What is the role of the organism in evolution?

Agency

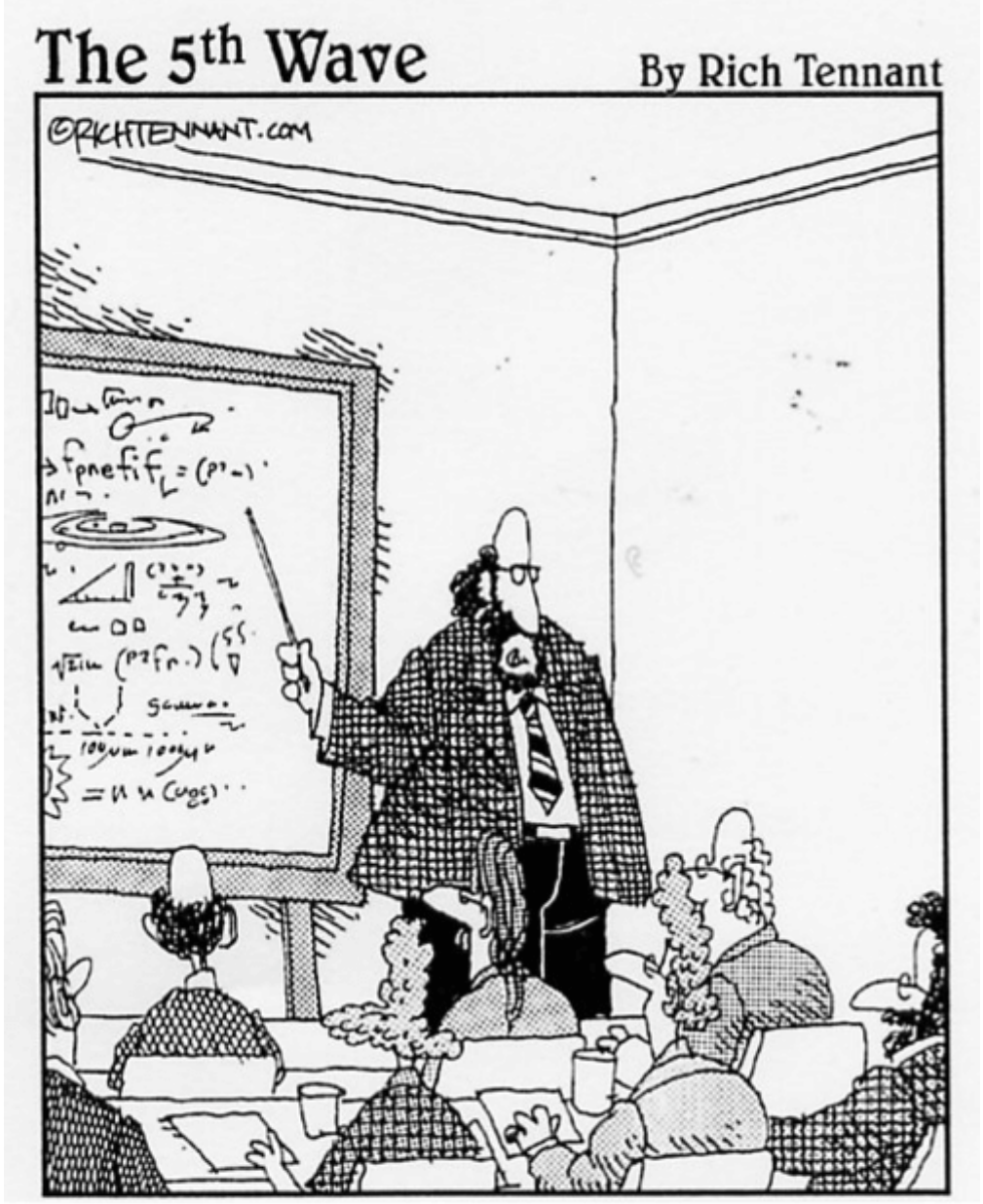
(ongoing thinking)

What is the level of threat and urgency it is to evolve an animal?

- Aristotle (300 BC) acknowledged four types of causes: the material, formal, efficient and final cause (= the purpose), which he called telos.
- Aristotle observed that a rock only moves by external forces, while an animal is self-motivated.
- Thus, he concluded that animals have telos, which gives them **agency** driven by internal **purposes**.
- Aristotle did NOT wonder how purpose came into the world, as he lived on "Mother Earth" and saw the natural world as purposeful: *it rains because the soil needs water*.

➢ **How can we understand what it is to be an animal?**

Johannes Kepler (1619): I calculate that the solar system is like a mechanical clockwork: no *telos* needed. There is no Mother Earth: it is a machinery.

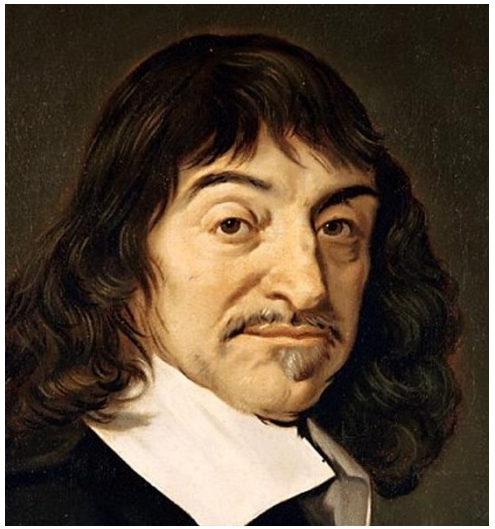


"After the discovery of 'antimatter' and 'dark matter', we have just confirmed the existence of 'doesn't matter', which does not have any influence on the Universe whatsoever."

- In an inanimate universe, there are causes and consequences, but "**nothing matters**": No purpose.

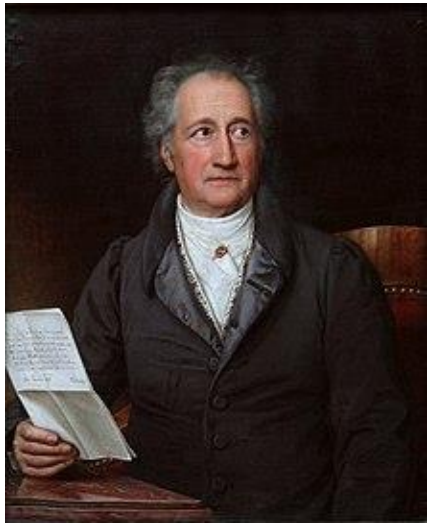
- Before life, all matter in the universe was of the form "**doesn't matter**".

Johannes Kepler (1619): I calculate that the solar system is like a mechanical clockwork: no *telos* needed. There is no Mother Earth: it is a machinery.



René Descartes (1637): I deduce (from astronomy and the Genesis account) that animals must be machines. *Telos* only in humans.

Immanuel Kant (1783): I observe that both plants and animals are purposive.



Johan Wolfgang von Goethe (ca 1800): “the moving spirit of the drama of evolution is the organism”.

Johannes Kepler (1619): I calculate that the solar system is like a mechanical clockwork: no *telos* needed. There is no Mother Earth: it is a machinery.

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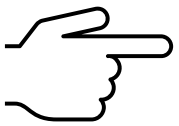
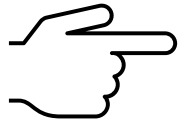
Immanuel Kant (1783): I observe that both plants and animals are purposive.

Johan Wolfgang von Goethe (ca 1800): "the moving spirit of the drama of evolution is the organism".

Charles Darwin (1859): Purposiveness in life comes from inheritance and natural selection.



