

Language & Languages at the crossroads of Disciplines, 1st Annual Meeting  
Sorbonne, Paris, September 11, 2024

## *Evolution* across disciplines

Terms, concepts, analogies, models

Arie Verhagen

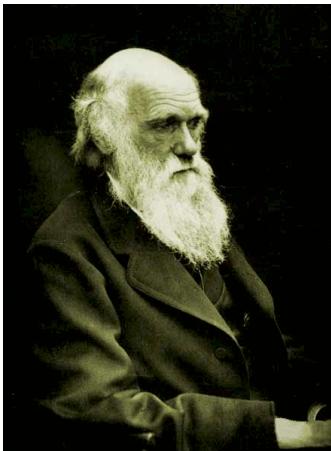


Universiteit  
Leiden  
The Netherlands

<https://www.arieverhagen.nl>

## 1. TERMS, CONCEPTS AND A FRAMEWORK FOR COMPARISON

### The discovery of a new kind of process

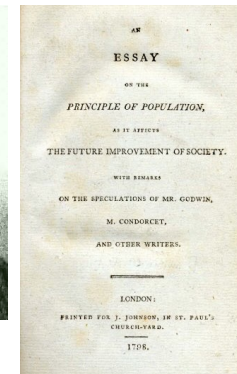


- Darwin in autobiography:

I soon perceived that selection was the keystone of man's success in making useful races of animals and plants. But how selection could be applied to organisms living in a state of nature remained for some time a mystery to me.

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### The discovery of a new kind of process

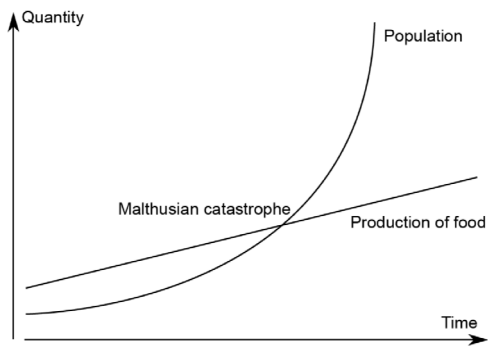


- Darwin in autobiography:

I soon perceived that selection was the keystone of man's success in making useful races of animals and plants. But how selection could be applied to organisms living in a state of nature remained for some time a mystery to me. In October 1838, [...], I happened to read for amusement Malthus on *Population*, ...

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## The discovery of a new kind of process

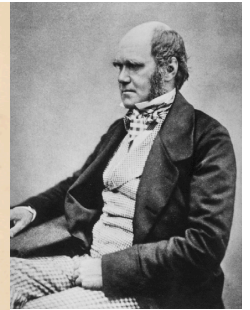
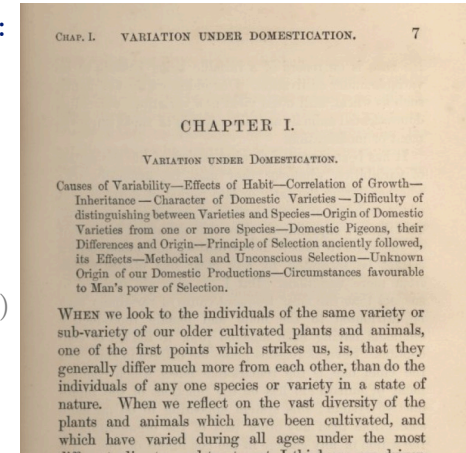


... and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species. Here, then, I had at last got a theory by which to work; [...]

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## The discovery of a new kind of process

- *Origin*, ch. I (7-43): Variation under domestication (Artificial selection)
- ch.II: Variation under nature
- ch.III: Struggle for existence (Malthus)
- p.80: ch.IV: Natural selection

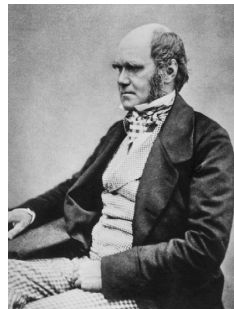


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## The discovery of a new kind of process

