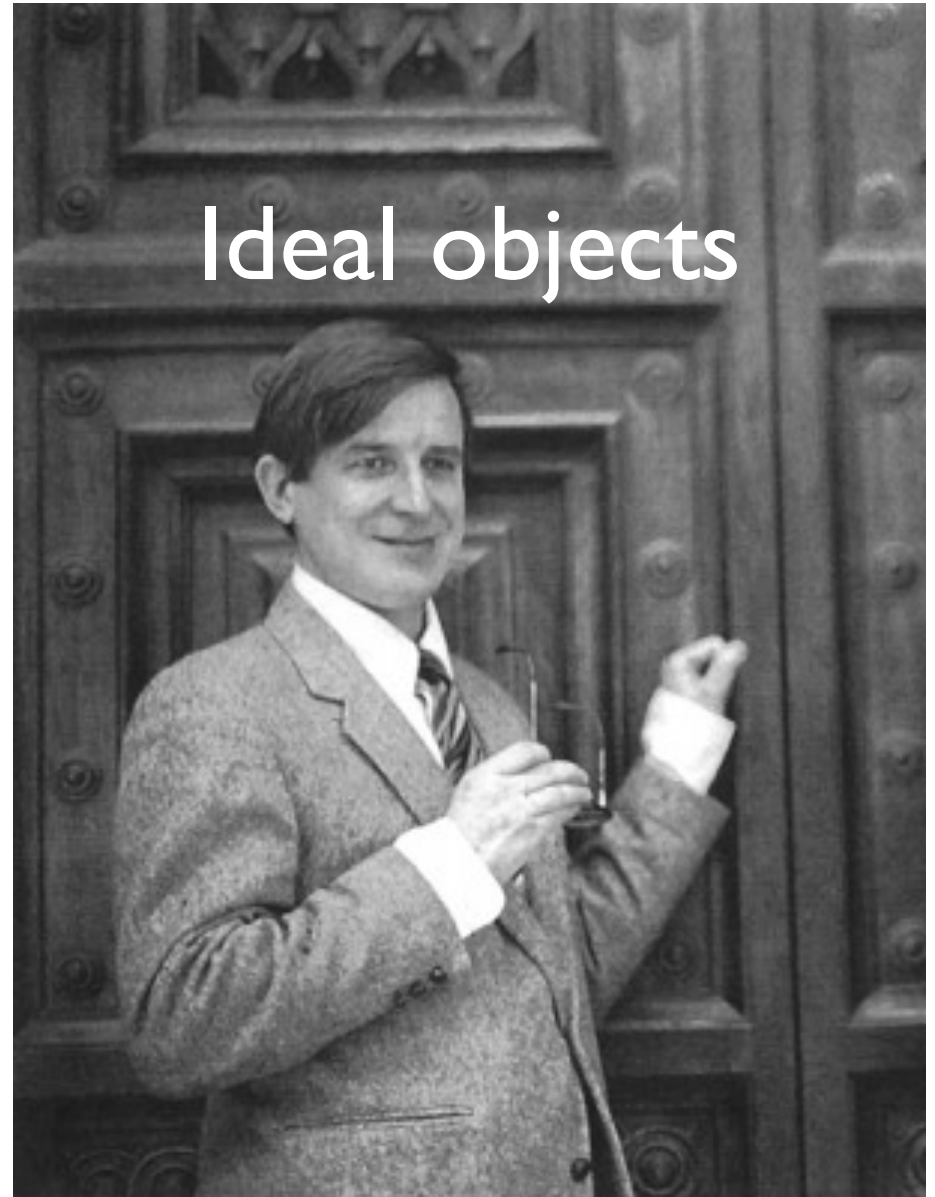


*Gnostic Mythology from Early
Christianity to Modern Nihilism*



Ioan P. Couliano

Ideal objects



"A profound study of Western religious dualism: an immensely learned chronicle of Gnosis and the varieties of Gnosticism."
—Harold Bloom, author of *The Book of J*

The Tree of Gnosis

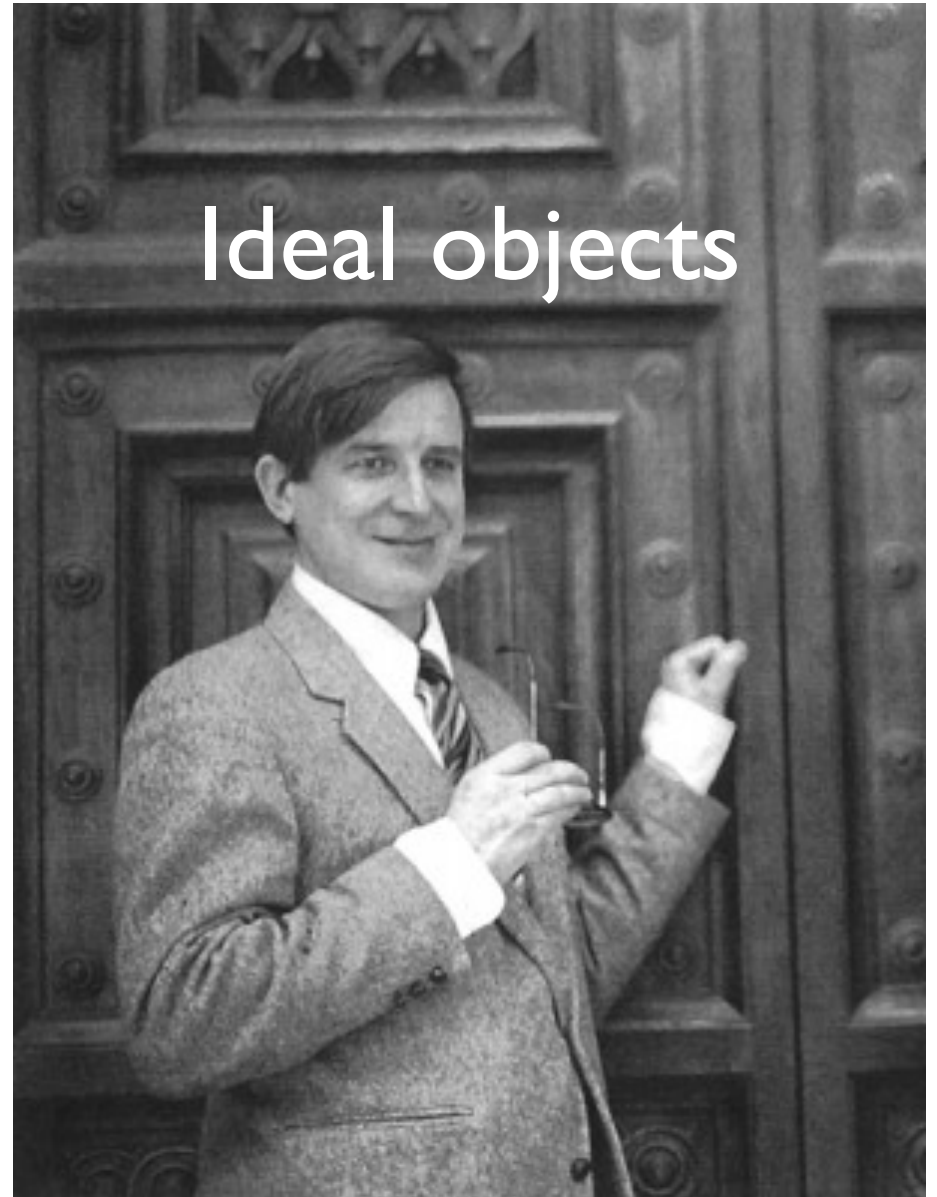


*Gnostic Mythology from Early
Christianity to Modern Nihilism*



Ioan P. Couliano

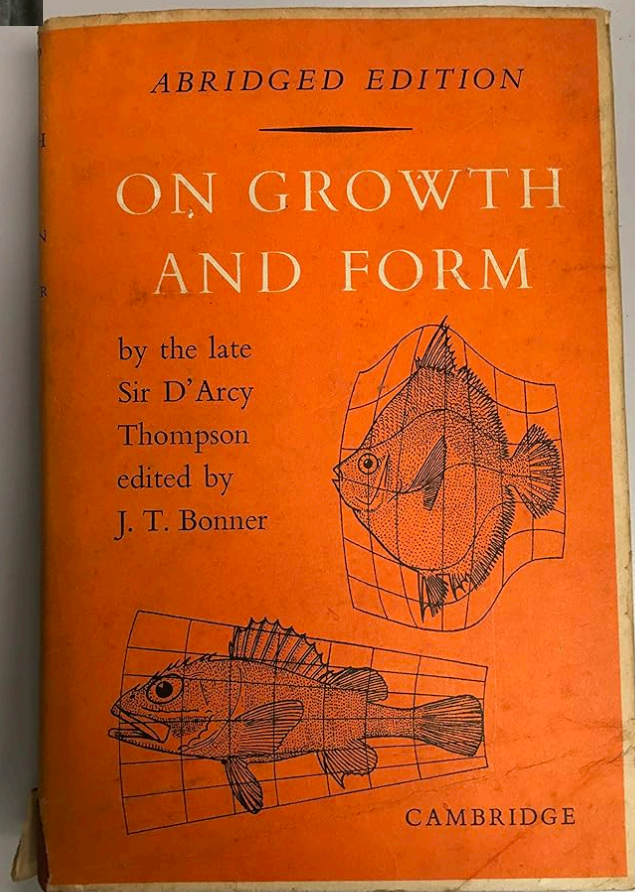
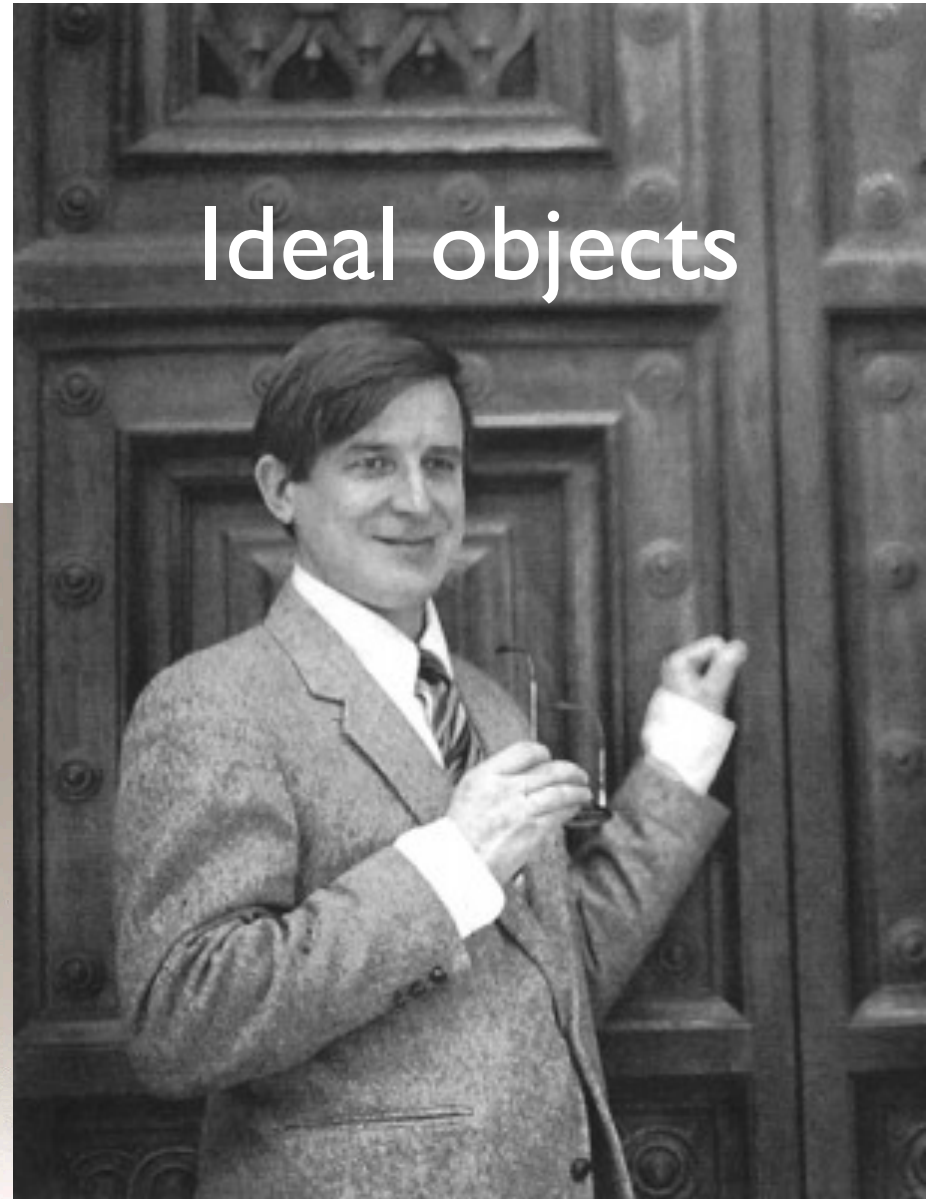
Ideal objects

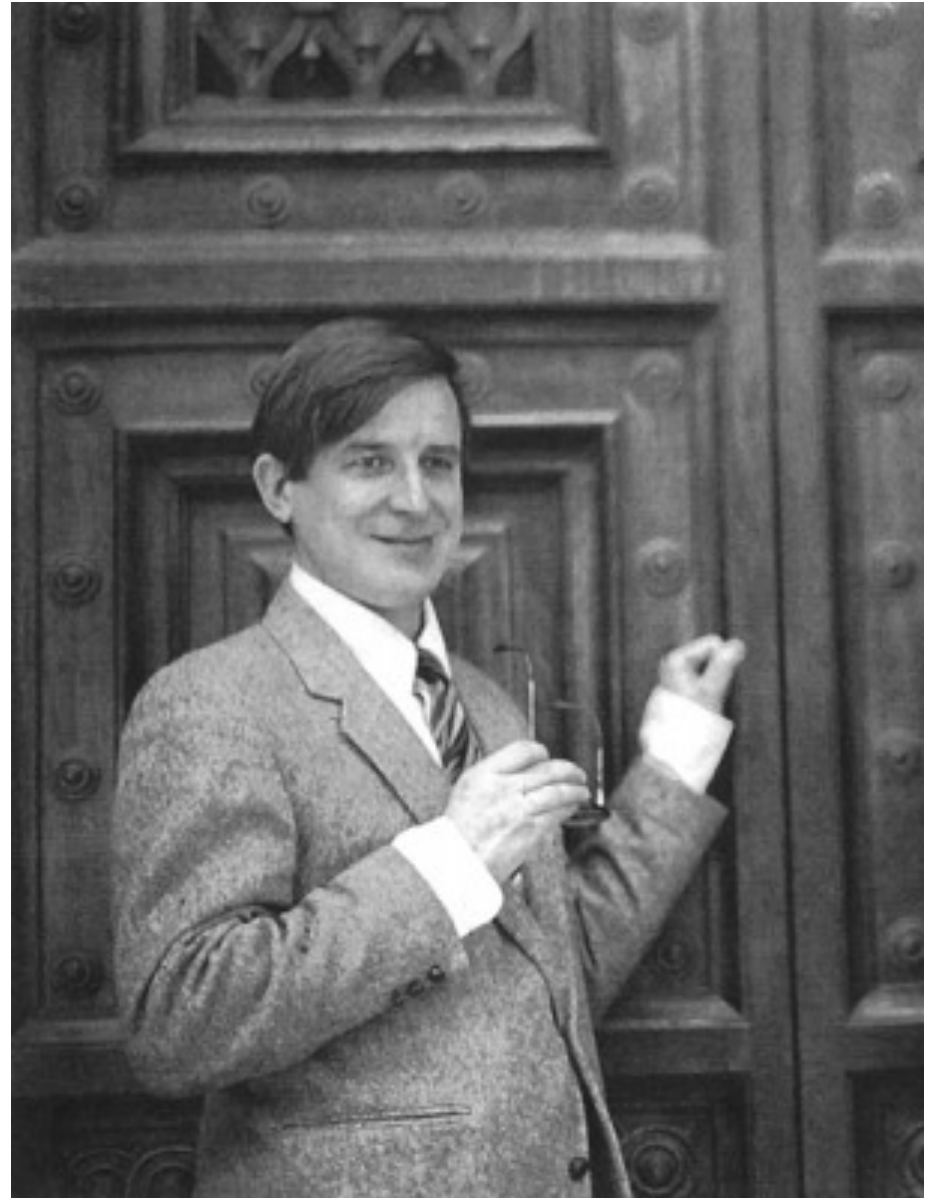


“Systems of ideas that exist
in their ‘logical dimension.’”