The organism

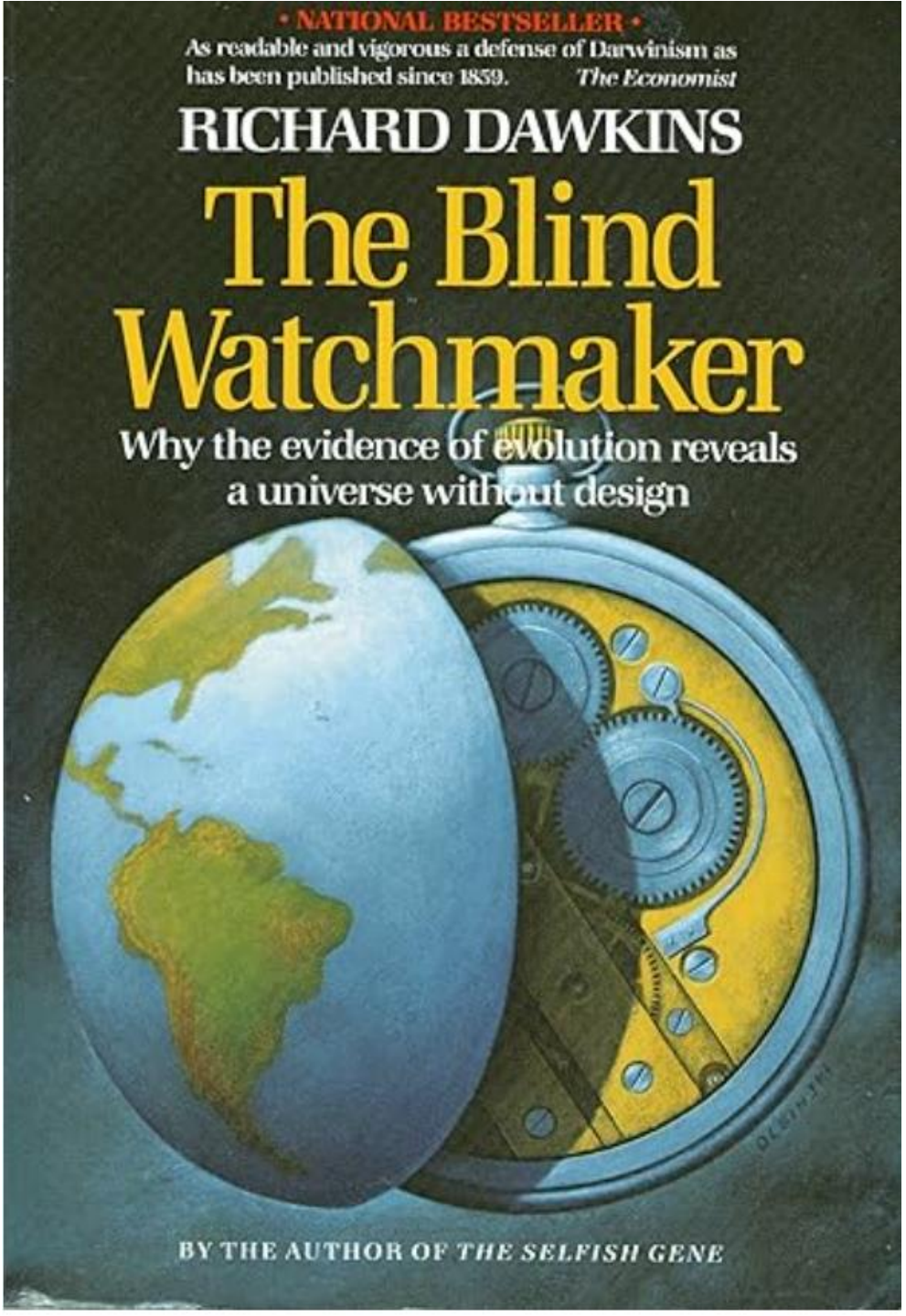


The heritable factors

➢ **How can we understand what it is to be an organism?**

Nothing in biology makes sense except in the light of evolution.

Theodosius Dobzhansky (1900-1975),
Russian-American evolutionary biologist



➢ **How can we understand what it is to be an organism?**

We are survival machines,

— Richard Dawkins

From Preface to The Selfish Gene (1976, 2006), p. xxi.

- Quite many excellent thinkers are offended by this statement.

➢A programmed robot vehicle may sound like a passive receiver of commands.

- But Dawkins did not mean this: *The Selfish Gene* describes through many chapters very dynamic and “calculating” agents.

➢ How can we understand what it is to be an organism?

"We are survival machines, robot vehicles blindly programmed to preserve the selfish molecules known as genes.

— Richard Dawkins

From Preface to *The Selfish Gene* (1976, 2006), xxi.

trade-off and optimization

kin selection and cooperation

parent-offspring conflicts

evolutionarily stable strategies

life history theory

Aristotle, Kant and Goethe are back: Denis Walsh and the purposefulness of the organism

Kant:
I observe that both plants and animals are purposive.

In recent years, some authors again place organismic agency center stage in evolution.

This organism-centered view is often portrayed as

- a new idea to replace the gene-centered view in neo-Darwinism and the Modern Synthesis,
- or even as Darwin's own view (Noble 2017; Walsh 2015),
- while it can also be seen as a resurgence of Goethe and the Romantics.

Goethe:
"the moving spirit of the drama of evolution is the organism".

Fulda, F. C. 2023. Agential autonomy and biological individuality. Evolution & Development 25:353-370.

Moczek, A. P., S. Sultan, S. Foster, C. Ledon-Rettig, I. Dworkin, H. F. Nijhout, E. Abouheif et al. 2011. The role of developmental plasticity in evolutionary innovation. Proc R Soc B-Biological Sciences 278:2705-2713.

Nadolski, E. M., and A. P. Moczek. 2023. Promises and limits of an agency perspective in evolutionary developmental biology. Evolution & Development 25:371-392.

Noble, D. 2017, Dance to the tune of life: Biological relativity, Cambridge University Press

Rosslenbroich, B. 2024. Evolutionary changes in the capacity for organismic autonomy. J Physiol-Lond. 602:2455-2468.

Shapiro, J. A. 2023. Engines of innovation: biological origins of genome evolution. Biol J Linnean Society 139:441-456.

Sultan, S. E., A. P. Moczek, and D. Walsh. 2022. Bridging the explanatory gaps: What can we learn from a biological agency perspective? Bioessays 44.

Walsh, D. M. 2015, Organisms, agency, and evolution, Cambridge University Press.

Walsh, D. M 2018. Objectcy and agency: Towards a methodological vitalism, Pages 167-185 in D. J. Nicholson, and J. Dupré, eds. Everything flows, Oxford University Press.

Aristotle, Kant and Goethe are back: Denis Walsh and the purposefulness of the organism

Vitalism!

Kant:
I observe that both plants and animals are purposive.

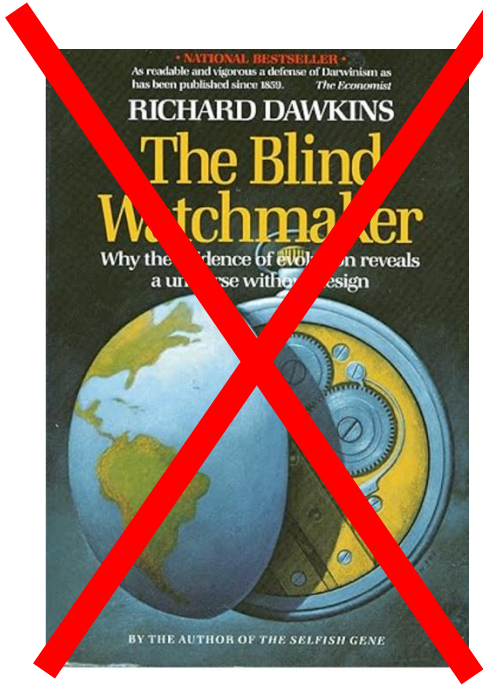
Goethe:
"the moving spirit of the drama of evolution is the organism".

They argue that organisms are natural purposive agents that actively engage with their environments,

that organismic agential adaptation and not natural selection drives evolutionary change,

and further that organismic purposiveness explains their own development,

and from this that evolution is the consequence of the organisms' pursuit of their own goals.



Walsh, D. M., and G. Rupik. 2023. The agential perspective: Countermapping the modern synthesis. Evolution & Development 25:335-352.

Evolution by genes or organisms?

- Walsh and others therefore claim that Dawkins' replicator/vehicle metaphor is wrong: organisms are the fundamental evolutionary agents.
- Is this a chicken and egg question? Or does one drive the other?