### *Evolution*

1. Variation (in a population of replicators, e.g. organisms)
  2. Selection: variant with feature F has higher chance of being replicated than variant without
  3. Heritability: features are passed on reliably in replication ('offspring resembles parents')
- Frequency of F in the population will increase, cumulatively
- 1) change of relative frequencies of variants in a population, over generations
  - 2) through natural selection



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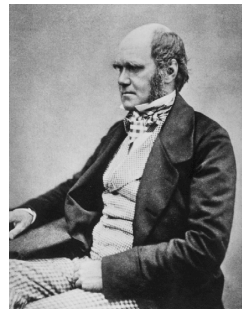
## The discovery of a new kind of process

### *Evolution*



“a process of gradual change”

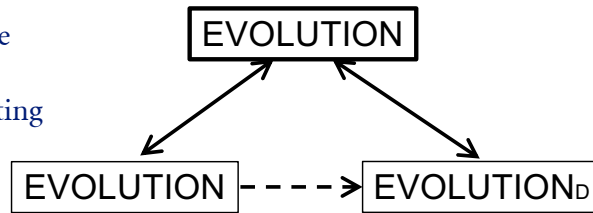
- Not used in 1<sup>st</sup> edition of *Origin* (1859)
  - except on last page, as last word: *evolved*
  - used in extended 6<sup>th</sup> edition (1872)



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## Scientific and semantic change

- In a particular community of scientists
- “evolution”: from
  - process of gradual change
- to
  - process of change exhibiting the logic of Darwin’s algorithm

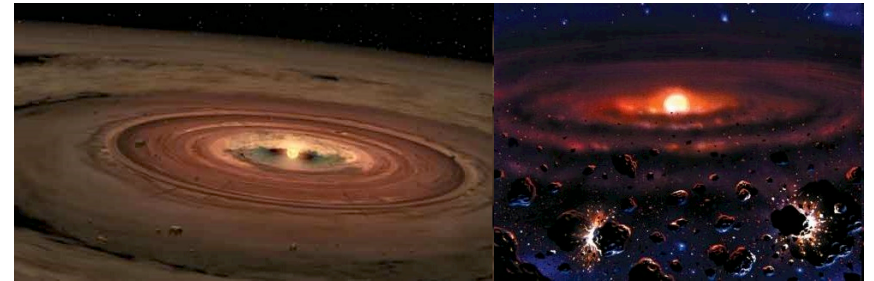


- EVOLUTION<sub>D</sub> is a new, special sense of EVOLUTION
  - Gives rise to (implicit) schematic notion EVOLUTION

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## Given a theory, terms have a precise meaning

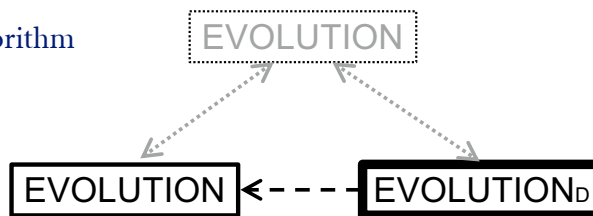
- ‘Evolution’ of solar system: variation (objects of different size, composition and position) and (blind) selection (some have more chance of ‘surviving’).
- But no replication, so not ‘Darwinian’



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## Scientific and semantic change

- In some communities of scientists
- “evolution”: from
  - instance of Darwin’s algorithm
- to
  - another domain = metaphor

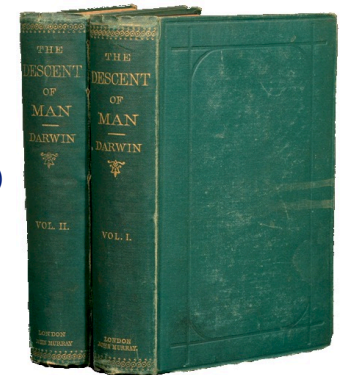


- from
  - biology, change through natural selection
- to, e.g.,
  - domain of language, culture, technology, ...