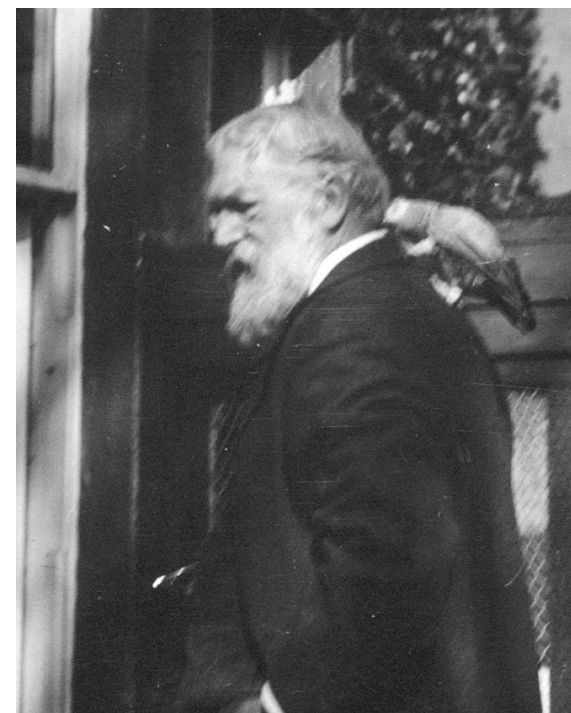
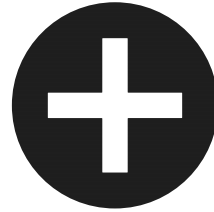
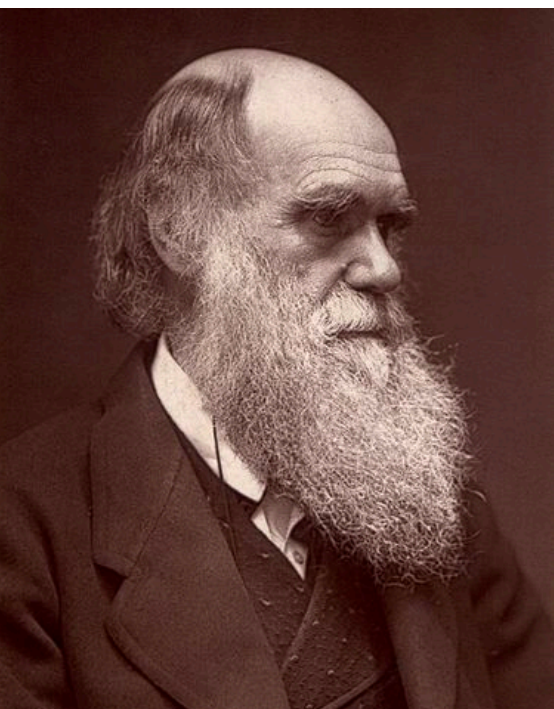


Ideal objects

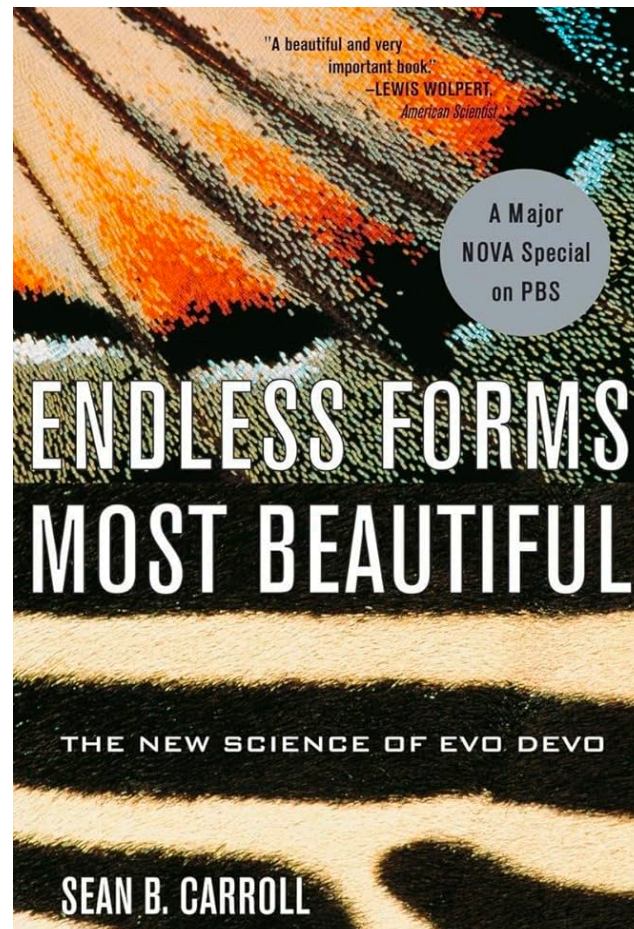




Morphodynamics



=




Cultural evolution
needs to go **evo-devo**


Parallel evolution of marsupial and placental mammals

▲ marsupial
● placental


▲ short-headed glider, sugar glider, flying phalanger, flying possum (*Petaurus breviceps*)



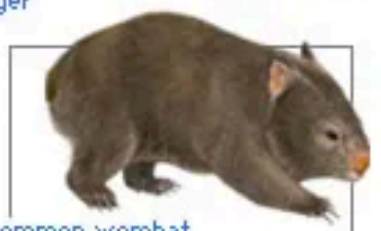
▲ marsupial mole (*Notoryctes typhlops*)




▲ thylacine, Tasmanian wolf, Tasmanian tiger (*Thylacinus cynocephalus*)




▲ common wombat (*Vombatus ursinus*)




● European mole (*Talpa europaea*)



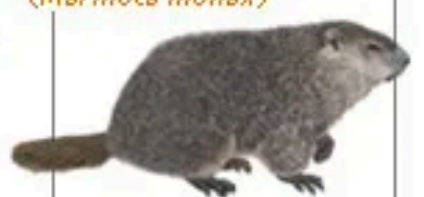
▲ crest-tailed marsupial mouse, mulgara (*Dasycercus cristicauda*)




● gray wolf, timber wolf (*Canis lupus*)




● woodchuck, groundhog, marmot (*Marmota monax*)




● southern flying squirrel, North American flying squirrel (*Glaucomys volans*)




● house mouse (*Mus musculus*)




● giant anteater (*Myrmecophaga tridactyla*)



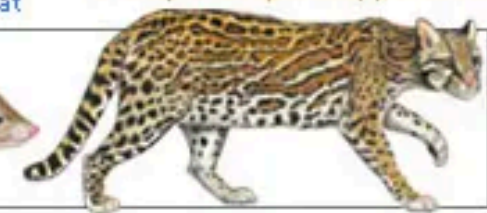
▲ numbat, banded anteater (*Myrmecobius fasciatus*)



▲ spotted-tailed native cat, tiger cat (*Dasyurus maculatus*)



● ocelot (*Felis, or Leopardus, pardalis*)



Animals are not shown to relative scale.

© 2005 Encyclopædia Britannica, Inc.

Diverged > 100 Million Years ago

Ecological demands plus **generative resources**



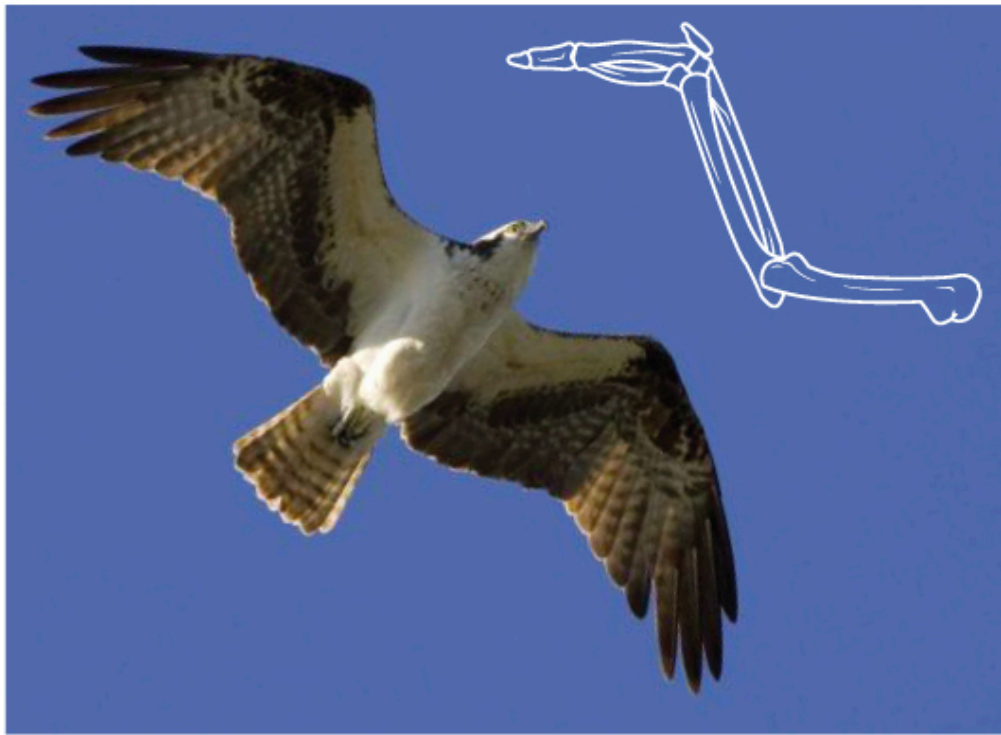
Feigin et al., 2019

Ecological demands plus **generative resources**

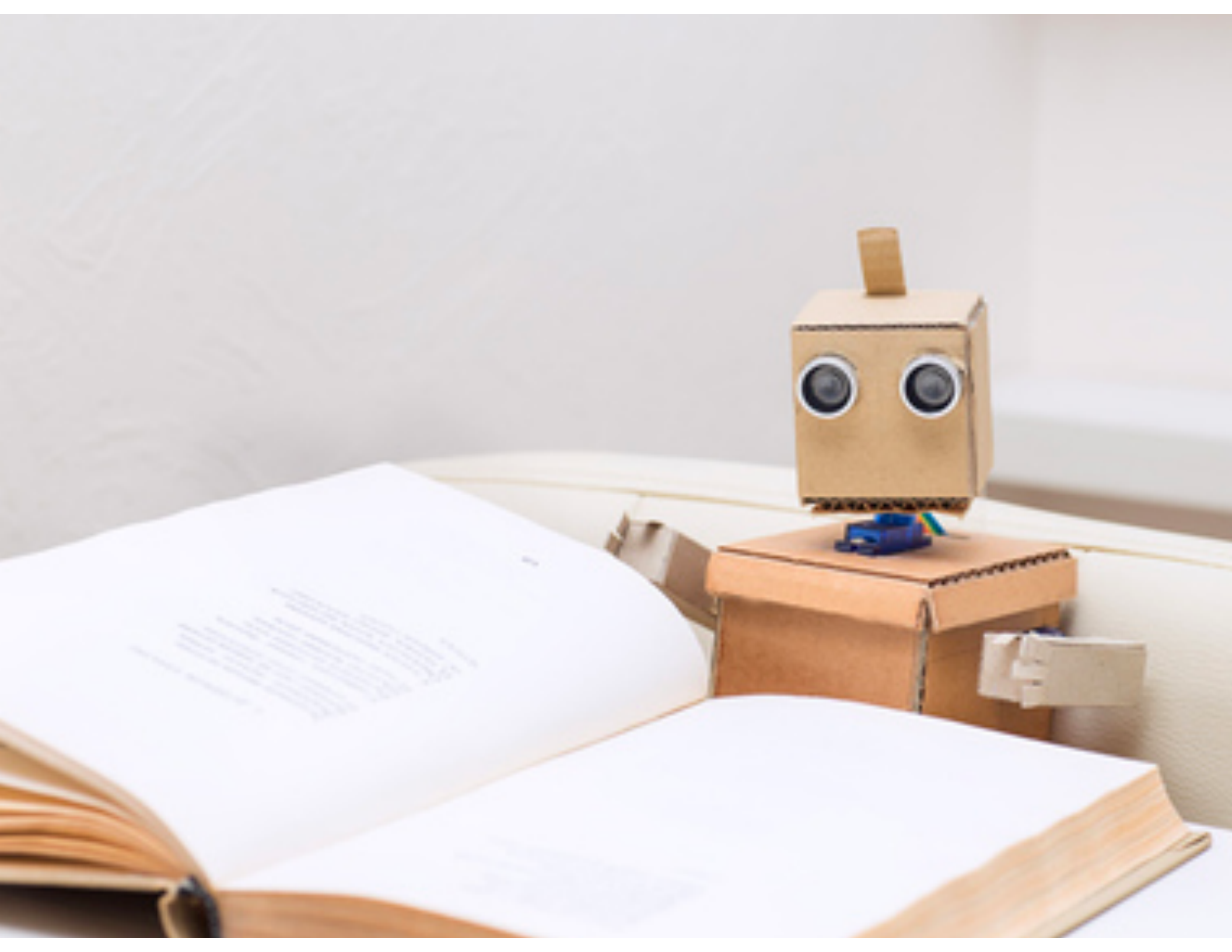


SMBC-Comics, 2009

Ecological demands plus **generative resources**



Foster (2017) in *Trajectories*
commenting on Emigh et al., *How Societies and States Count*





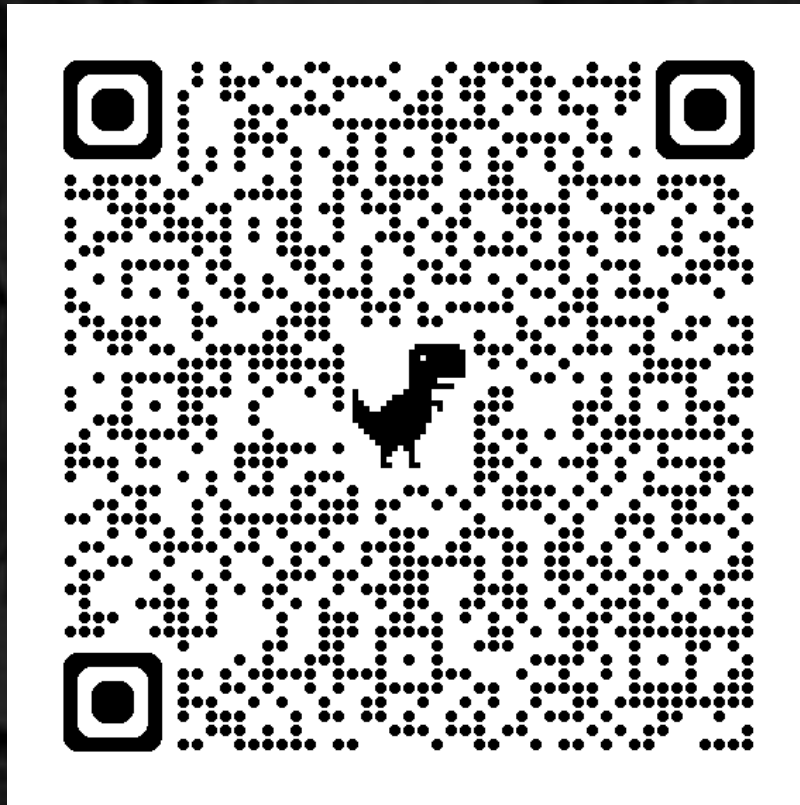
EVOLUTIONARY DYNAMICS OF CULTURAL CHANGE

W/ BERNARD KOCH AND DANIELE SILVESTRO



Conditionally accepted at *American Journal of Sociology*

EVOLUTIONARY DYNAMICS OF CULTURAL CHANGE



The data



Search:

Band name

ADVANCED SEARCH

SUBMIT

HELP

RULES

FORUM

FAQ

|

SUPPORT US

|

ADD-ONS

AMORPHIS

report an error

| | | | |
|--------------------|-------------------|-----------------|---|
| Country of origin: | Finland | Genre: | Progressive/Death/Doom Metal (early); Melodic Heavy Metal/Rock (later) |
| Location: | Helsinki, Uusimaa | Lyrical themes: | War, Legends (early); Death, Finnish legends, Kalevala |
| Status: | Active | Current label: | Nuclear Blast |
| Formed in: | 1990 | | |
| Years active: | 1990-present | | |

The first band added to the Metal Archives.

Amorphis is derived from the Greek 'amorphous' which means without determinate form, shapeless.

With Violent Solution's break-up, Jan Rechberger and Esa Holopainen formed Amorphis in 1990 with Jan on drums, Esa on lead guitars, Tomi Koivusaari as vocalist, and Olli-Pekka Laine as bassist. Soon after signing with Relapse Records (which would remain ...

READ MORE

- DISCOGRAPHY
- MEMBERS
- REVIEWS
- SIMILAR ARTISTS
- RELATED LINKS

| COMPLETE DISCOGRAPHY | MAIN | LIVES | DEMOS | MISC. |
|-----------------------------|--------------------|-------------|----------|-------|
| | | | | |
| Name | Type | Year | Reviews | |
| <i>Dismant of Soul</i> | Demo | 1991 | 2 (73%) | |
| Amorphis | Single | 1991 | 1 (85%) | |
| The Karelian Isthmus | Full-length | 1992 | 11 (85%) | |



Buy their stuff

Search on eBay [more...](#) >>

Search on Amazon.com [more...](#) >>

Buy from No Remorse

The data

Thanks to our anonymous informant, HellBlazer



Search: Band name ▼

ADVANCED SEARCH SUBMIT ➤

HELP ⌕ RULES ⌕ FORUM

FAQ | SUPPORT US | ADD-ONS

AMORPHIS

[report an error](#)

| | | | |
|--------------------|-------------------|-----------------|---|
| Country of origin: | Finland | Genre: | Progressive/Death/Doom Metal (early); Melodic Heavy Metal/Rock (later) |
| Location: | Helsinki, Uusimaa | Lyrical themes: | War, Legends (early); Death, Finnish legends, Kalevala |
| Status: | Active | Current label: | Nuclear Blast |
| Formed in: | 1990 | | |
| Years active: | 1990-present | | |

The first band added to the Metal Archives.