A chicken and egg problem?

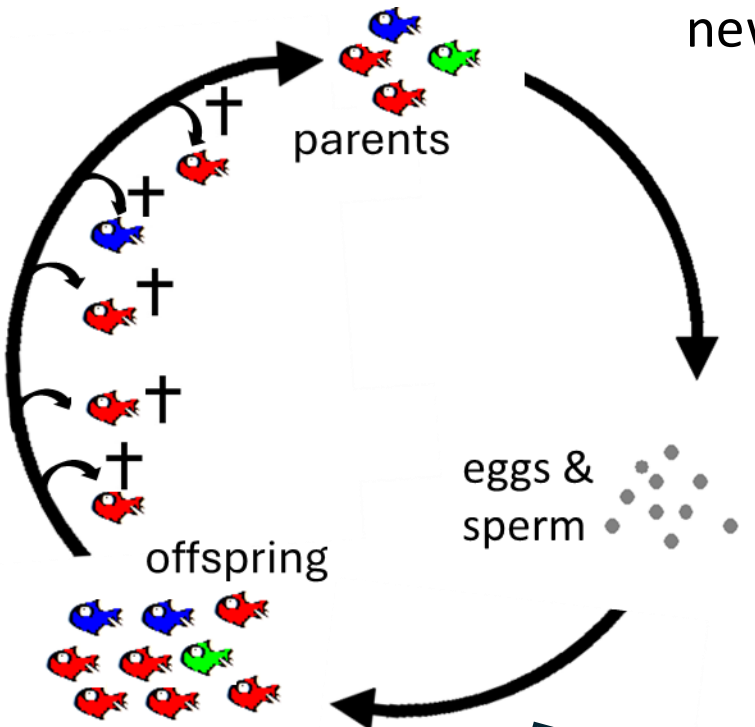
Is is possible (useful) to separate the organism from its genes?

Is evolution better explained by the organism than by the genes?

The development of a vertebrate animal's body is basically a roll-out orchestrated by 500 million years old Hox genes (39 in mammals, 47 in teleosts),

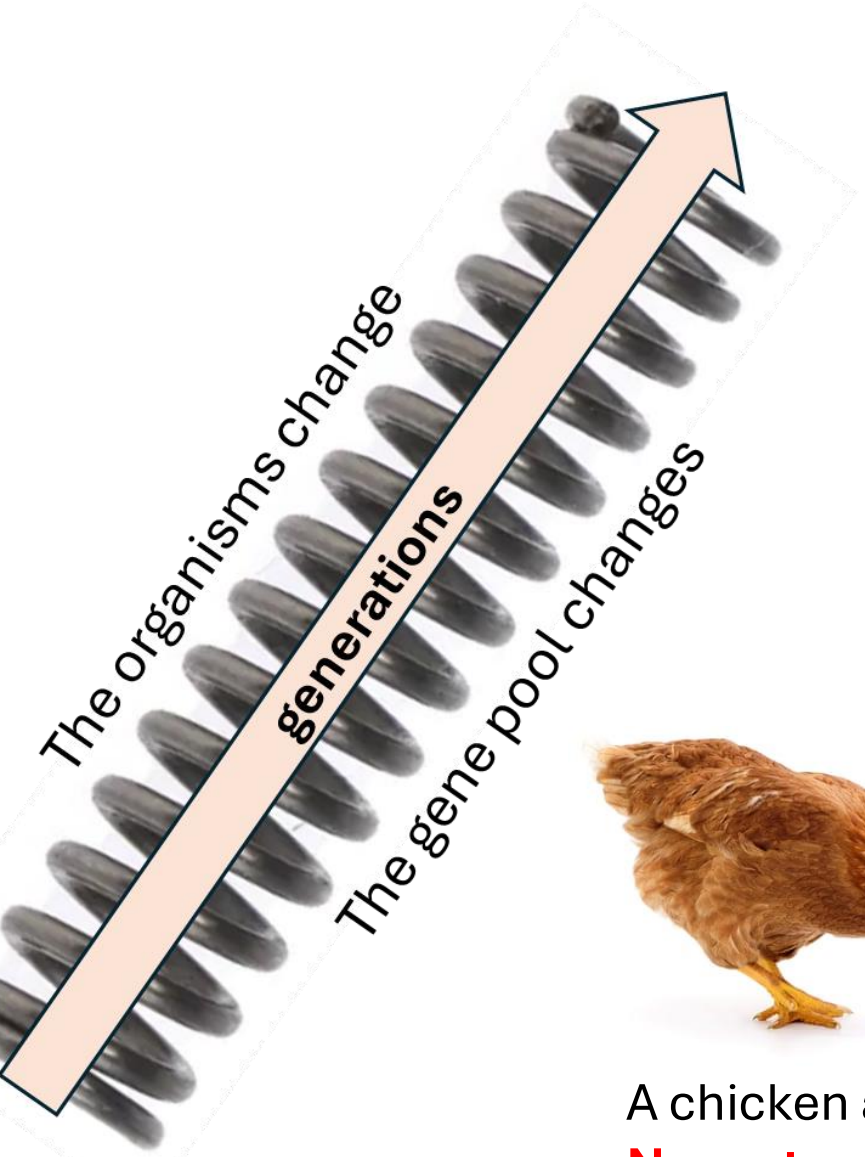
while the agentic capacities of some vertebrates also depend on social learning and parental care.

Evolution by natural selection or genetic drift happened whenever the parents were a genetically non-random subset of the newborns in each past generation.



In the start of every multicellular life, the organism is only a zygote with genes, some molecules, and 1 cell from the mother.

Is is possible (useful) to separate the organism from its genes?
Is evolution better explained by the organism than by the genes?



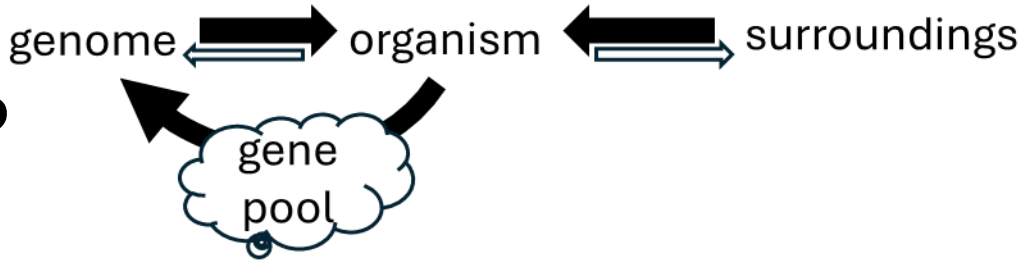
One cannot understand the gene pool except from the non-random reproduction of organisms in previous generations.

One cannot understand the ephemeral organism except through the past evolution of its genes.

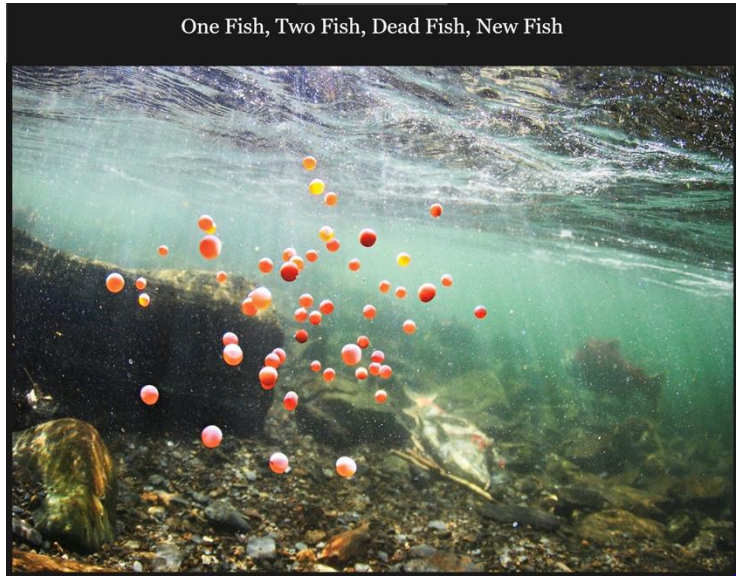
A chicken and egg problem?