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## The evolutionary algorithm

- “Substrate neutral”
  - Breeding, sexual selection, language (Darwin)
  - Immune systems, brains (Edelman)
  - Cultural systems (Boyd & Richerson, Dawkins)
  - Science (Hull)
  - Learned vocal communication systems, in humans and in animals



*The Descent of Man, and Selection in Relation to Sex* (1871)

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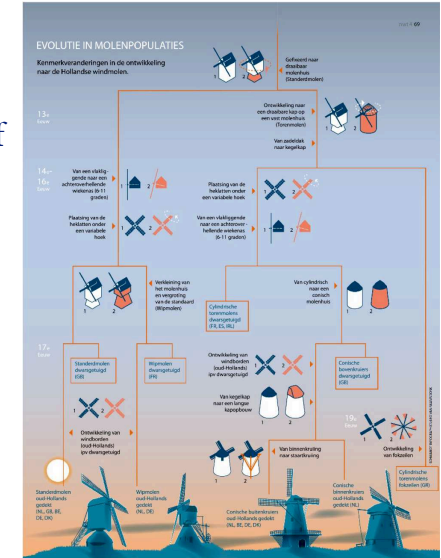
## Multiple instantiations

- Example: Chaffinch song in Europe including Canary Islands
- Selection pressures
  - Availability/opportunity of mate choice
  - Costs (time for learning, brain)
- All extant populations (song repertoires): “descent with modification”, by cultural evolution



## Multiple instantiations

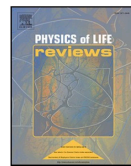
- Example: evolution in populations of windmills
- Selection pressures
  - Environment (e.g. variable wind direction)
  - Costs/resources (material, labor, cognition, ...)
- All extant populations (types) of windmills: “descent with modification”, by cultural evolution



## Substrate neutral evolution

Language follows a distinct mode of extra-genomic evolution

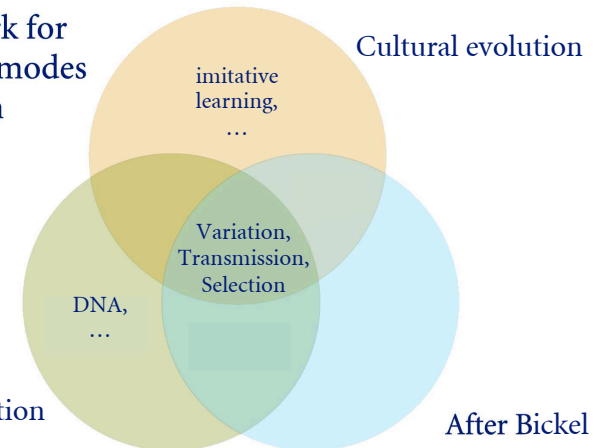
Balthasar Bickel<sup>a,b,\*</sup>, Anne-Lise Giraud<sup>c,d</sup>, Klaus Zuberbühler<sup>b,e,f</sup>,  
Carel P. van Schaik<sup>b,g,h</sup>



50 (2024) 211–225

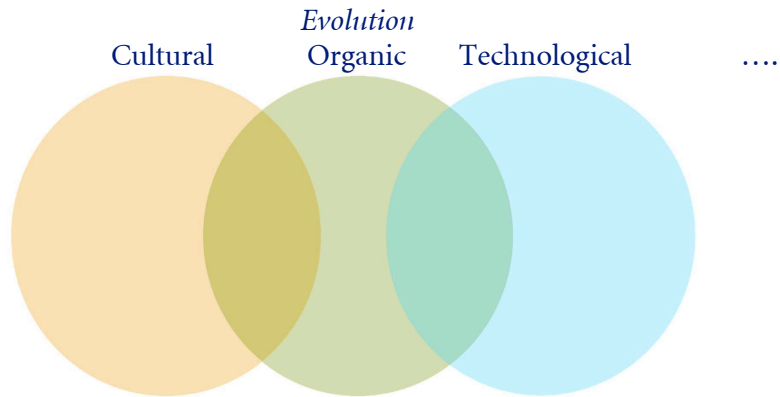
## Substrate neutral evolution

- A framework for comparing modes of evolution



## Substrate neutral *evolution*

- Theoretical terms/concepts: no ‘family resemblance’



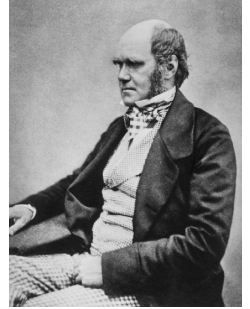
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## “plain signification”

- Metaphors, analogies
  - useful as instruments in processes of investigation and education (natural selection  $\rightarrow$  breeding!); less so, or even potentially harmful, in theoretical explanations.