Amorphis is derived from the Greek 'amorphous' which means without determinate form, shapeless.

With Violent Solution's break-up, Jan Rechberger and Esa Holopainen formed Amorphis in 1990 with Jan on drums, Esa on lead guitars, Tomi Koivusaari as vocalist, and Olli-Pekka Laine as bassist. Soon after signing with Relapse Records (which would remain ...

[READ MORE](#) ➤

- DISCOGRAPHY
- MEMBERS
- REVIEWS
- SIMILAR ARTISTS
- RELATED LINKS

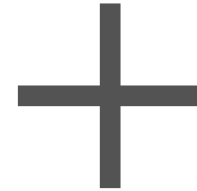
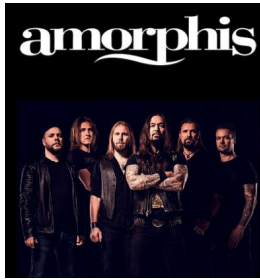
| COMPLETE DISCOGRAPHY | MAIN | LIVES | DEMOS | MISC. |
|-----------------------------|--------------------|-------------|----------|-------|
| | | | | |
| Name | Type | Year | Reviews | |
| <i>Dismant of Soul</i> | Demo | 1991 | 2 (73%) | |
| Amorphis | Single | 1991 | 1 (85%) | |
| The Karelian Isthmus | Full-length | 1992 | 11 (85%) | |



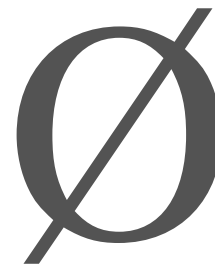
Buy their stuff

Search on eBay [more...](#) >>
Search on Amazon.com [more...](#) >>
[Buy from No Remorse](#)

birth:



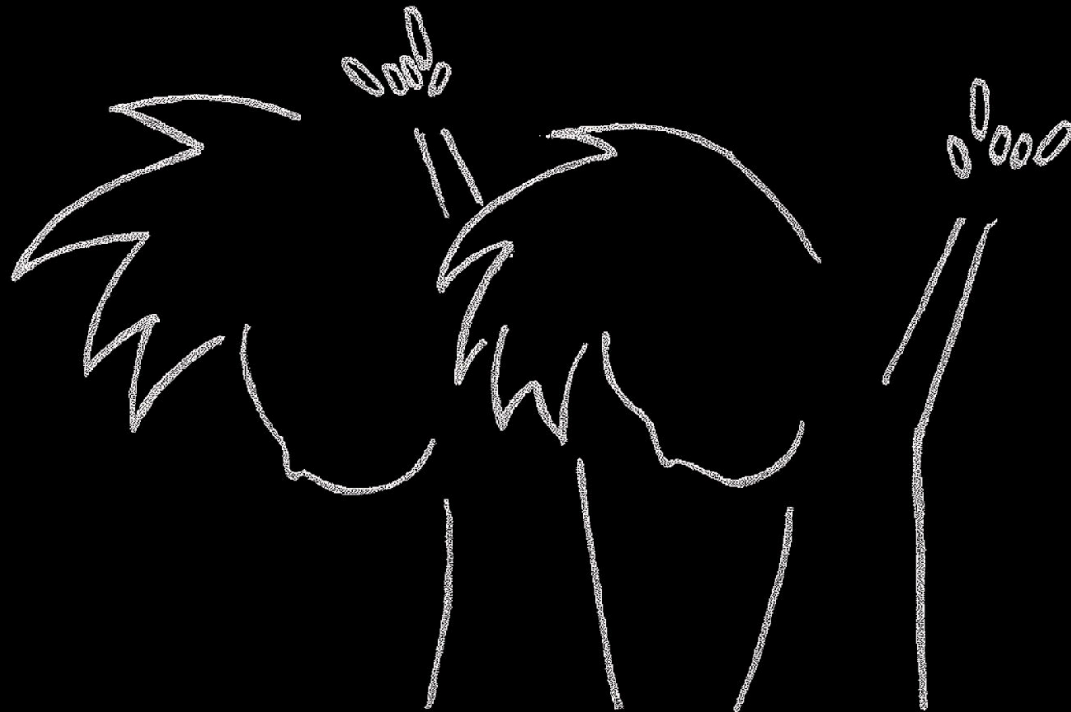
death:



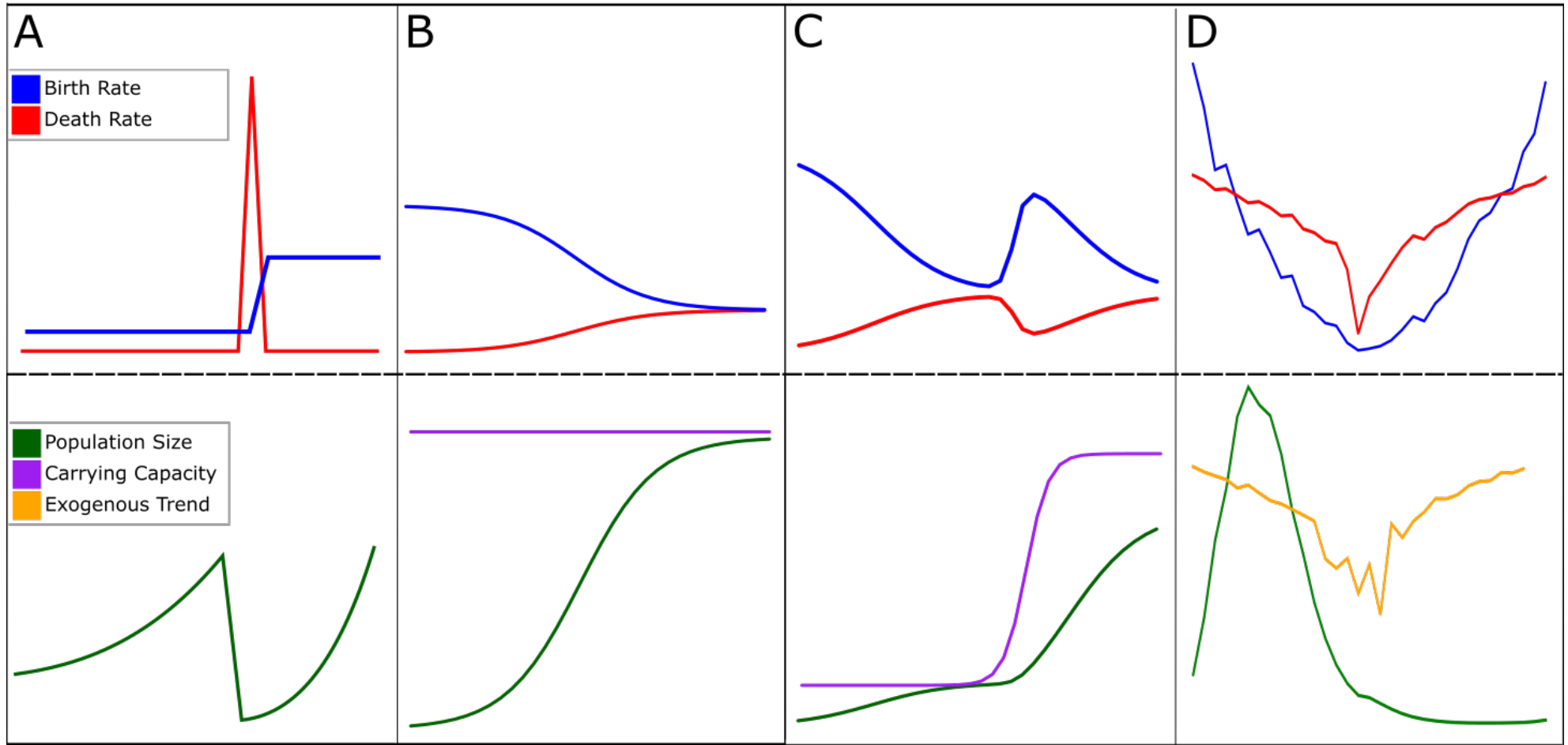
Bands compete for...

Bands compete for...