No, not really.

Evolution by genes or organisms?



- Here is a clue: Organisms perish for the sake of reproduction.
- This is life history theory, established by Lotka in 1925.
  - ➢The Disposable Soma Theory.
- Other clues:
  - Sexual reproduction (offspring gets half your genes, half from someone else, often a stranger)
  - Conflicts between genes (also cooperation, cheating, selfish genetic elements)
  - Kin selection (forego own reproduction to help relatives)



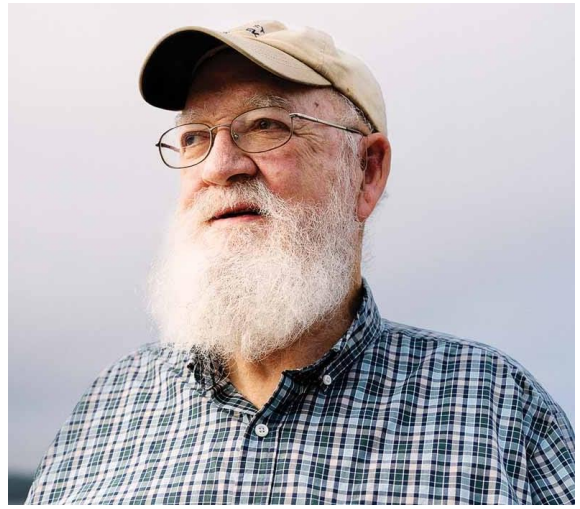
"*Dawkins and I*" mean to say (what life-history theory, kin selection and much more tell us) that biological organisms are agents of the James Bond type: *on behalf of* our replicators.

All agentic capacities in biological organisms have evolved by mutations and natural selection. However, this selection is between organisms.

Agent on behalf of MI6

007

Okasha (2024): “As if” agency



Daniel Dennett argued that organisms appear **as if** they were designed by an intelligence, but natural selection is an unconscious, mindless process.

This aligns with **Richard Dawkins**' *Blind Watchmaker*: there seems to have been a designer, but there probably isn’t one.

Samir Okasha argues that all living organisms are **“as if” agents** on behalf of the genes. (He comes to Bergen next spring.)

Dawkins, R. 1986, The blind watchmaker, Norton & Company.
Dennett, DC. 1995. *Darwin’s Dangerous Idea: Evolution and the Meanings of Life*. Simon & Schuster.
Okasha, S. 2024. The concept of agent in biology: Motivations and meanings. Biological Theory 19:6-10

It is the algorithm, stupid!

- Bodies, phenotypes, are not coded for by genes.
- There is no gene combination for my body mass.
- But there are gene combinations for the strategies a body use to gain weight.
- The agentic profile of the organism is defined by the architectures and strategies that the genes in concerts code for: **the algorithms**.

➢ Summary statement

➢ **How can we understand what it is to be an organism?**

While remembering “as if” from Dennett and Okasha, we can now come to a tripartite evolutionary account of agency:

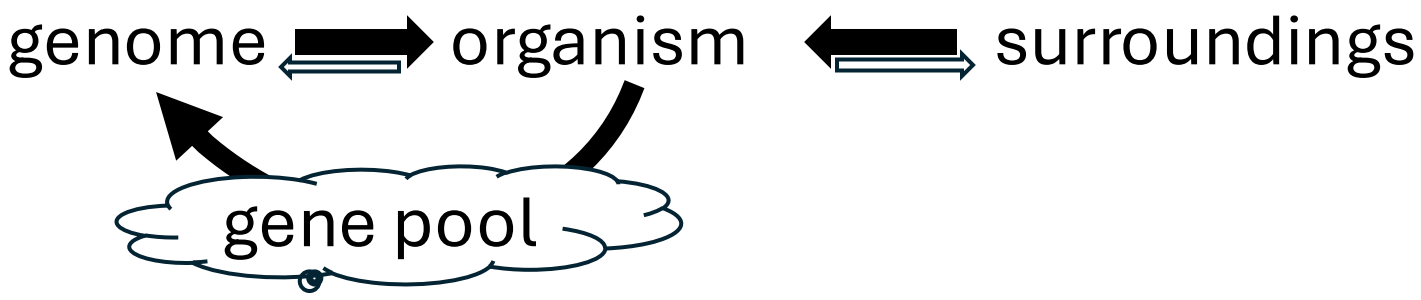
(i) The organism is an autonomous agent,

(ii) the genes are replicators and the ultimate source of this agency, and

(iii) the gene-based architectures and algorithmic rules that the organism follows encompass the expression of the agency.

Now, let us follow the unfolding of greater agentic capacities through evolution.