The other and more general departments of natural history [*besides Systematics*] will rise greatly in interest. The terms used by naturalists of affinity, relationship, community of type, paternity, morphology, adaptive characters, rudimentary and aborted organs, &c., will cease to be metaphorical, and will have a plain signification.

(Darwin 1859: 485)



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## Shared implication: population thinking

- Darwinian evolution:
  - Change in relative frequencies of variants in a population, over generations
  - “Populations evolve, individuals are selected”
  - Due to external causes (unlike *development* – growth, life history – which is guided by internal ‘program’)

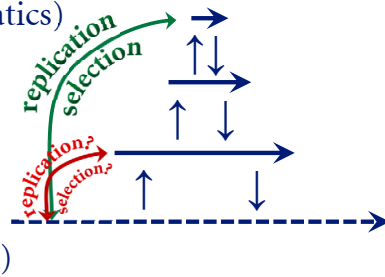


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## 2. LANGUAGE AS A PROCESS OF PROCESSES

## Language as a process of processes

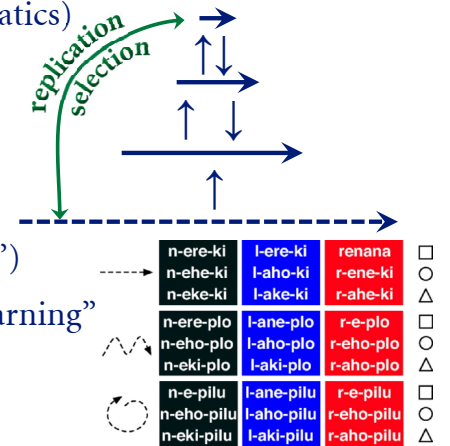
- Communicative interaction (pragmatics)
- Text, conversation (microgenesis)
- Acquisition, processing, memory (ontogeny)
- Language community, conventions (history, 'system')
- A role for acquisition?



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## Language as a process of processes

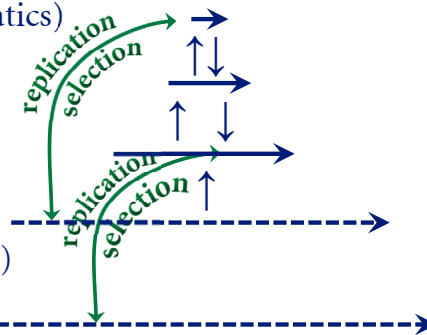
- Communicative interaction (pragmatics)
- Text, conversation (microgenesis)
- Acquisition, processing, memory (ontogeny)
- Language community, conventions (history, 'system')
- Cultural transmission → “iterated learning”
  - produces structure over generations (Kirby et al. 2008)



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## Language as a process of processes

- Communicative interaction (pragmatics)
- Text, conversation (microgenesis)
- Acquisition, processing, memory (ontogeny)
- Language community, conventions (history, 'system')
- Genetic evolution
- No *direct* link between linguistic and organic evolution



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## Interlocking time scales and causal processes

- Avoid ‘organic’ interpretations of language (items)
  - “a language/word is a virus”, etc.
  - no direct link between reproductive success and linguistic systematicity
- Alternative view, also biologically inspired: “niche construction”
  - Beavers have evolved adaptations for living in a certain kind of environment, which has evolved itself as a result of activities of (proto)beavers
  - Humans have evolved adaptations for communication with language, which has evolved itself as a result of activities of (proto)humans

Odling-Smee et al. (2003), Sinha (2009, 2023)



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## Tinbergen's "Four Why's"

Tinbergen, N. (1963), On aims and methods of ethology. *Zeitschrift für Tierpsychologie* 20: 410-433.