METAL HEADS



Evolutionary mechanisms



Time

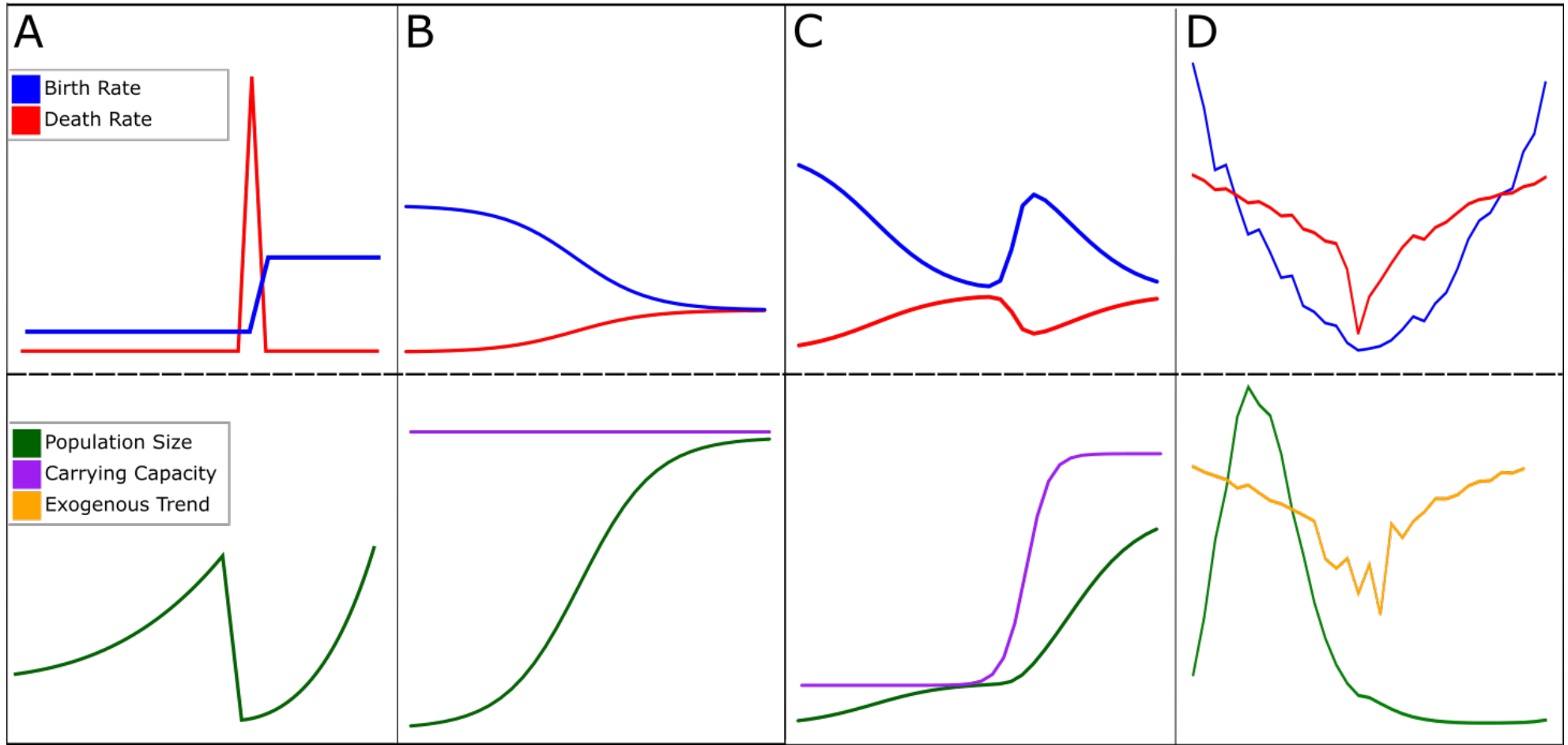
**Mass
extinction**

Competition

**Key
innovation**

**Exogenous
forcing**

Evolutionary mechanisms



Time

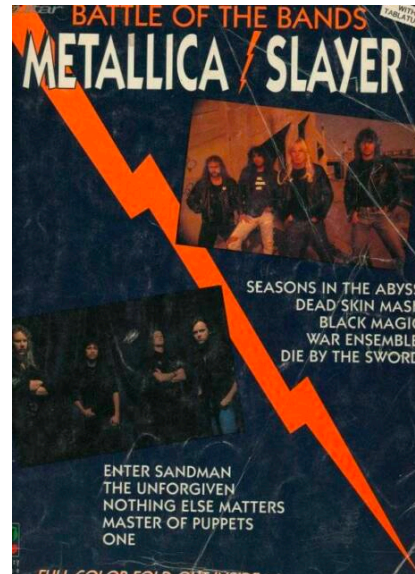
**Mass
extinction**

Competition

**Key
innovation**

**Exogenous
forcing**

Evolutionary mechanisms



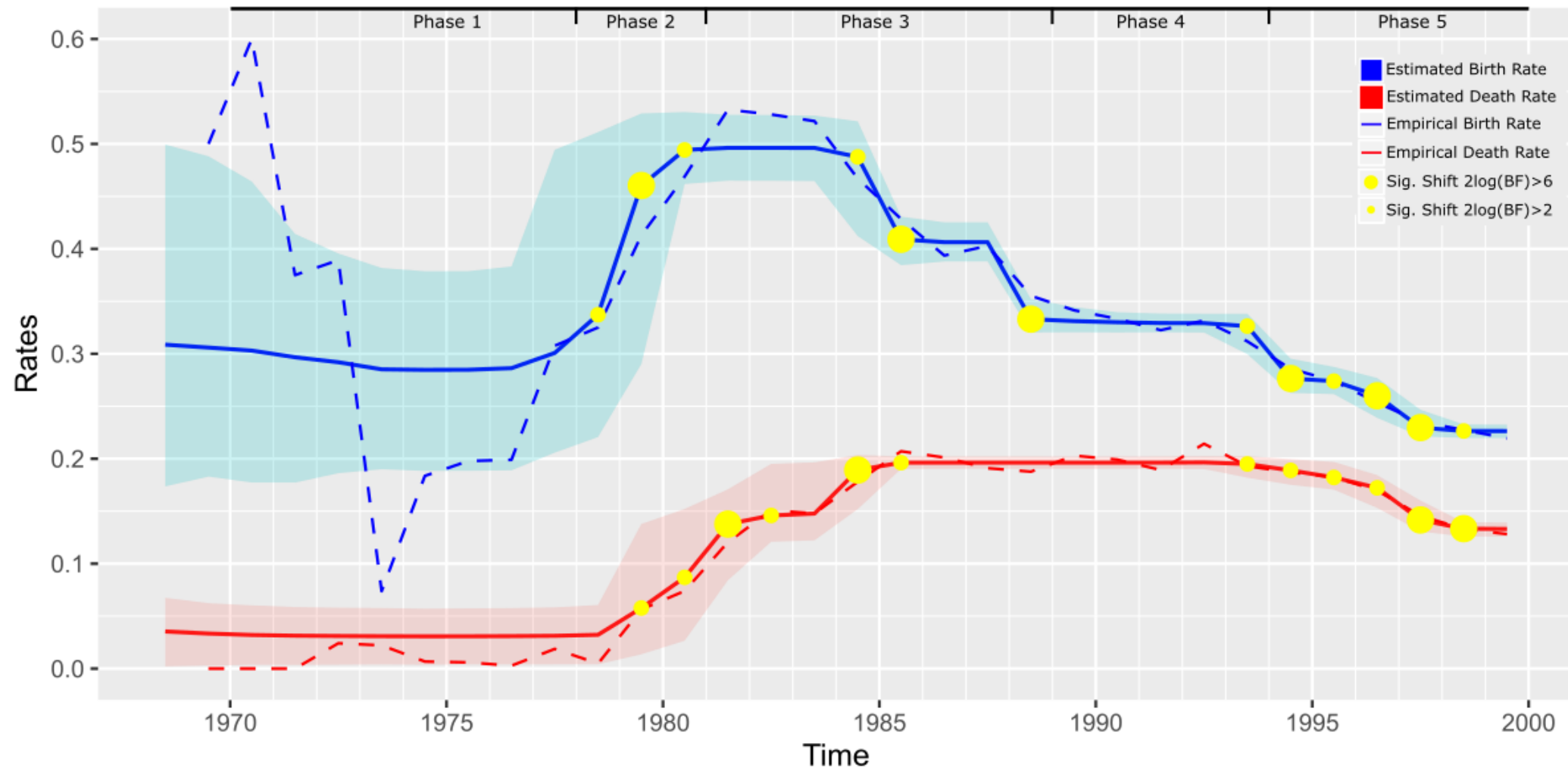
**Mass
extinction**

Competition

**Key
innovation**

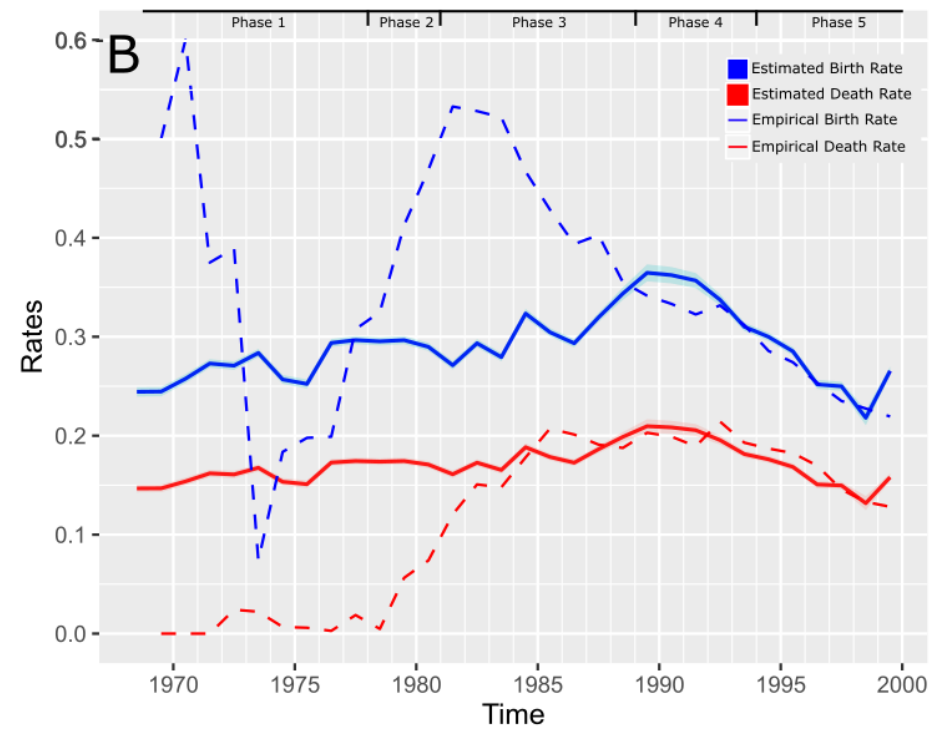
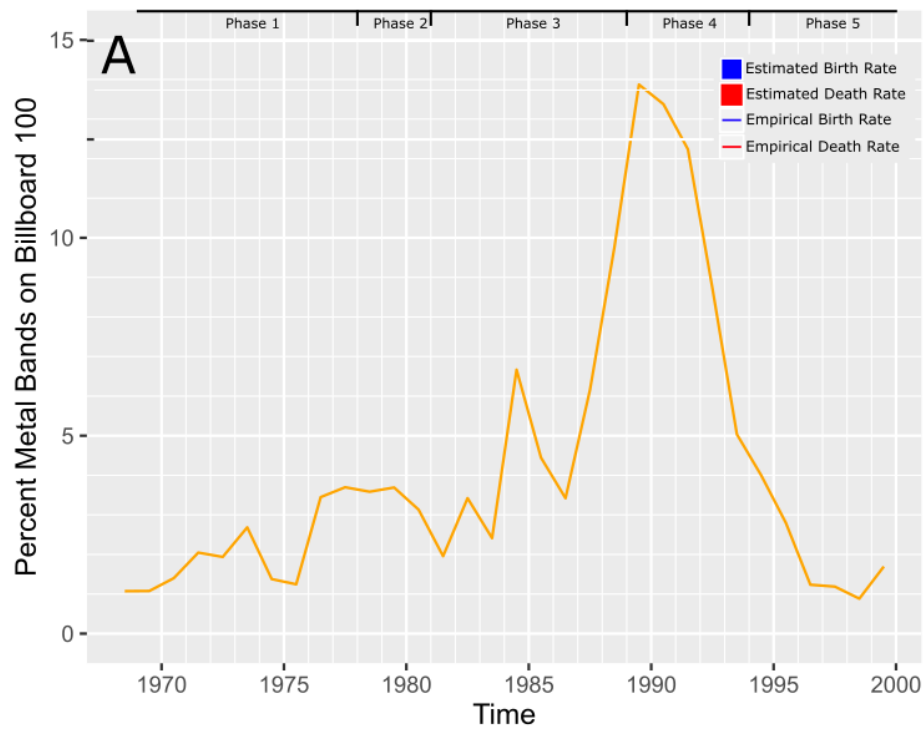
**Exogenous
forcing**

No evidence for mass extinction

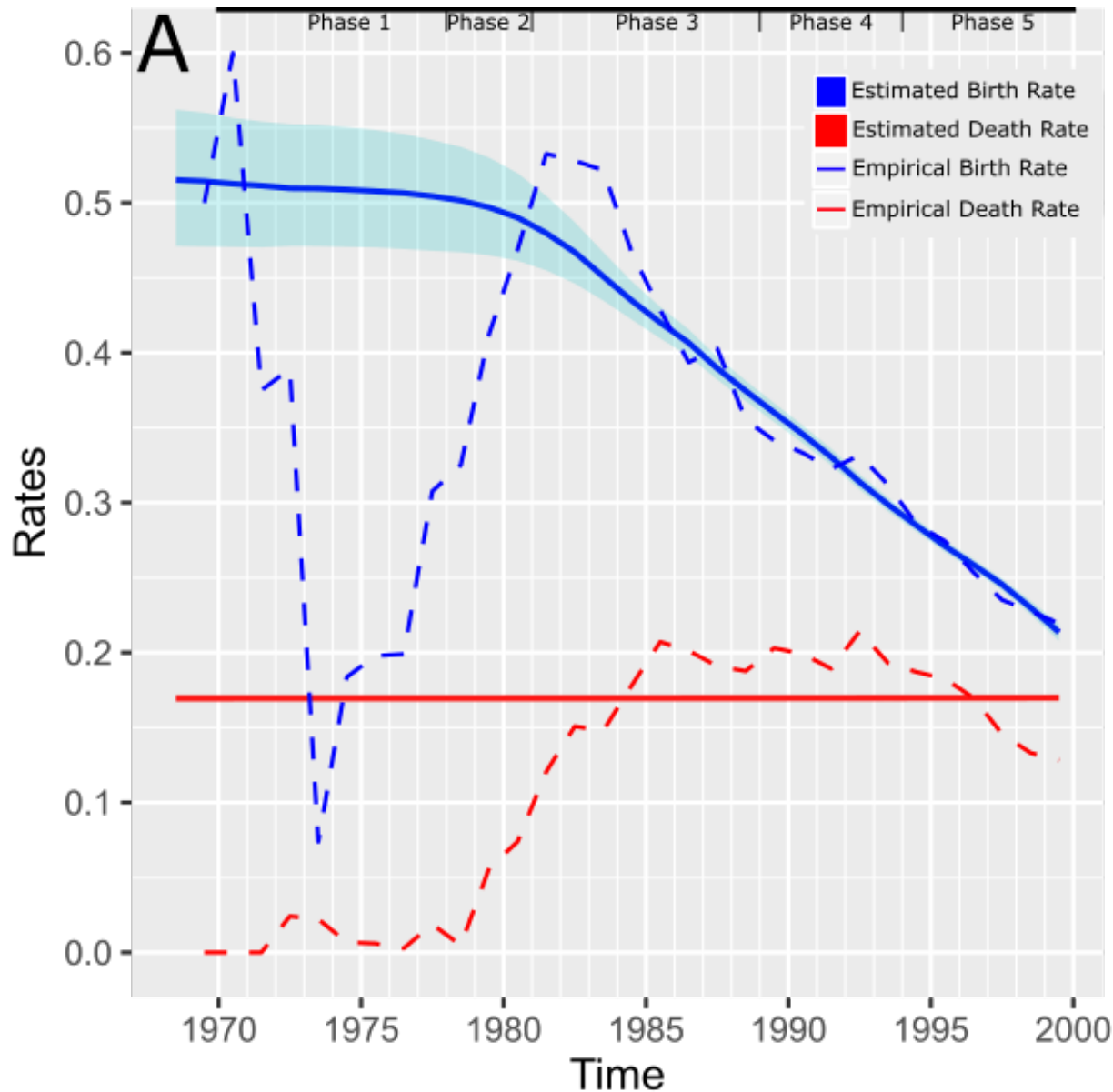


with **RJMCMC** (minimal assumptions)

rejecting a crude economic story



not just competition



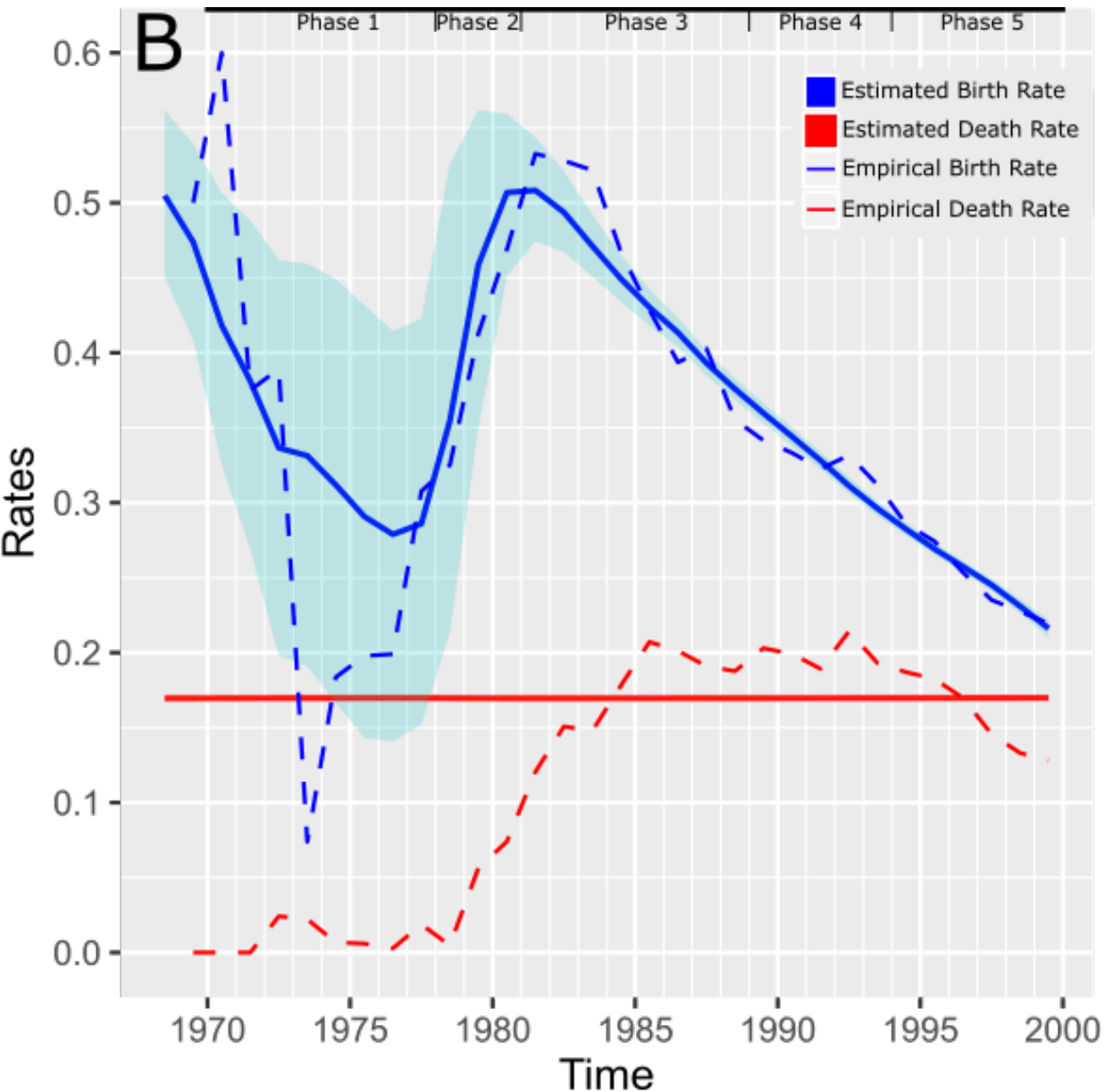
$$\lambda(t) = \lambda_{\max} - (\lambda_{\max} - \kappa) \left(\frac{D(t)}{K} \right)^{\delta}$$

$$\mu(t) = \mu_{\min} + (\kappa - \mu_{\min}) \left(\frac{D(t)}{K} \right)^{\gamma}$$

birth & death rates
converge as **carrying capacity** filled



innovation relaxes competition

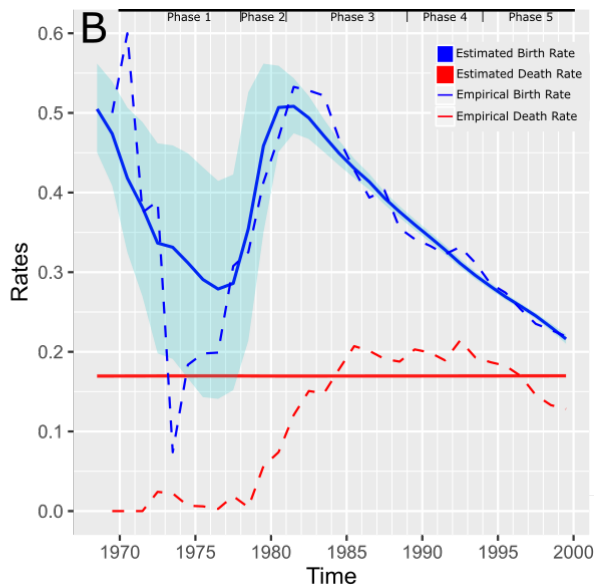


$$\lambda(t) = \lambda_{\max} - (\lambda_{\max} - \kappa) \left(\frac{D(t)}{K(t)} \right)^{\delta}$$

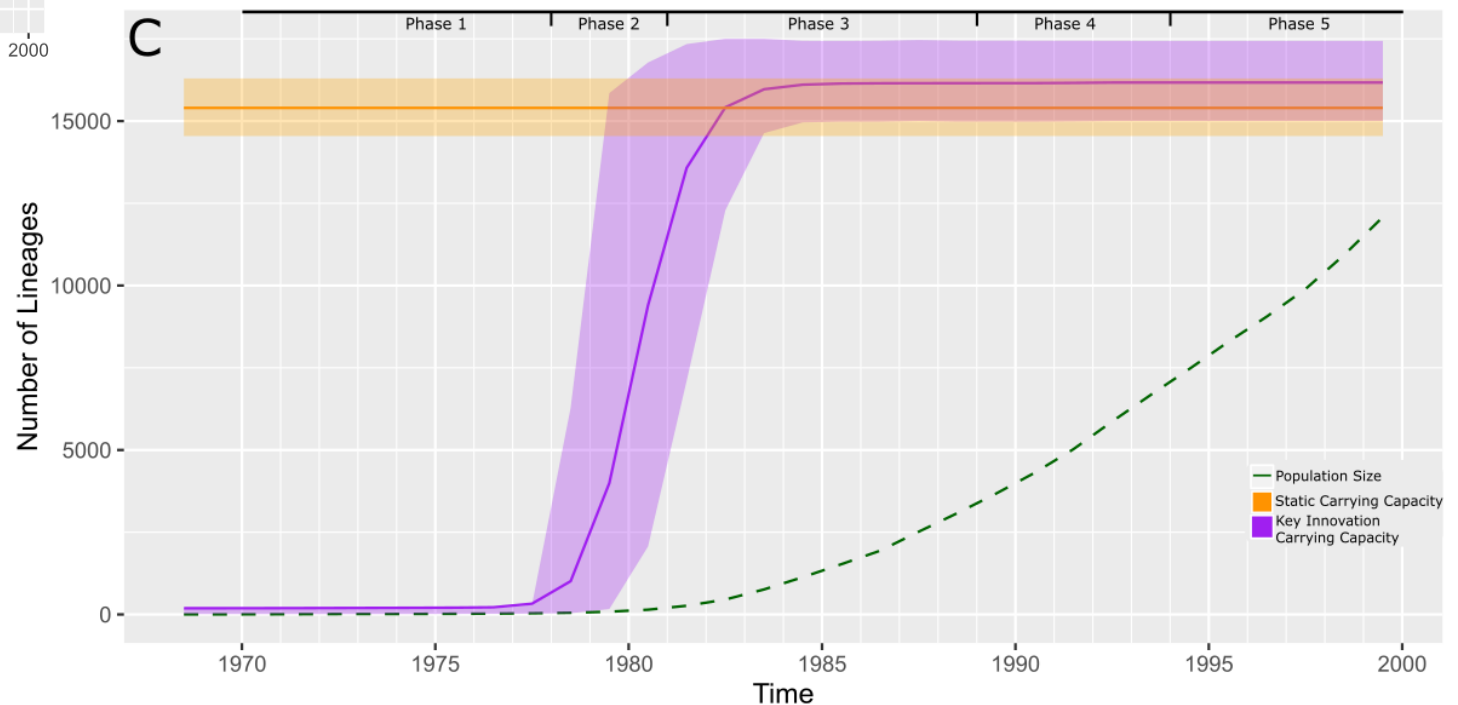
$$\mu(t) = \mu_{\min} + (\kappa - \mu_{\min}) \left(\frac{D(t)}{K(t)} \right)^{\gamma}$$

birth & death rates
converge as **carrying capacity** filled
but carrying capacity is **dynamic**