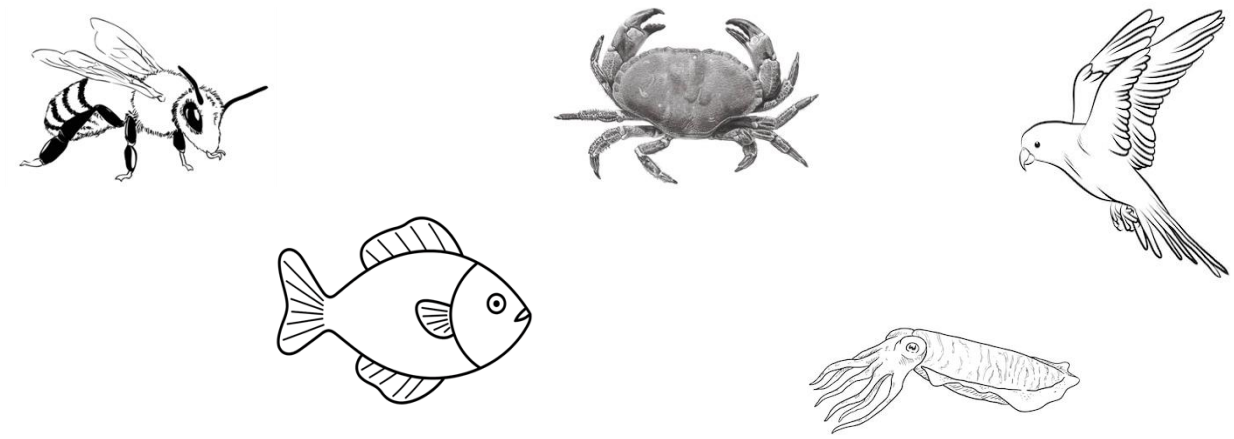
Agency has evolved and diversified

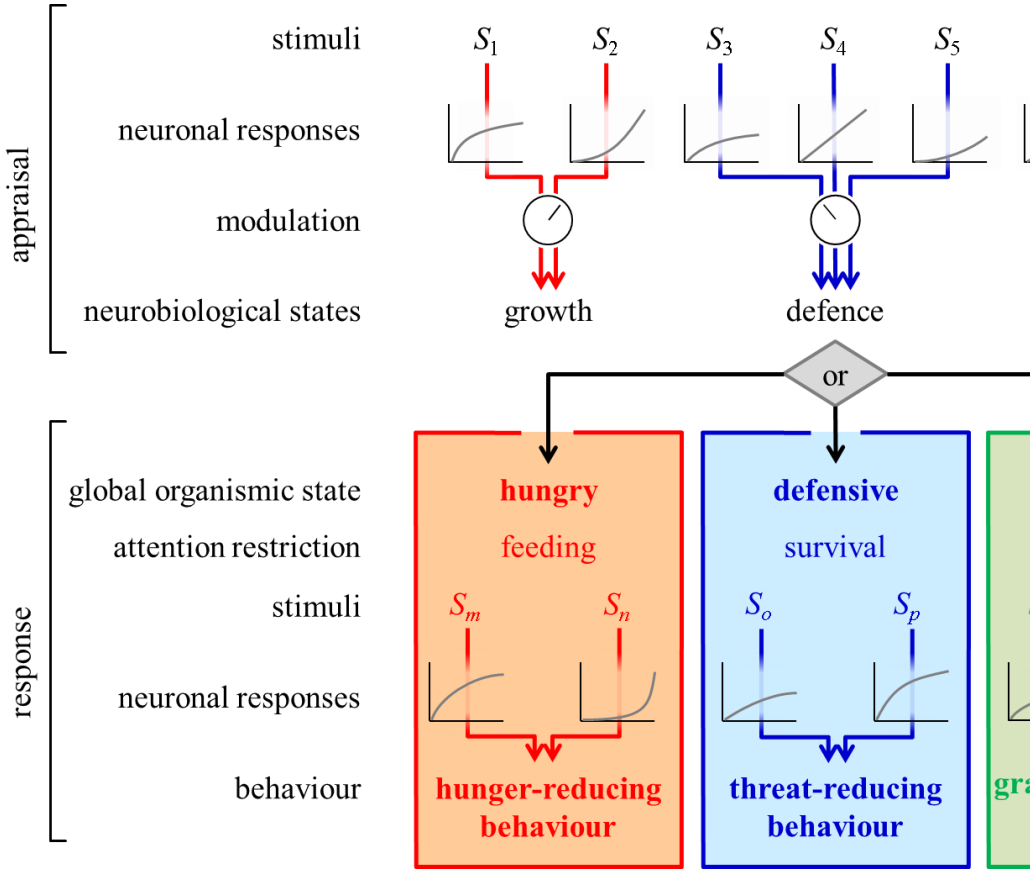


Some **genes** that originated by random mutation, **have evolved**
as **they increased the algorithmic capacity and competence of the organism**
in making decisions on behavior or development,
leading to more offspring, and thus, more copies of these genes.

Agency has evolved and diversified

- “As if” (Okasha 2024): Agency of the first organisms was rooted in genes
- The first cells
- Agents who learn
- **Agents with conflicting emotions and with unlimited associative learning**






Aardvark


Antelope


Emu


Eagle


Eel


Armadillo


Beaver


Baboon

Agency has evolved and diversified

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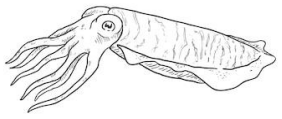
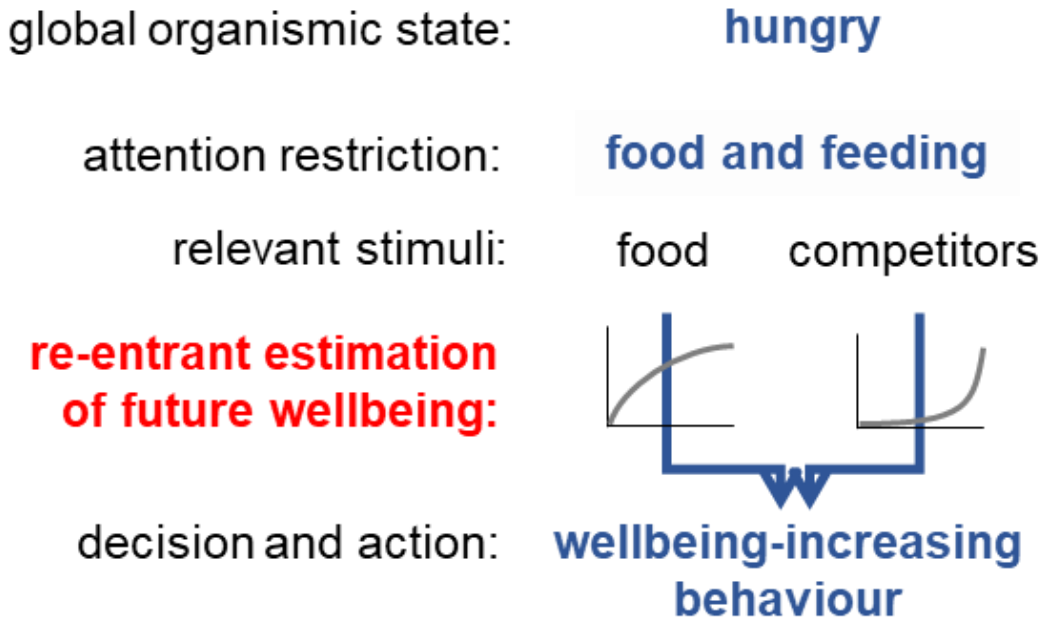
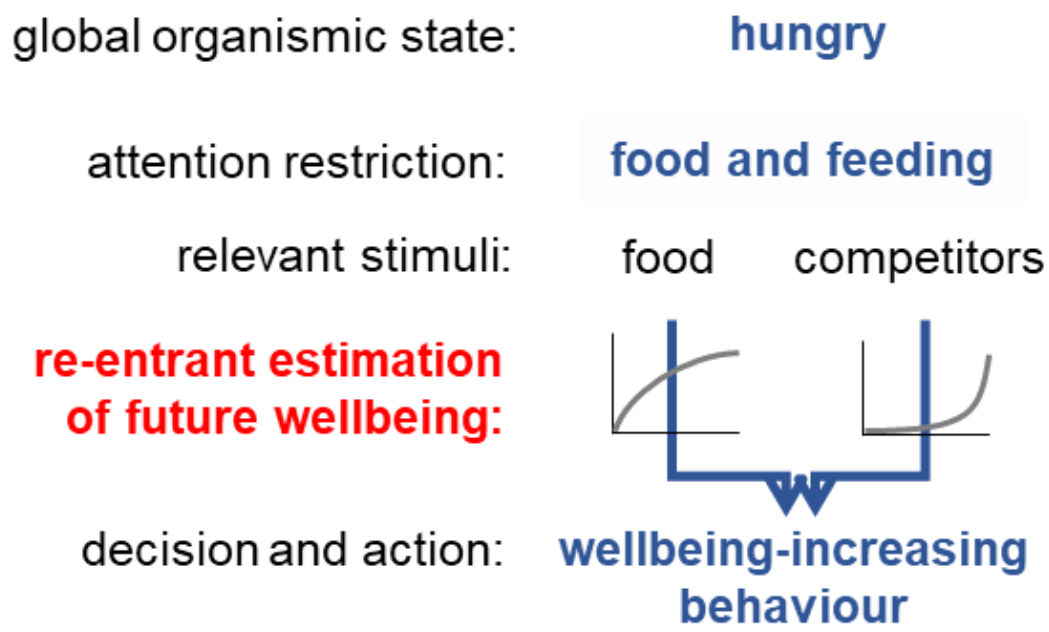
- The first cells
- Agents who learn
- Agents with conflicting emotions
- **Agents with imagination**





Agents with imagination and simulation

- **Vertebrates** (and some others) have episodic-like memory: information in memory about where/what/when/with whom
- Damasio: “The feeling of what happens”
- Imagination (prediction) of the emotion that a behavior may result in.



The Hypothesis

We hypothesize that decision making in vertebrates is a two-step common currency mechanism in which the individual

(1) determines its current priority by competition between sensory-derived emotions in the brain, and

(2) chooses its behavior by imagining its expected wellbeing in different scenarios, utilizing episodic-like memory.

Animal Behaviour 221 (2025) 123101

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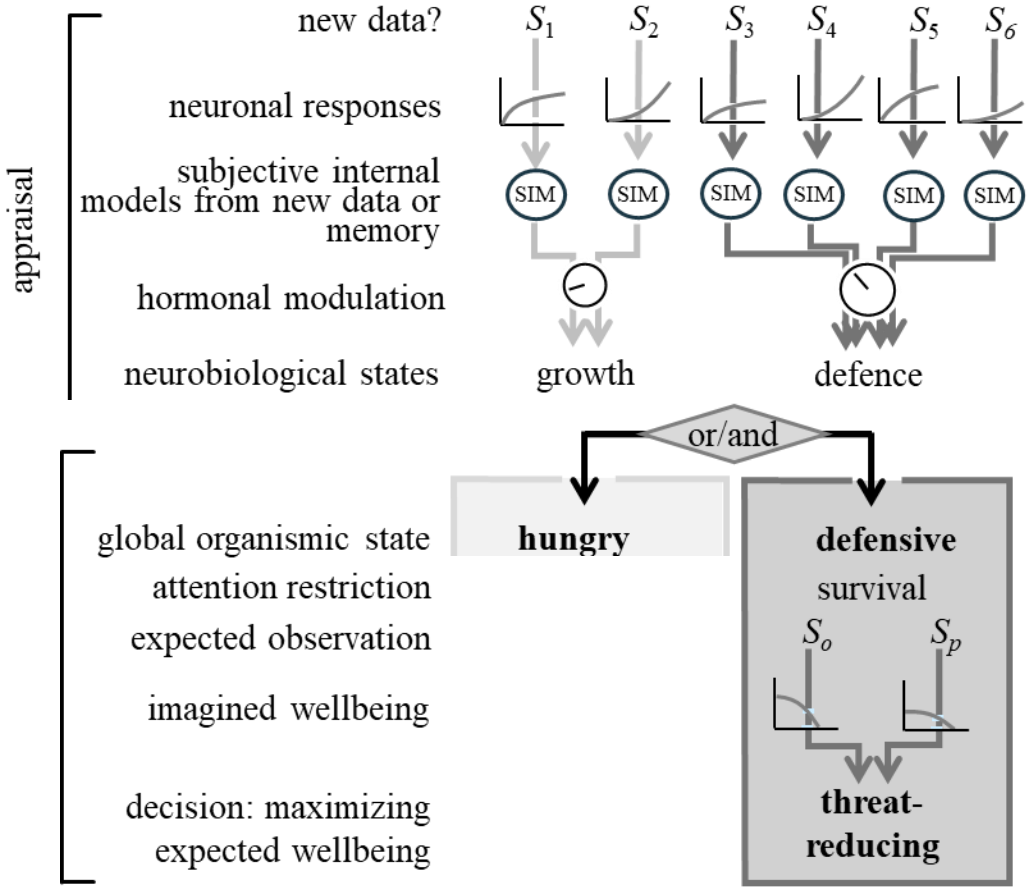
journal homepage: www.elsevier.com/locate/anbehav

Review

Vertebrate decision making leads to the interdependence of behaviour and wellbeing

Jarl Giske [a, *], Sergey Budaev [a], Sigrunn Eliassen [a], Andrew D. Higginson [b], Christian Jørgensen [a], Marc Mangel [a, c]

[a] Department of Biological Sciences, University of Bergen, Bergen, Norway
[b] Centre for Research in Animal Behaviour, Faculty of Health and Life Sciences, University of Exeter, Exeter, U.K.
[c] Department of Applied Mathematics, University of California, Santa Cruz, CA, U.S.A.



The Hypothesis

We hypothesize that decision making in vertebrates is a two-step common currency mechanism in which the individual

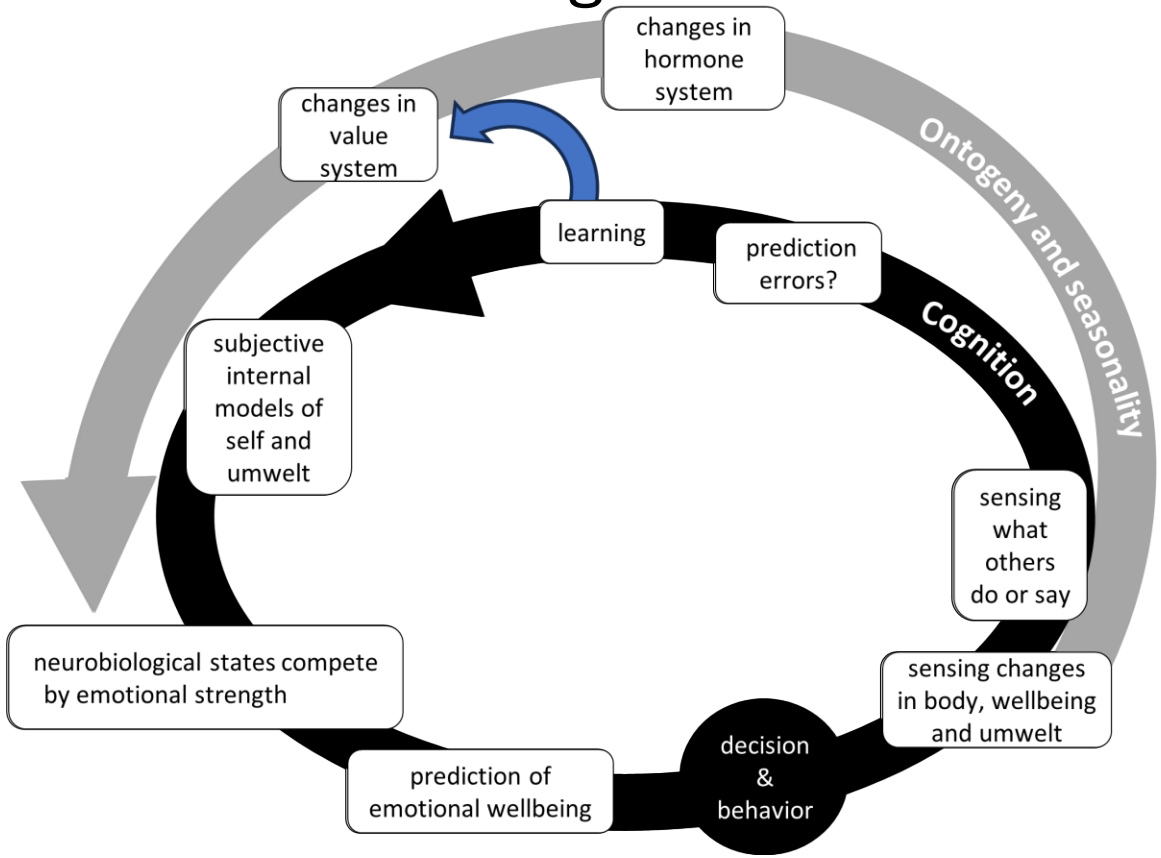
(1) determines its current priority by competition between sensory-derived emotions in the brain, and

(2) chooses its behavior by imagining its expected wellbeing in different scenarios, utilizing episodic-like memory.

This means that vertebrates (and others?) are agents that make their decisions to obtain the highest possible (short-term) emotional wellbeing.

Agency has evolved and diversified

- “As if”: Agency of the first organisms was rooted in genes
- The first cells
- Agents who learn
- Agents with conflicting emotions
- Agents with imagination
- **Agents with learned <u>values</u>**



Agency has evolved and diversified

- The first cells
- Agents who learn
- Agents with conflicting emotions
- Agents with imagination
- Agents with learned values

norms and

Chimpanzees Show Skills in Managing Conflict

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The New York Times

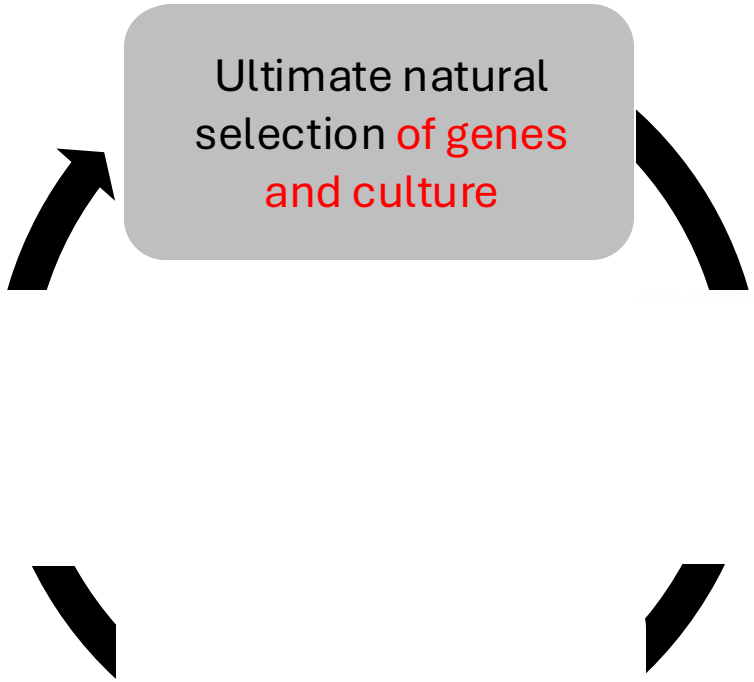
Claudia Rudolf von Rohr

The self-domestication hypothesis

Human culture may have tamed human genetics,

because some phenotypes (and their genes) were selected for their ability to live according to culturally transmitted norms and values.