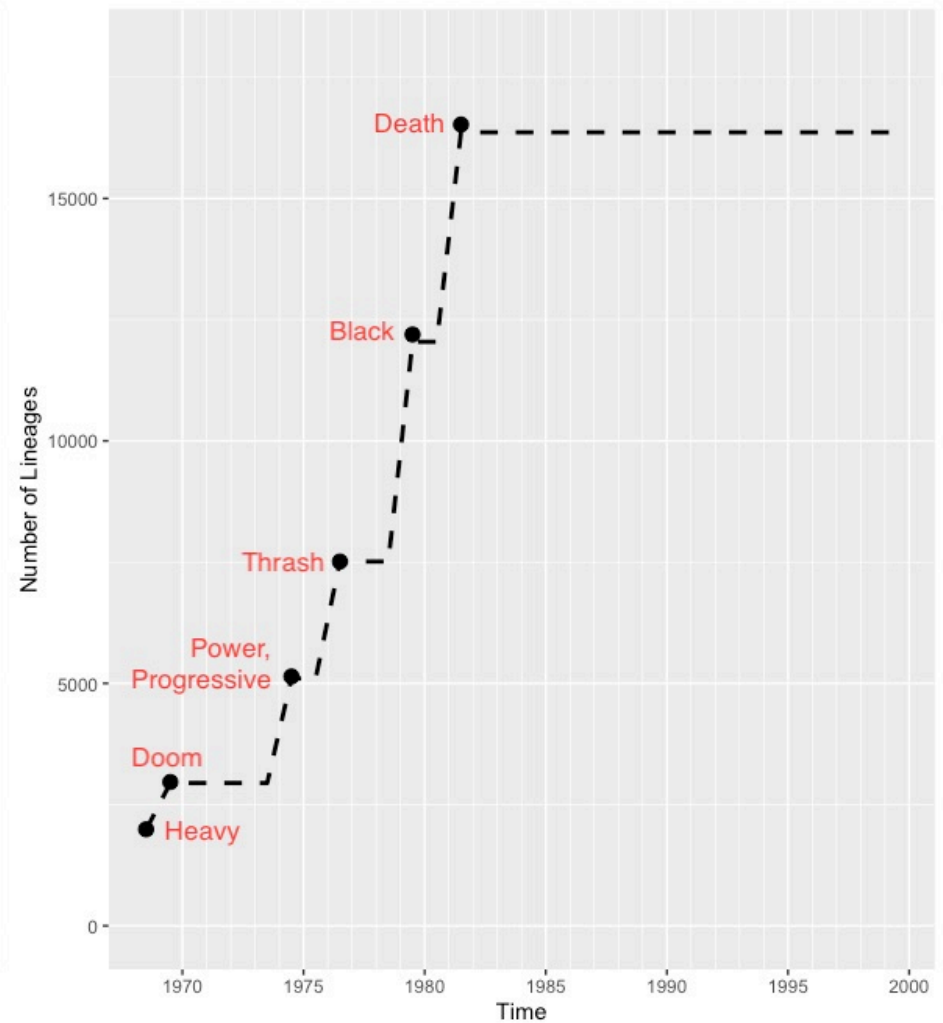
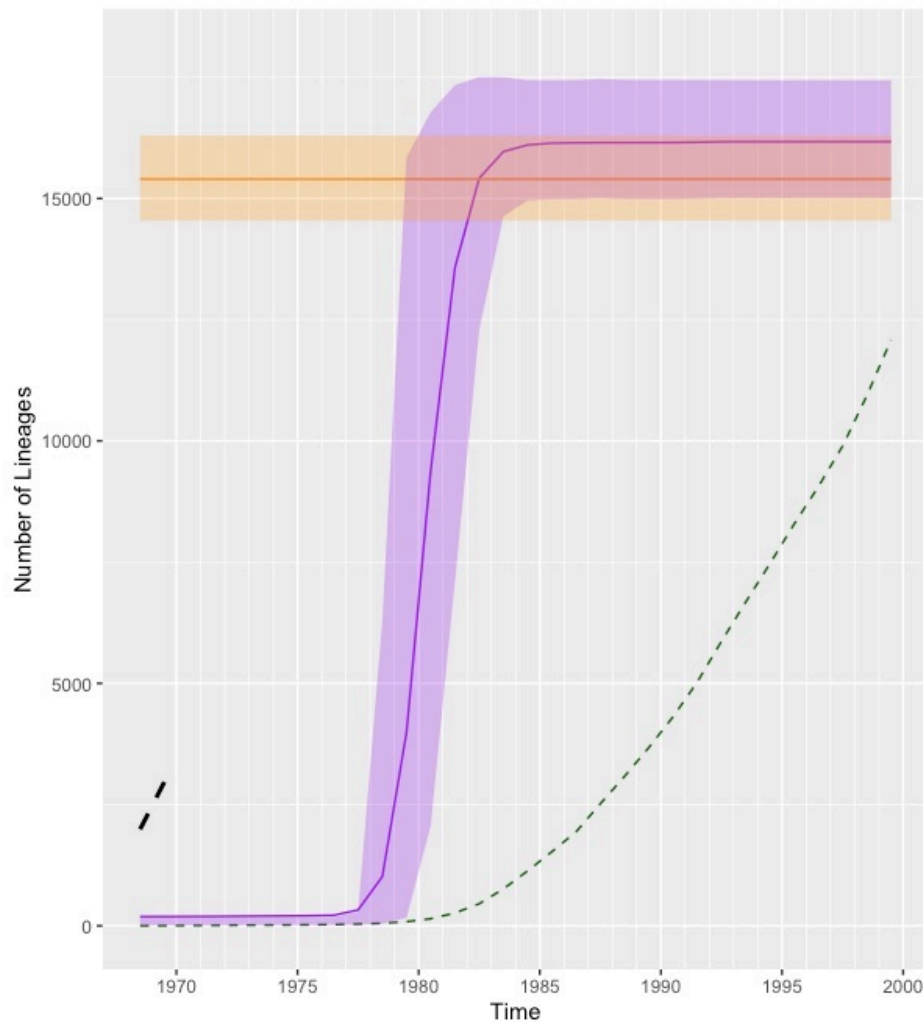
innovation relaxes competition by expanding carrying capacity



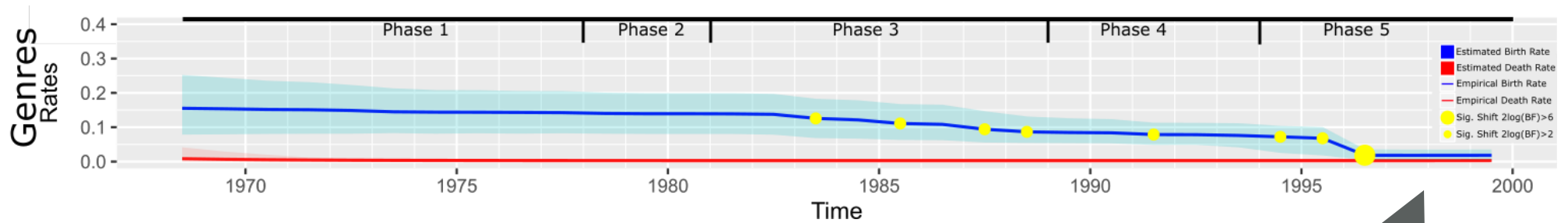
(note this model is more parsimonious
than direct rate modeling)



new genres build up the niche

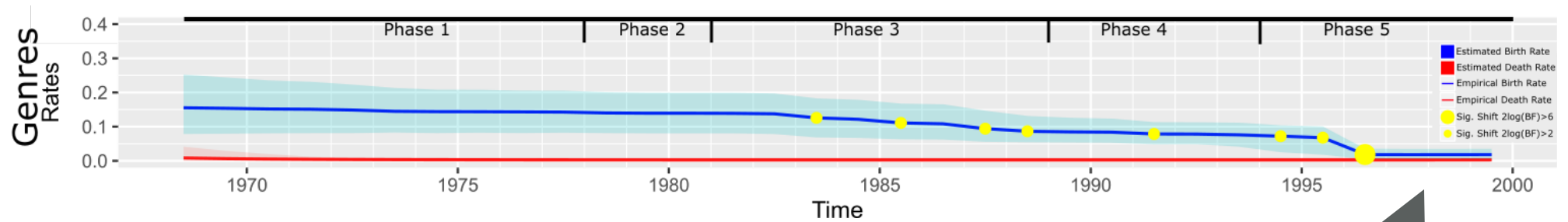


niche expansion through novelty



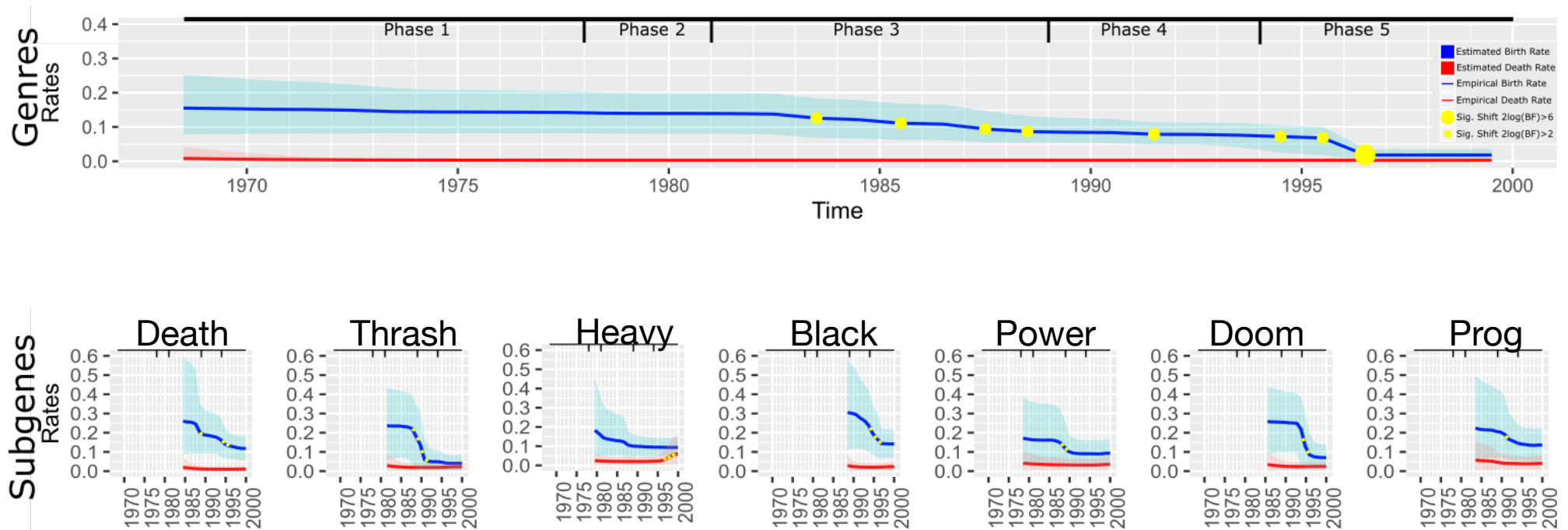
exhaustion of
the form

niche expansion through novelty



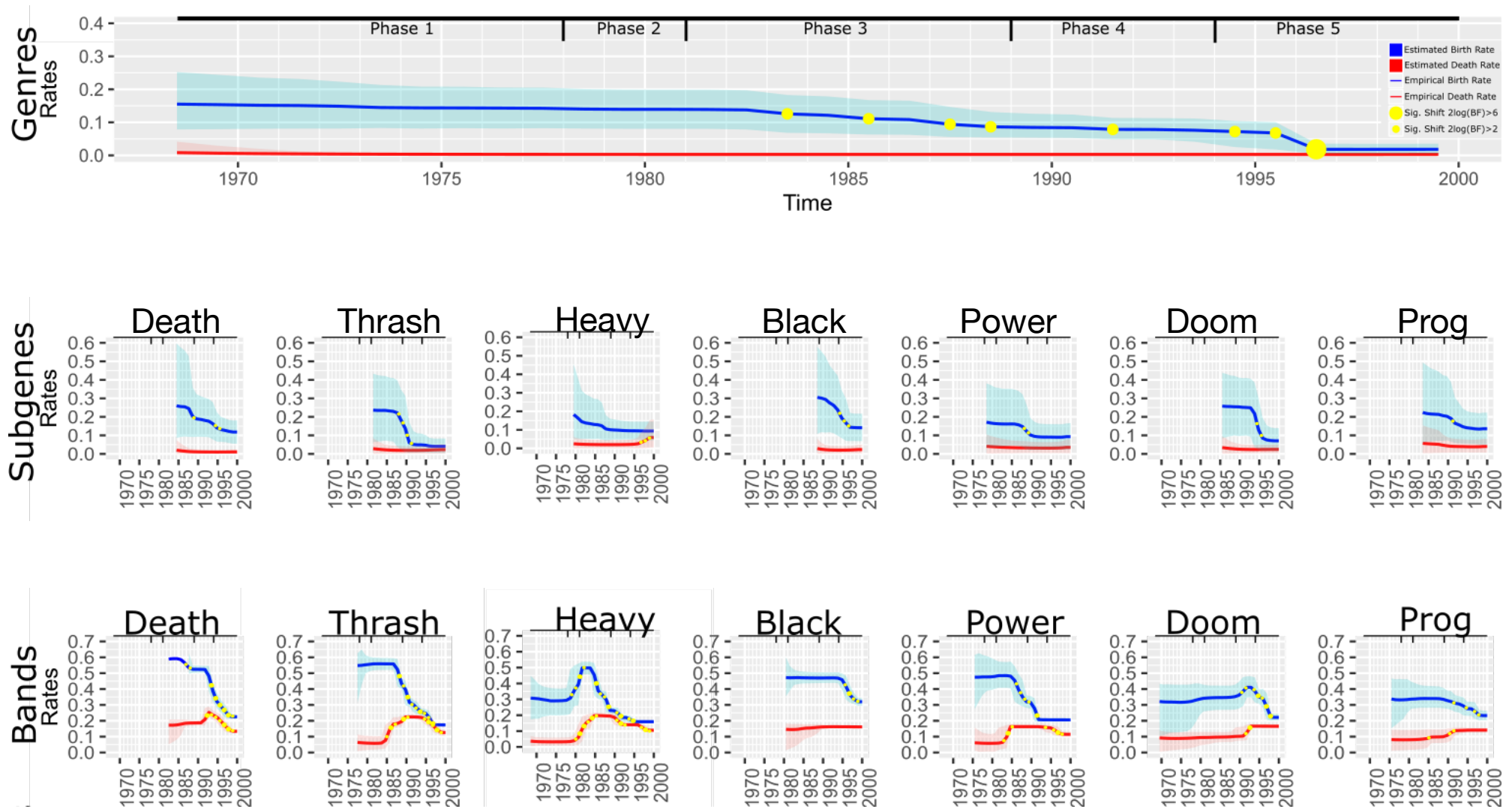
Limits of
the ideal object

niche expansion through novelty



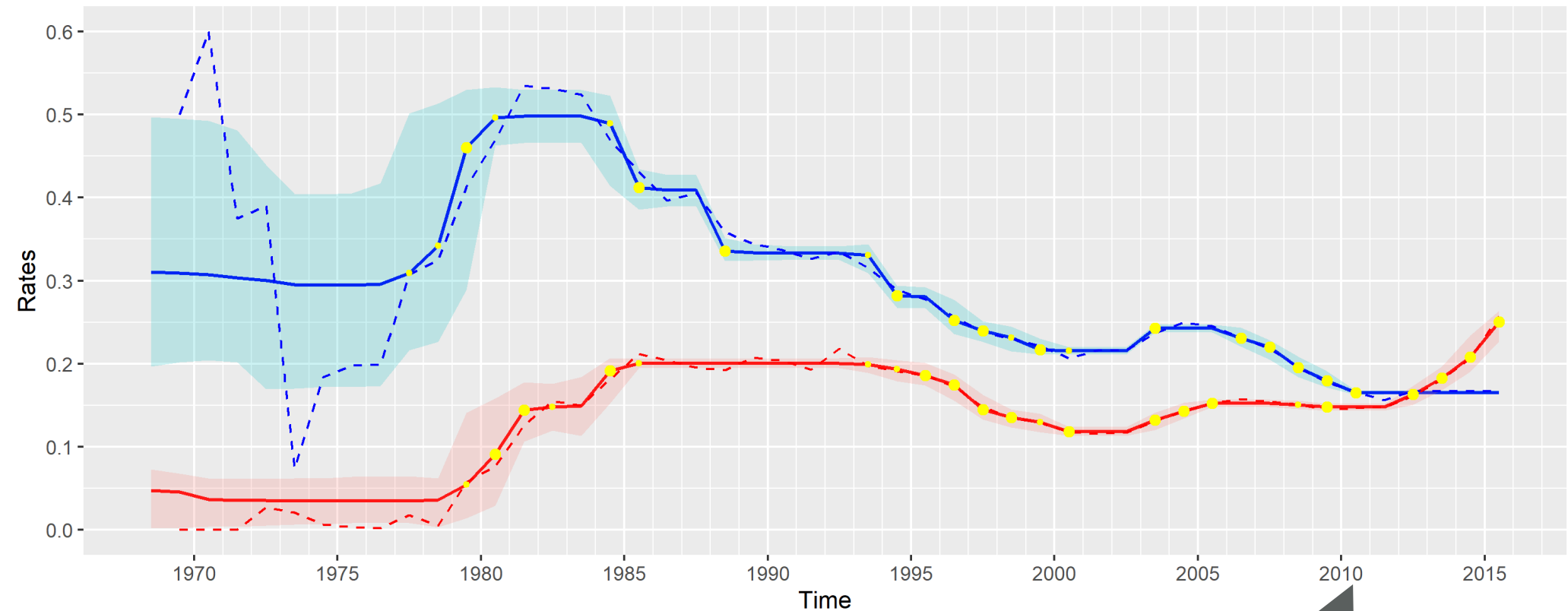
(note: similar genre and sub-genre dynamics)

niche expansion through novelty

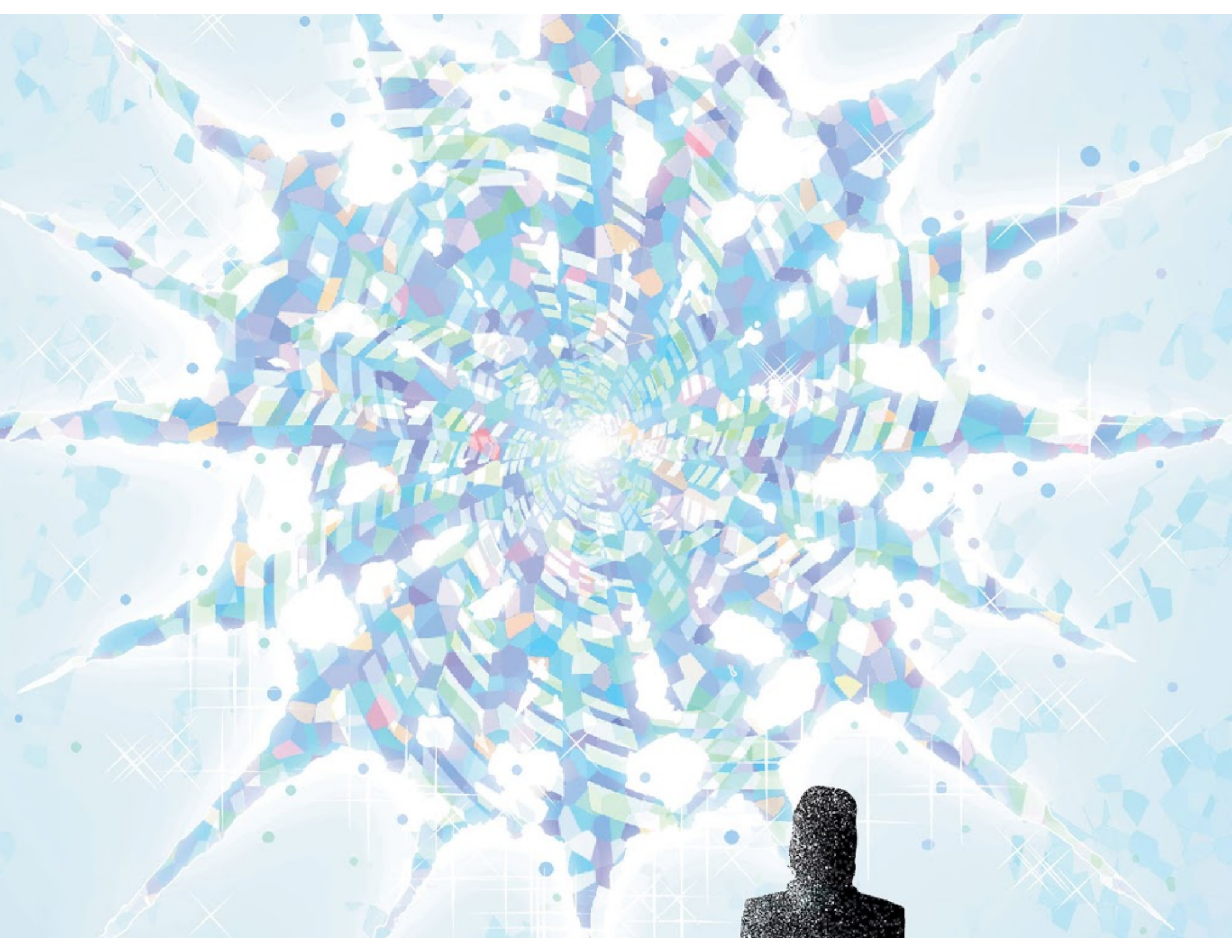


(note: similar genre and sub-genre dynamics)

a prediction borne out



birth and death rates **converge**
consistent with carrying capacity being met
and no further innovations to expand niche



Different kinds of creativity

- Exploratory
- Combinatorial
- **Transformational**

Margaret Boden



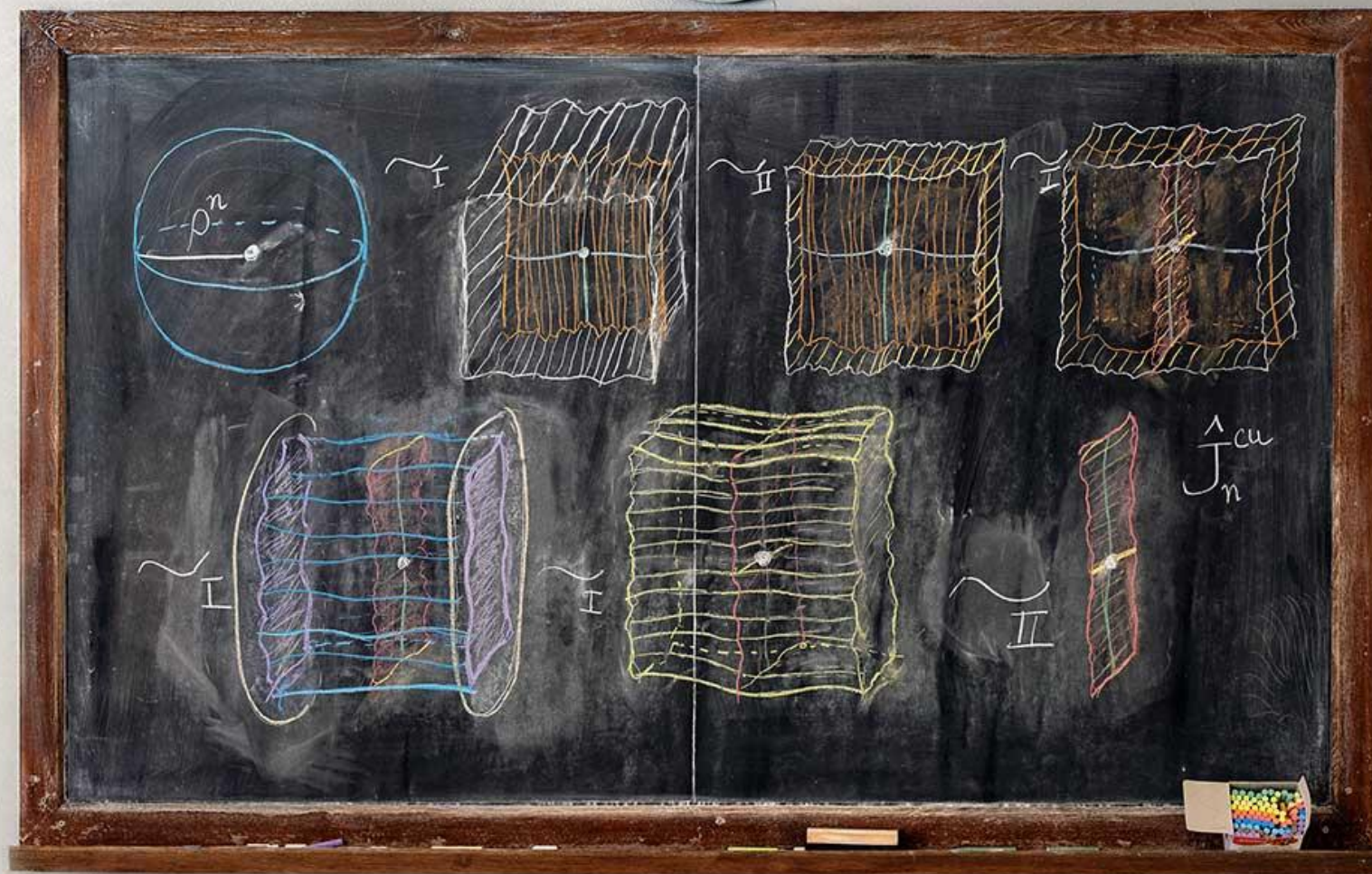
THE MATHEMATICAL EXPERIENCE

Philip J. Davis
Reuben Hersh



'AN INSTANT CLASSIC. IT DESERVES TO BE READ BY
EVERYONE WITH AN INTEREST IN THE FUTURE OF THE
HUMAN RACE' —NEW SCIENTIST

Mathematics is the study of
mental objects with
reproducible properties.

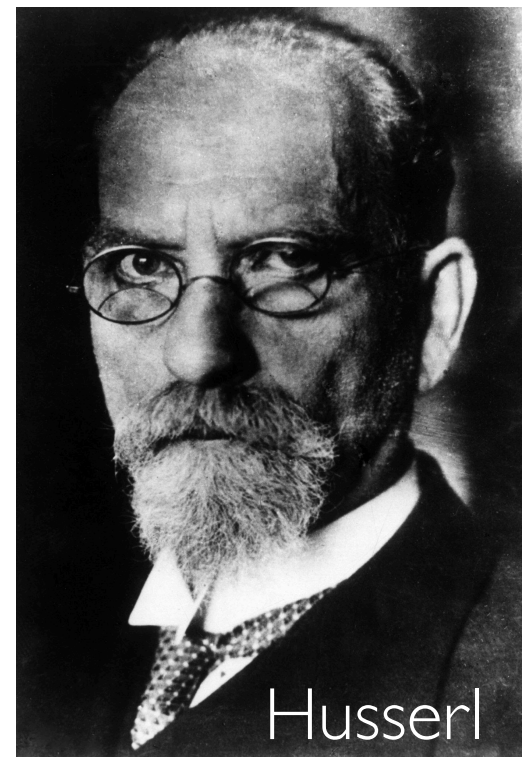


Amie Wilkinson's chalkboard, from *Do Not Erase* (PUP, 2021)

Intentionality:

What the mind does when it's directed toward something under a particular aspect... the “aboutness” of mental activity, the directness of the mind toward meaning, identification, recognition, purpose...

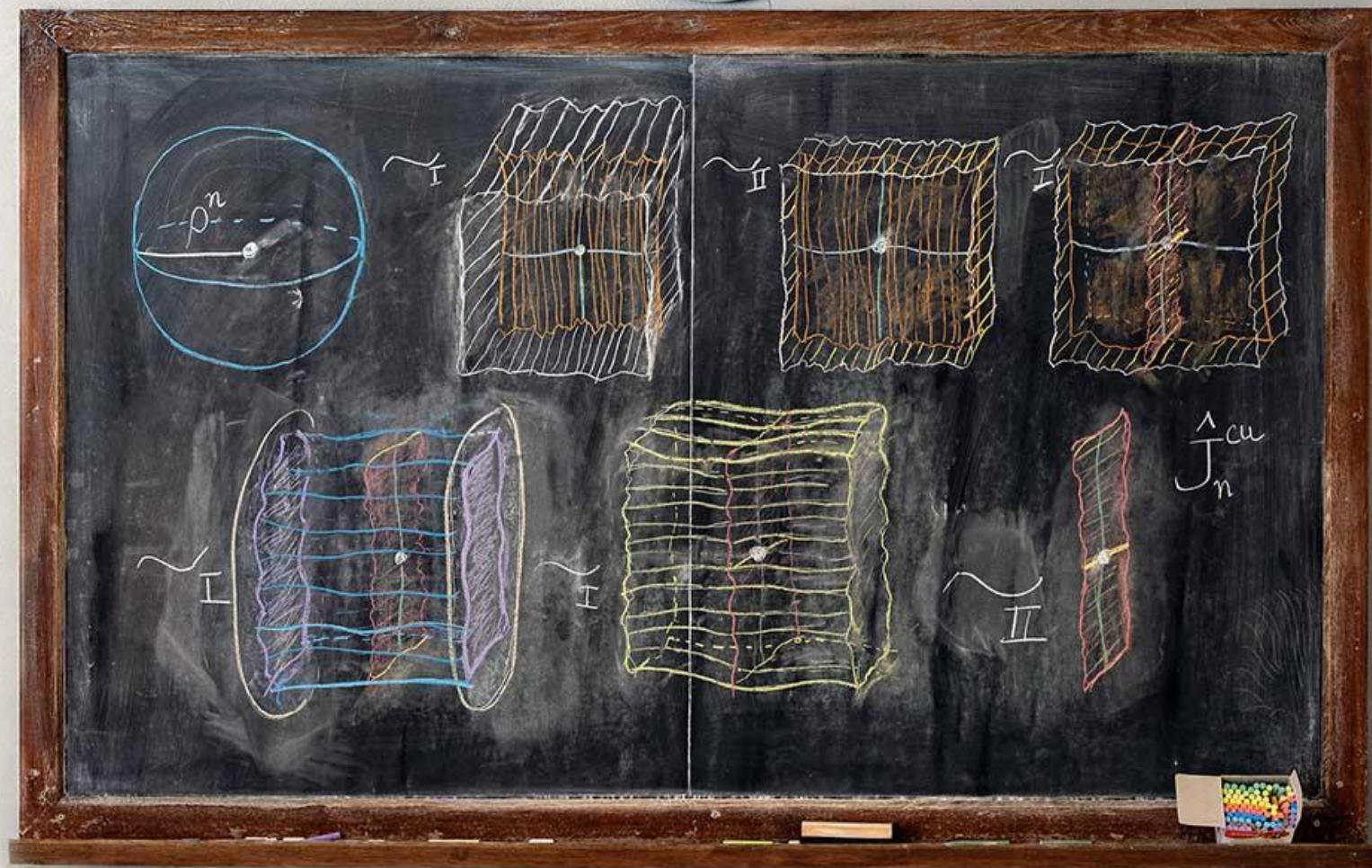
—David Bentley Hart,
All Things Are Full of Gods

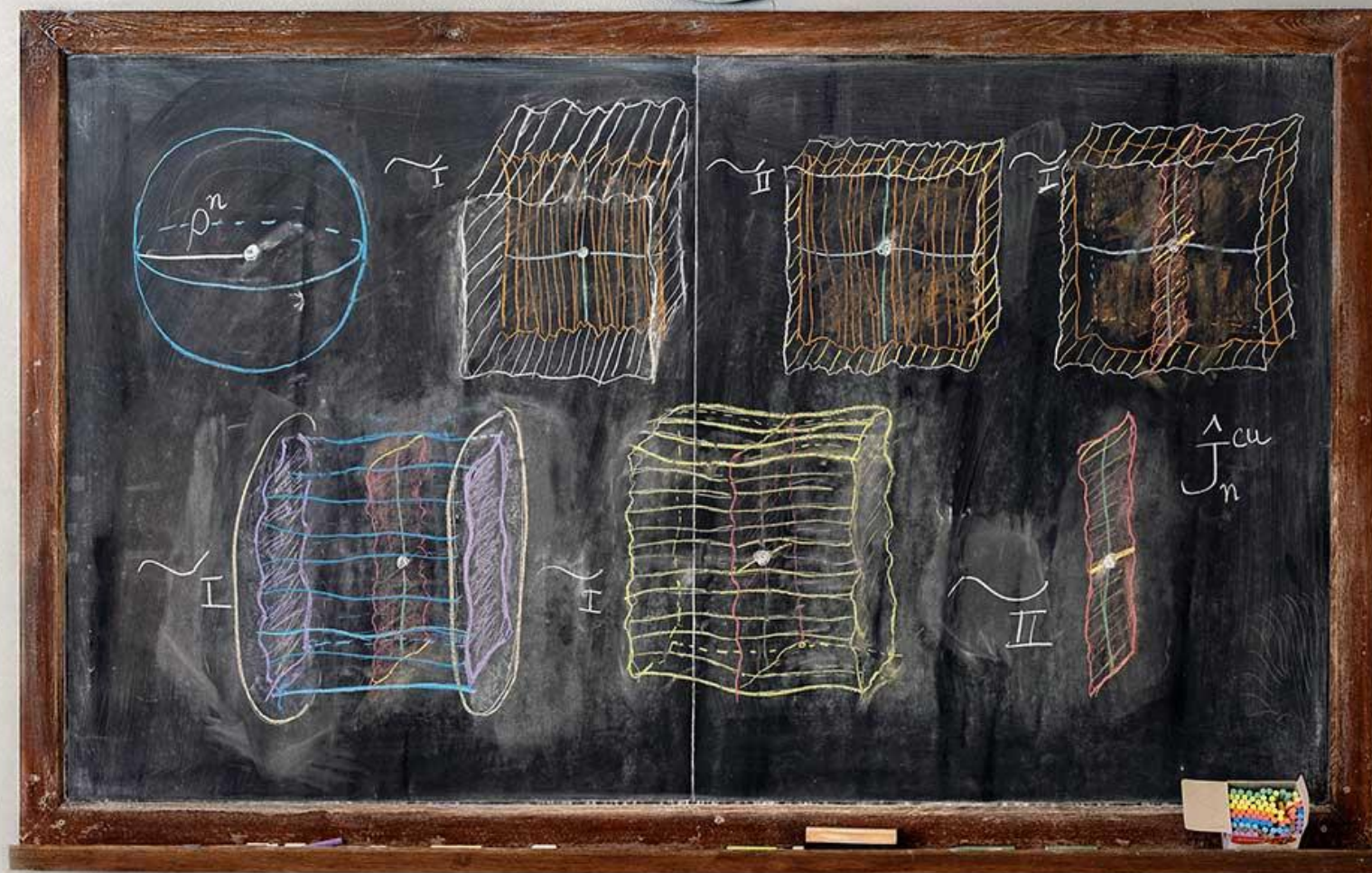


Husserl



Brentano





How do mathematicians point their minds at the SAME mental object?