We think of this explanation:



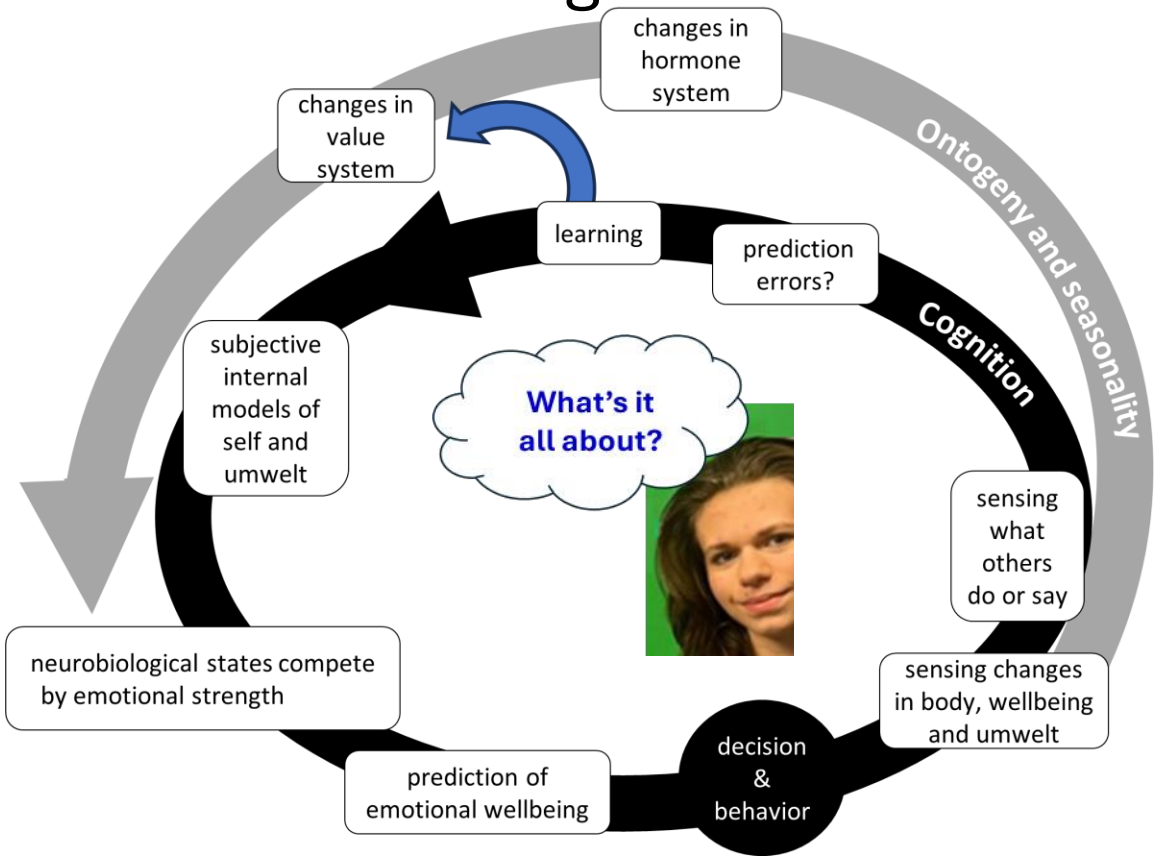
Gavrilets, S. 2012. Human origins and the transition from promiscuity to pair-bonding. PNAS 109: 9923-9928.
Hare, B. 2017. Survival of the friendliest: *Homo sapiens* evolved via selection for prosociality. Annu Rev Psychol 68: 155-186.
Wrangham, R. W. 2018. Two types of aggression in human evolution. PNAS 115: 245-253.

In the modern human society, one does not automatically adopt the norms of one's peers.

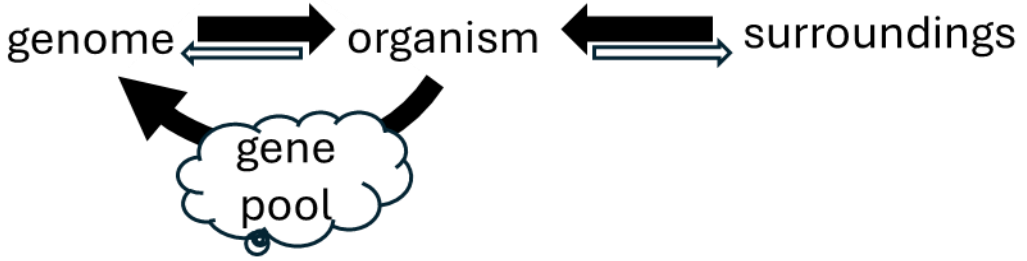
Now, norms and values are available on the global market, and they evolve fast.

Agency has evolved and diversified

- “As if”: Agency of the first organisms was rooted in genes
- The first cells
- Agents who learn
- Agents with conflicting emotions
- Agents with imagination
- Agents with learned values
- **Agents with “as if” free will**



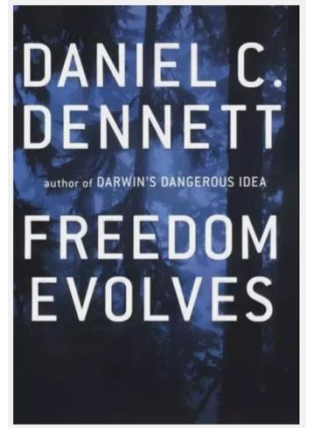
Agents with “as if” free will



learning

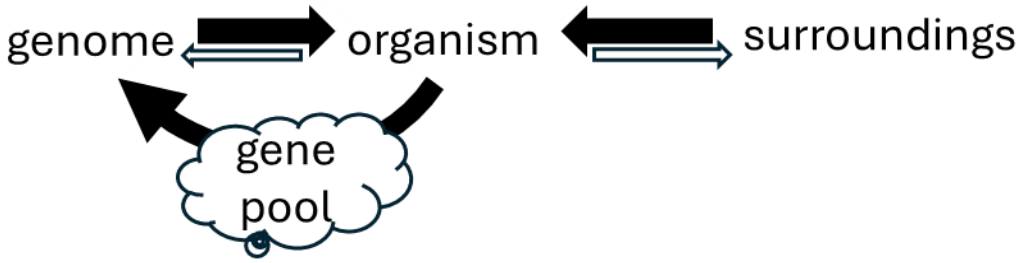
free will

Some **genes** that originated by random mutation, **have evolved**
as **they increased the algorithmic capacity and competence of the organism**
in making decisions on behavior or development,
leading to more offspring, and thus, more copies of these genes.



- In humans, norms and values are now much more the individual’s own choice. Thus, there is an active role of the individual in deciding its norms and values, but not its genes.
- This is as close to free will as evolution has brought any biological agent. For most practical purposes, “as if” free will is close enough (Dennett 2003).