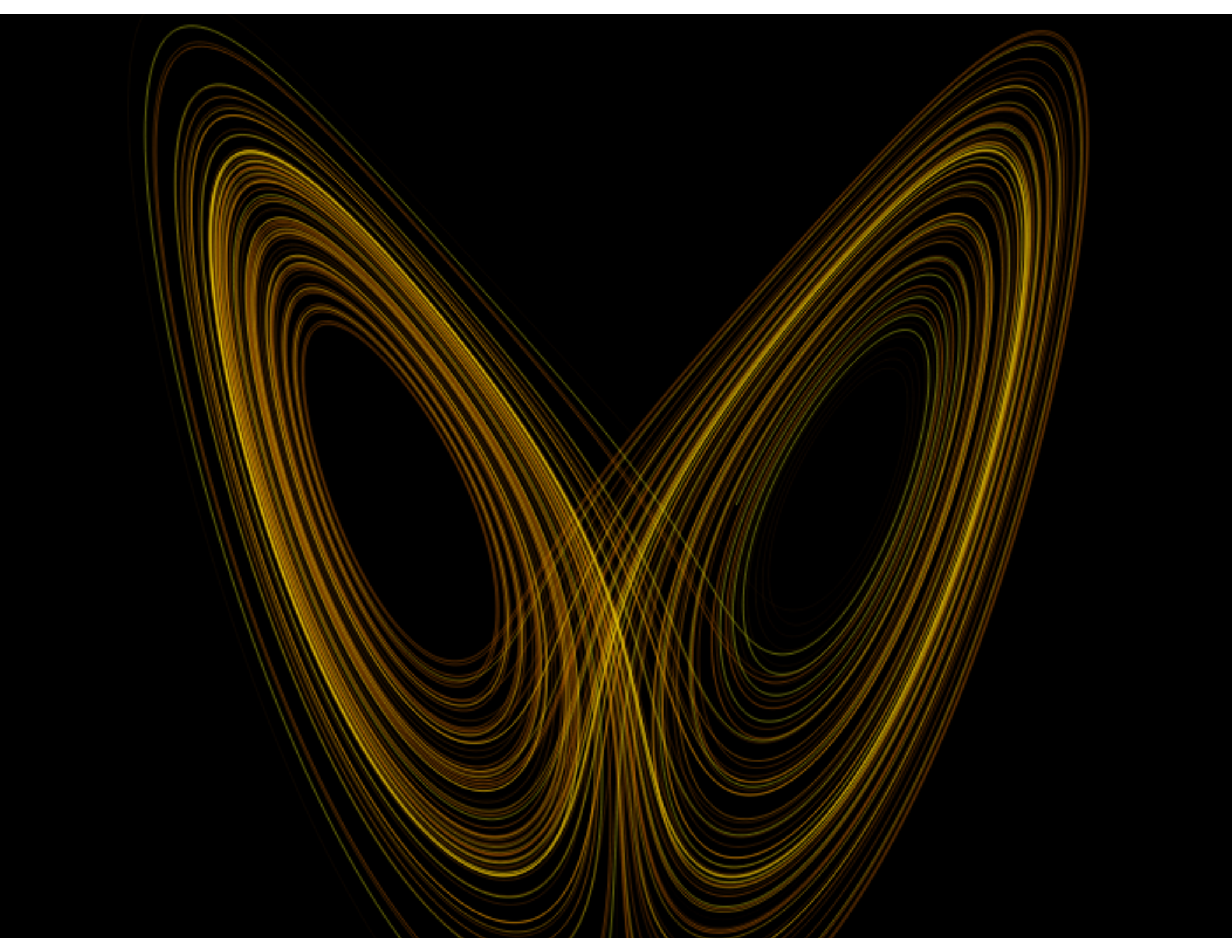
USING ONLY

- Natural language
- Formal language
- Pictures
- Computer exploration (nowadays)
- And of course lots of prior training

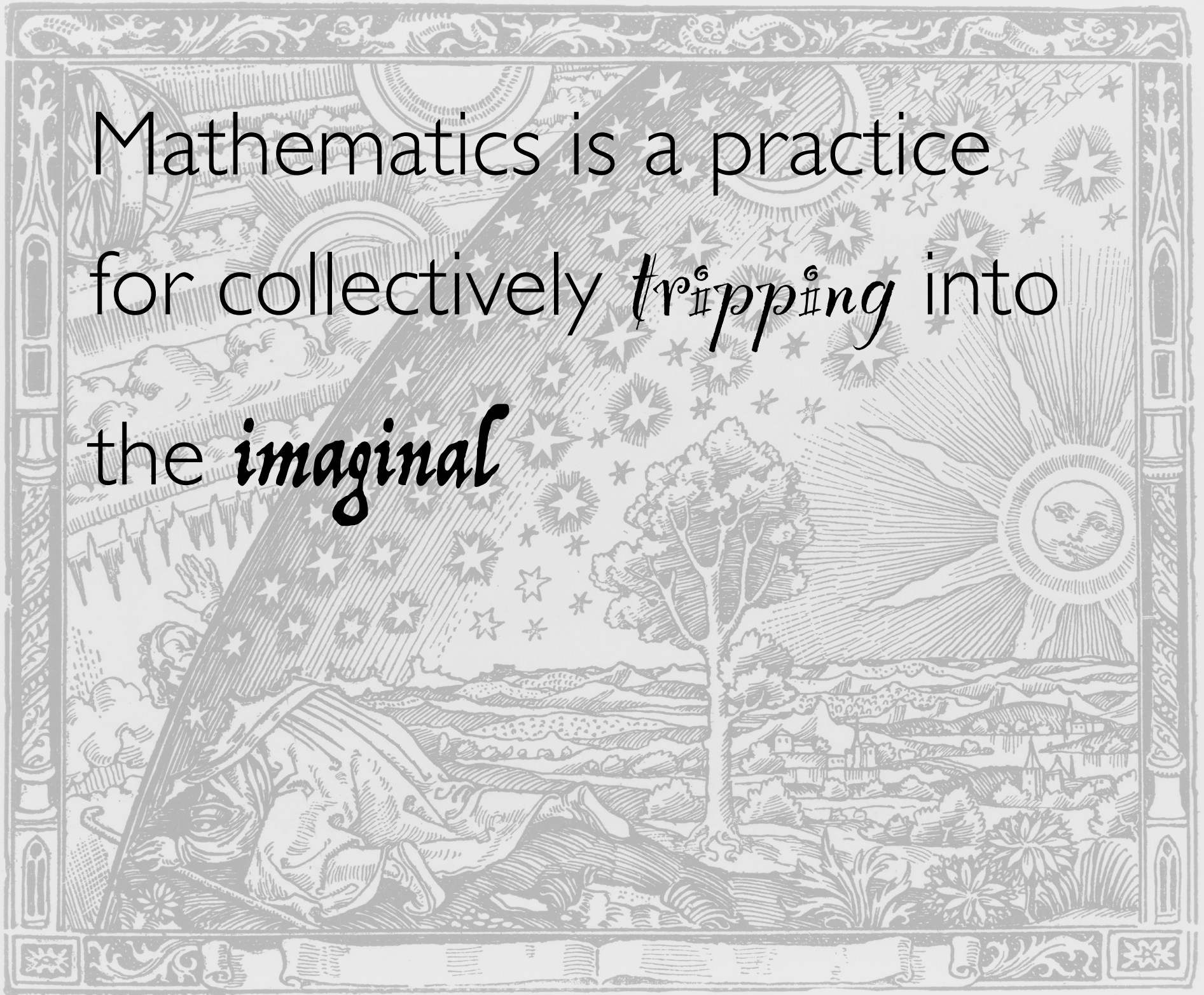
Mathematics seems to be a
limit case of (all?) other
cases of collective
intentionality.

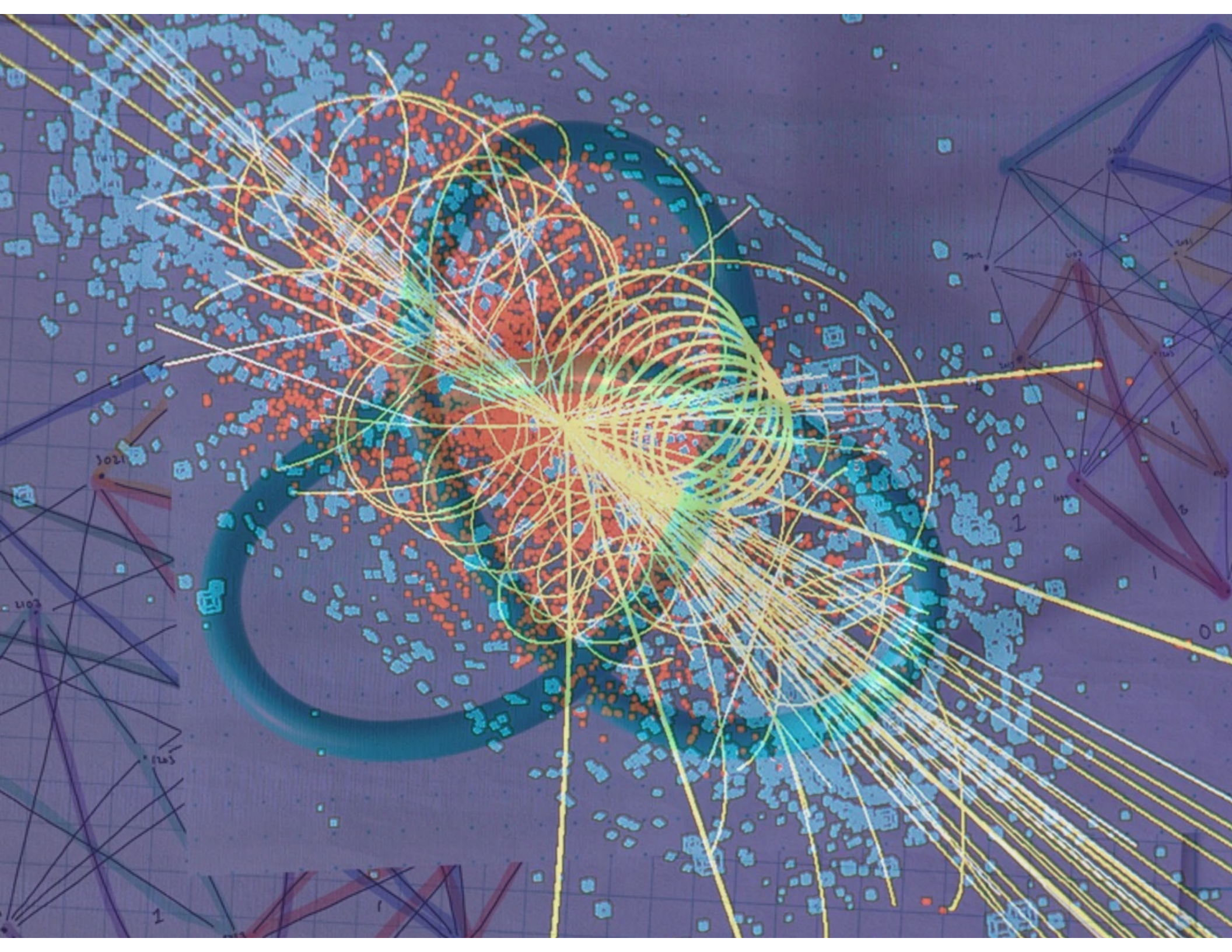
It is also a data-rich
example of Couliano's
ideal object —

It is also a data-rich
example of Couliano's
ideal object —
as well as his notion of
mind games



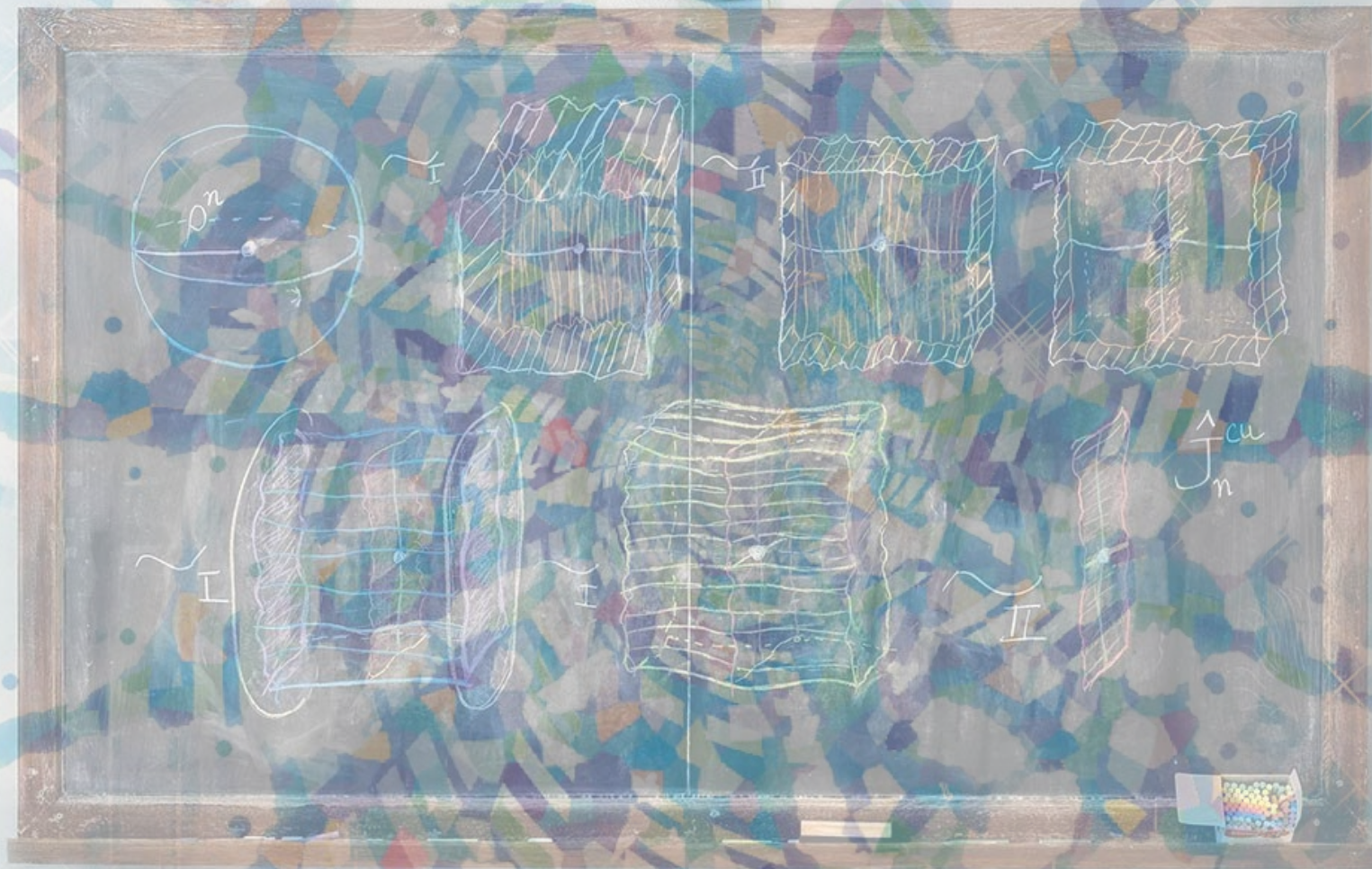
Mathematics is a practice
for collectively *tripping* into
the *imaginal*