Daniel Dennett (1942-2024)

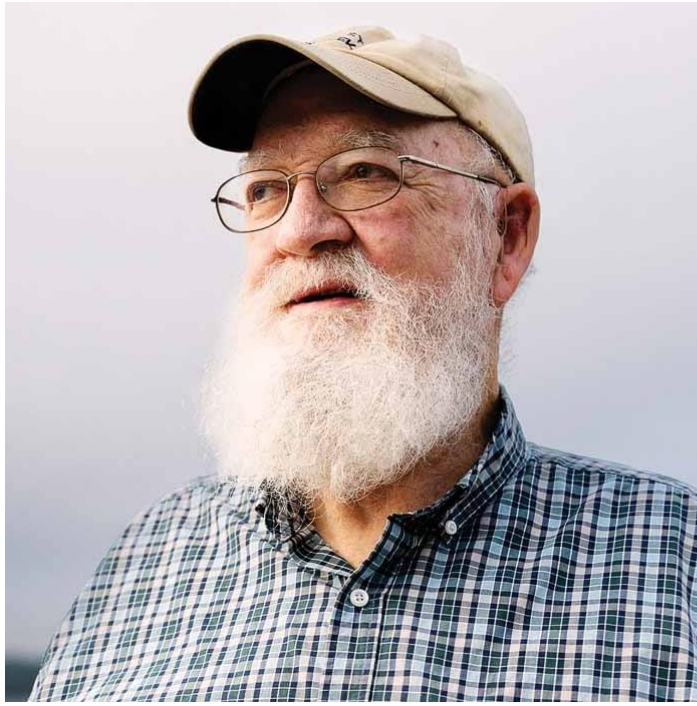


We act as if we have free will, and that's all we need.

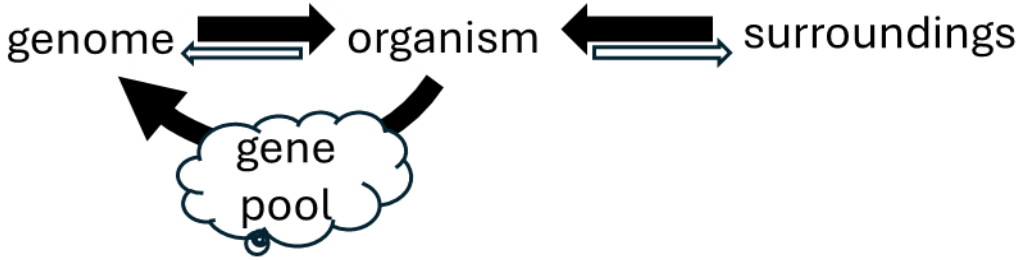
This is enough for **morality, responsibility, and decision making**.

Determinism and free will are compatible.

We don't need total independence from prior causes, just **enough flexibility** to act meaningfully.

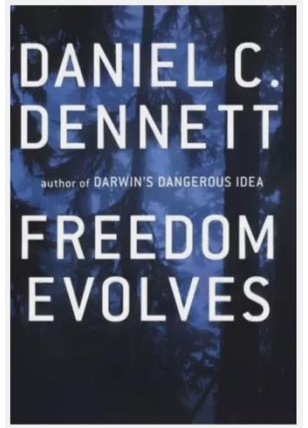


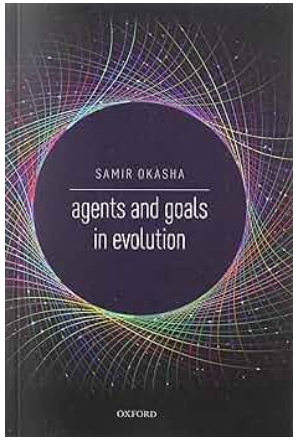
Dennett, DC 1984. *Elbow Room: The Varieties of Free Will Worth Wanting*. MIT Press.
Dennett, DC 2003. *Freedom Evolves*. Viking Press.
Dennett, DC 2015. Varieties of free will worth wanting, in *The Oxford Handbook of Free Will* (2nd ed.).

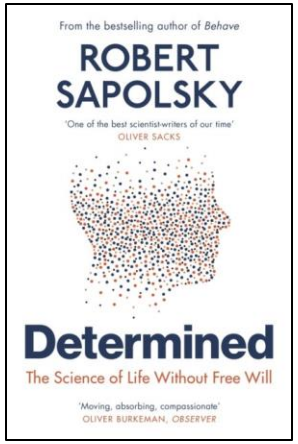


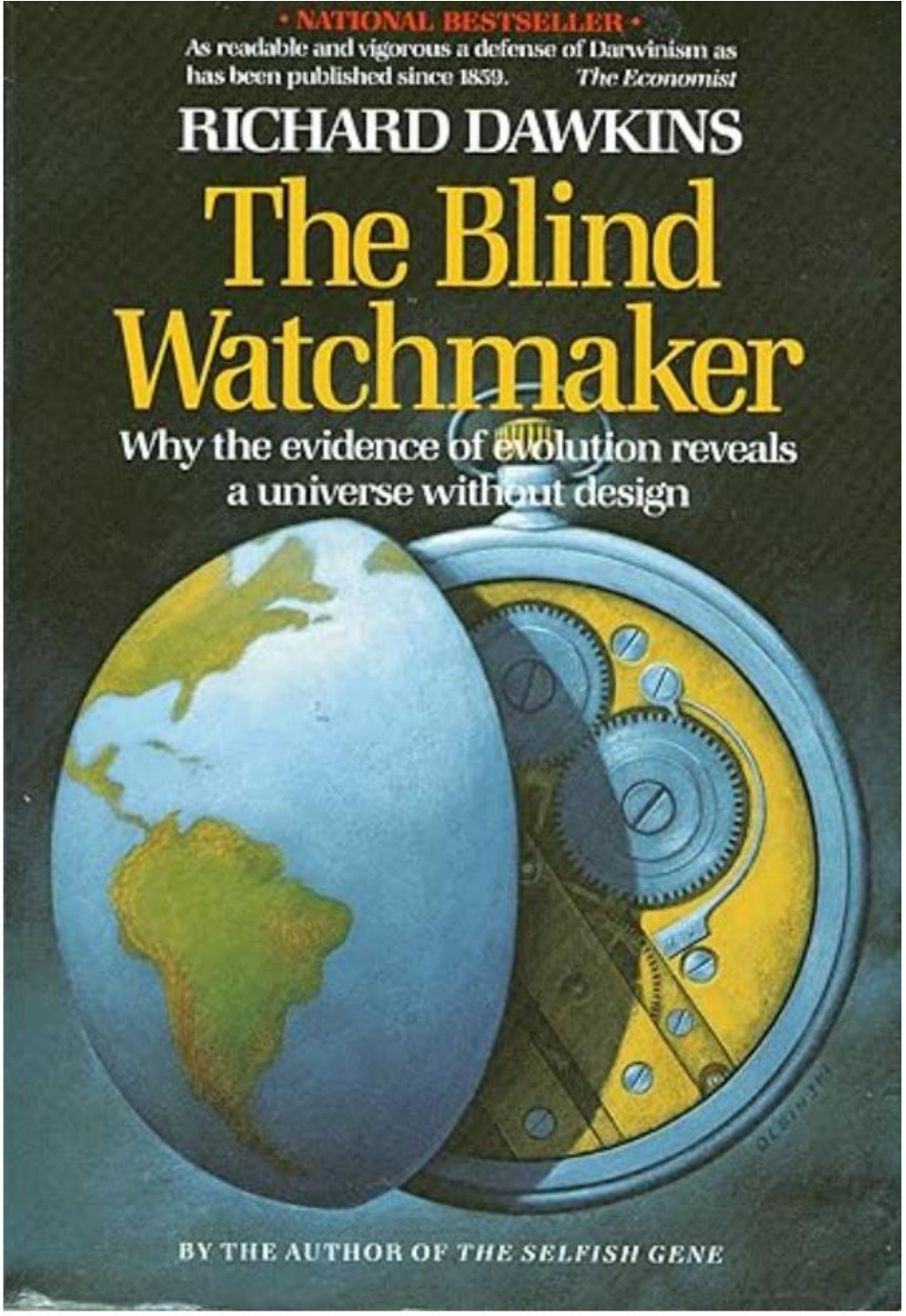
Agents with “as if” free will

- For most practical purposes, “as if” free will is close enough (Dennett 2003).
- Sapolsky (2023) argues that all organismic agency is non-existent, due to the ultimately total control of genes and culture.
- We think this is too far. Both “as if” agency (Okasha 2024) and “as if” free will are important factors in genetic and cultural evolution.









Actually, we mean that the evolutionary emergence of “as if” free will on a planet is worth a celebration.

It is a great feat of the blind watchmaker.

It started with replicators, who are the ultimate causes for organisms.