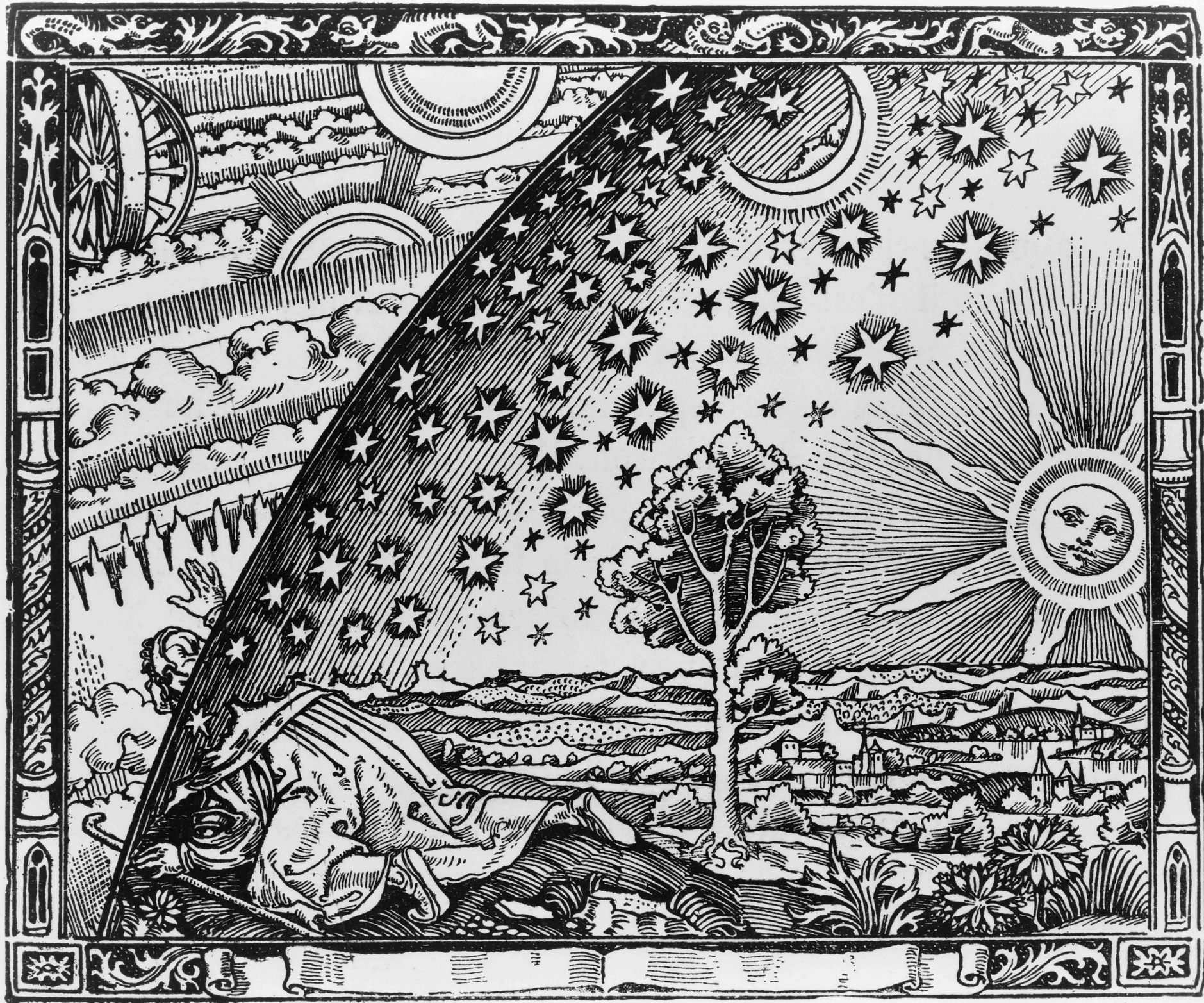














in search of TRUTH

www.ARTofDiNo.com

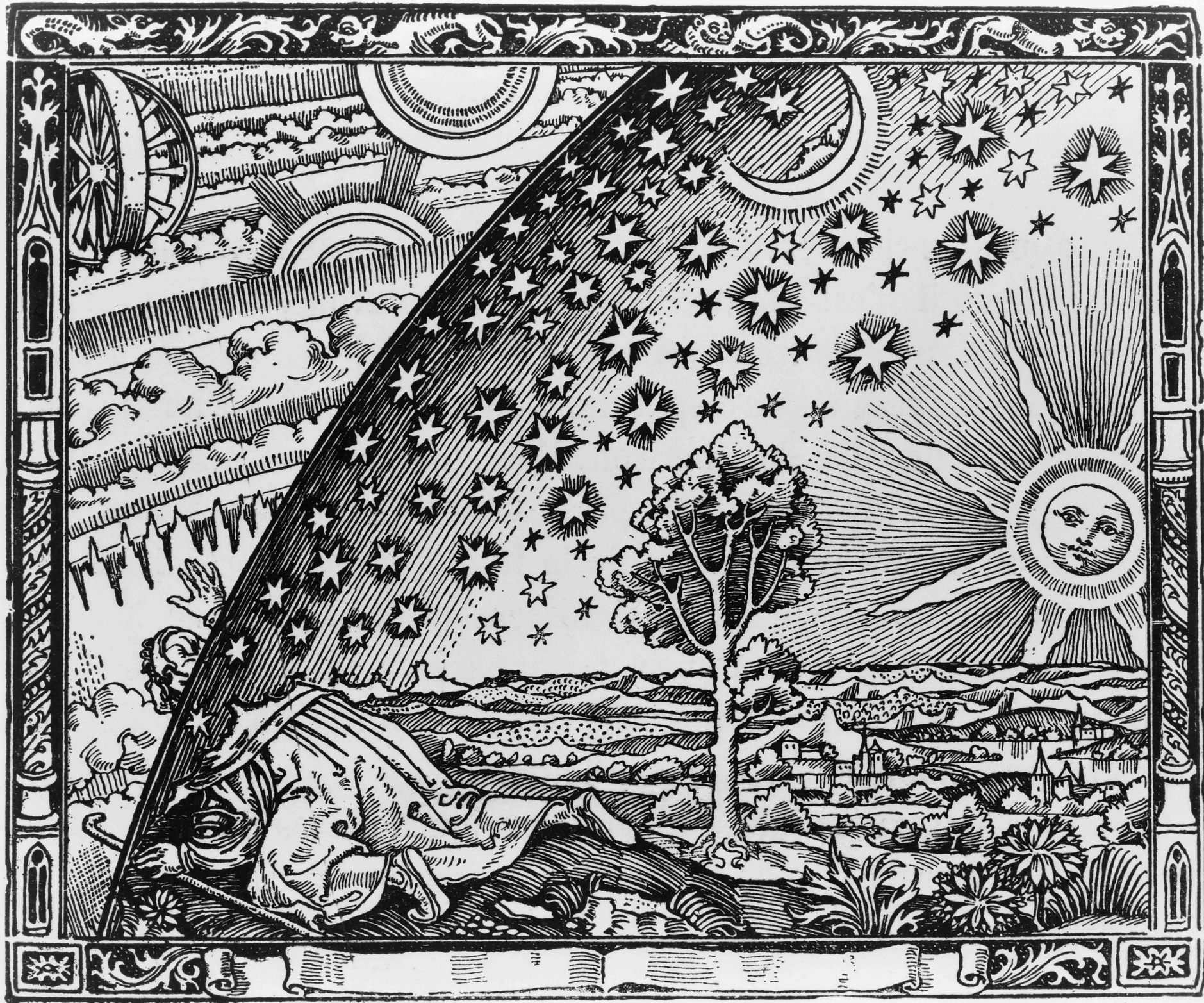
dinodinap@aol.com

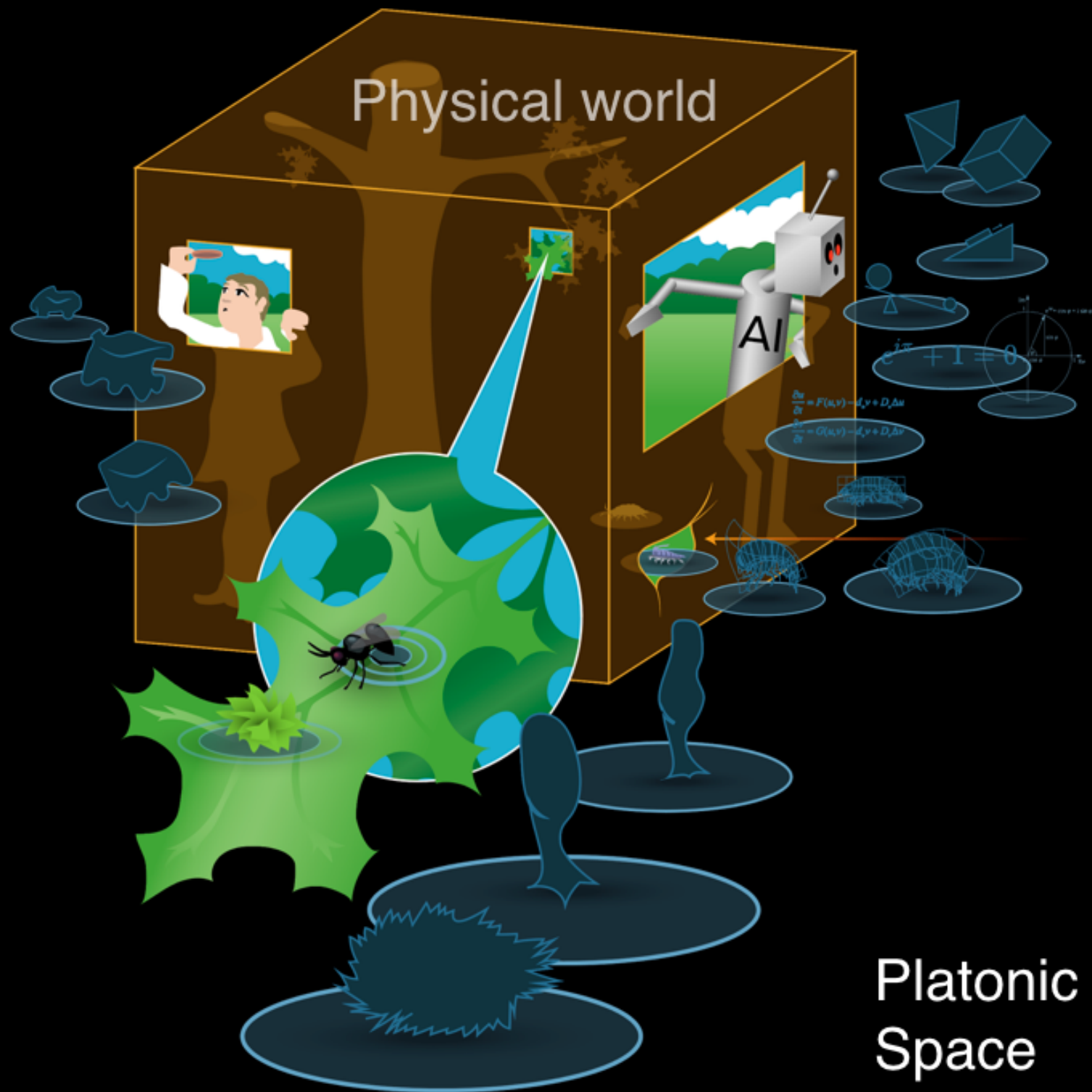


in search of TRUTH

www.ARTofDiNo.com

dinodinap@aol.com





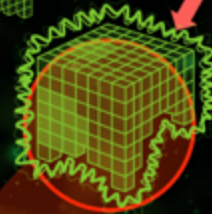
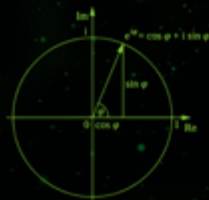
$$MSE = \frac{1}{n} \sum_{i=1}^n (Y_i - \hat{Y}_i)^2$$

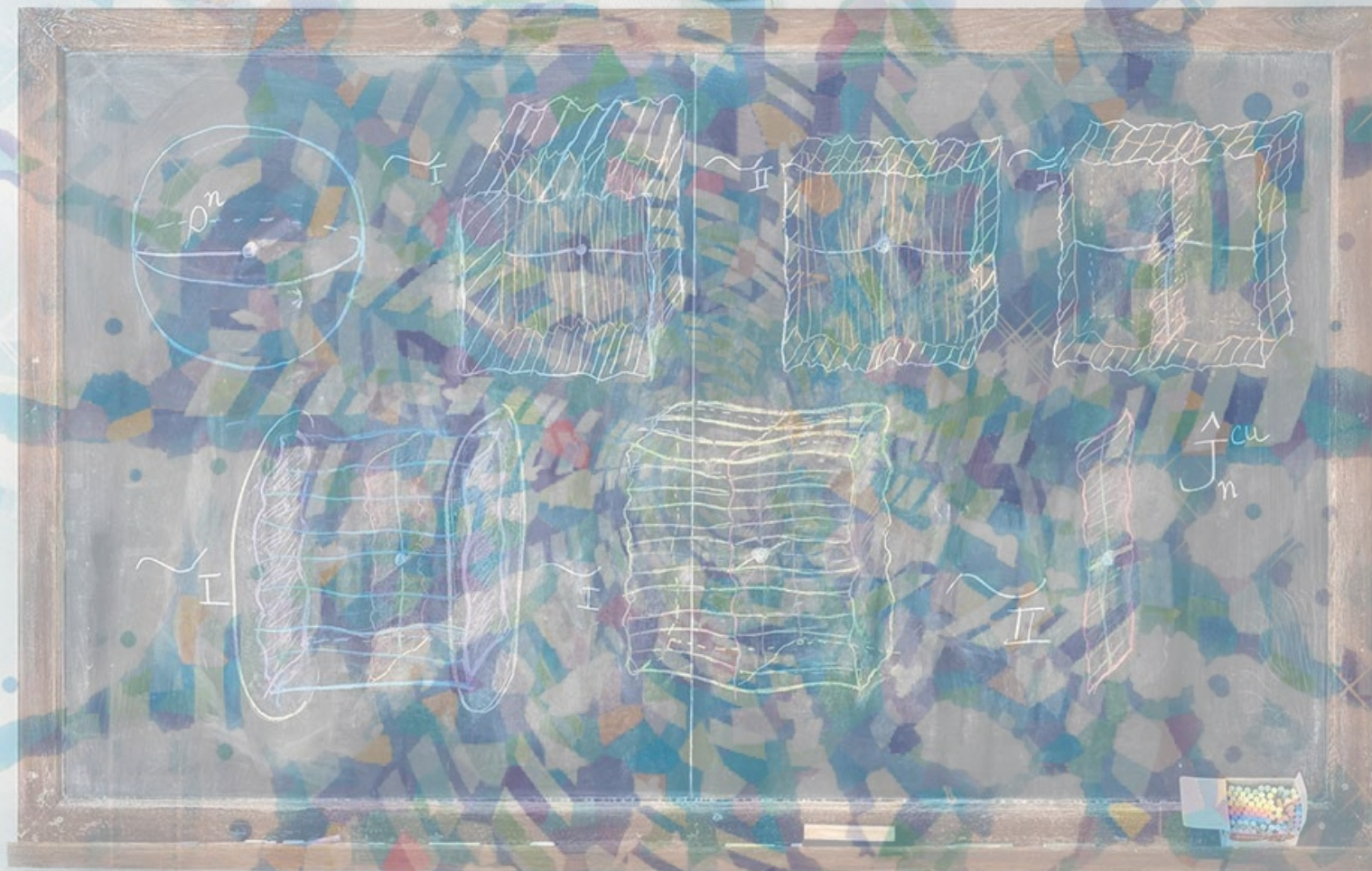
$$e^{i\pi} + 1 = 0$$

$$\frac{\partial u}{\partial t} = F(u, v) - d_u v + D_u \Delta u$$

$$\frac{\partial v}{\partial t} = G(u, v) - d_v v + D_v \Delta v$$

$$c = \sqrt{a^2 + b^2}$$







SANTA FE
INSTITUTE



CENTER FOR
ADVANCED
STUDY IN THE
BEHAVIORAL
SCIENCES

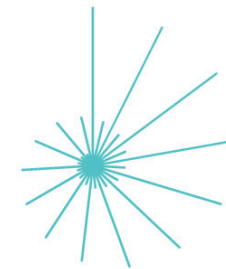


IAS

INSTITUTE FOR
ADVANCED STUDY



TEMPLETON WORLD
CHARITY FOUNDATION



JOHN TEMPLETON
FOUNDATION

Exploring the origins, nature, and future of intelligences

What is DISI?

I'm here to apply

I'm attending the institute

Meet our alumni

disi.org

The Center for Possible Minds

@ Indiana University, Bloomington

Dedicated to the transdisciplinary study of minds
in biological, cultural, and artificial forms



possibleminds.org

THANK YOU!