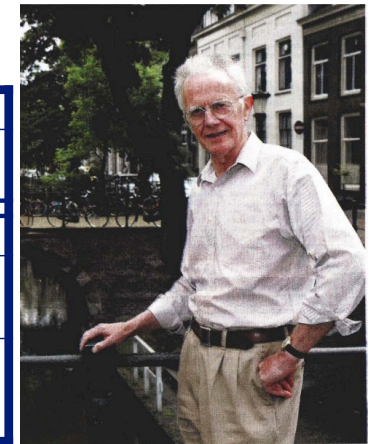


Proximate (individual)	Mechanism	Development
	situation → processing → behavior	ontogeny
Ultimate (population)	Function	Evolution
	survival value, contribution to fitness	phylogeny

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## Tinbergen's "Four Why's" + cultural dimension

Hurford, James R. (1990), Nativist and functional explanations in language acquisition. In: Roca (ed.)



Proximate (individual)	Mechanism	Development
	situation → processing → behavior	ontogeny
Ultimate (population, (epi)genetic)	Function	Evolution
	survival value, contribution to fitness	phylogeny
(population, linguistic)	contribution to communicative, social success	glossogeny (Hurford)

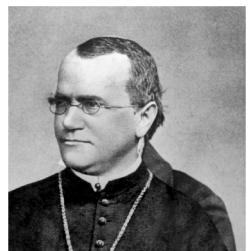
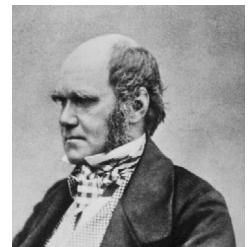
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## 3. IMPLEMENTING THE EVOLUTIONARY ALGORITHM

### A. Replicators and interactors

## Functions and units

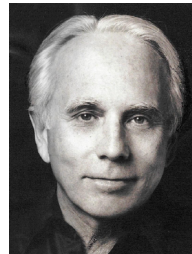
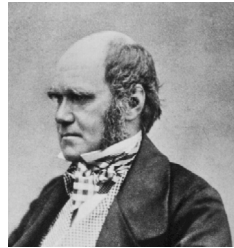
- Darwin's algorithm:
  - comprises differential replication of certain entities
  - caused by some form of interaction with the environment
- Late 19<sup>th</sup> century: crisis of inheritance
  - Mechanism?
  - Blending of heritable features? Will reduce variation quickly!
- Early 20<sup>th</sup> century: "Modern synthesis"
  - (after heated debates)
  - Mendelian inheritance: genes/alleles
  - Population genetics



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## Functions and units

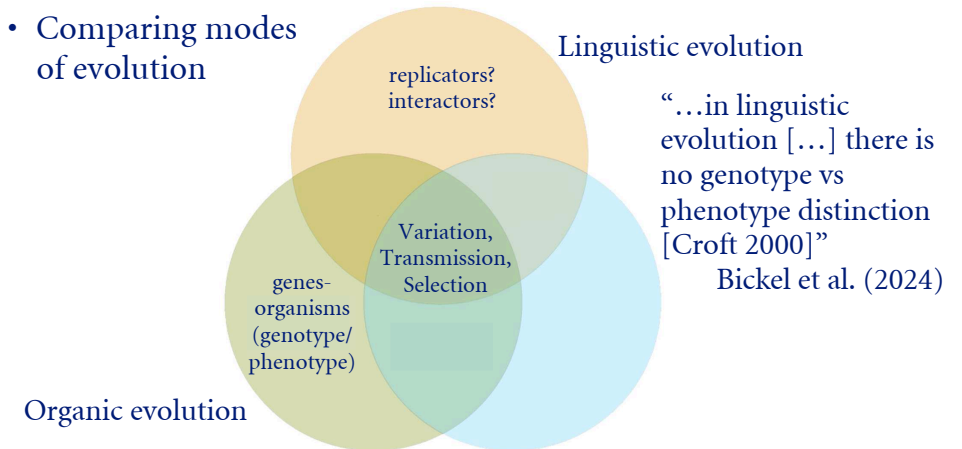
- Darwin's algorithm:
  - comprises differential replication of certain entities
  - caused by some form of interaction with the environment
- Modern synthesis, implication
  - replicating entities need not be identical to the ones interacting with the environment, as long as the latter cause differential replication of the former
  - Abstractness of algorithm
    - "Generalized Theory of Selection" (Hull)
    - **Each case: identify replicators and interactors for that case**



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## Inspiration versus analogies

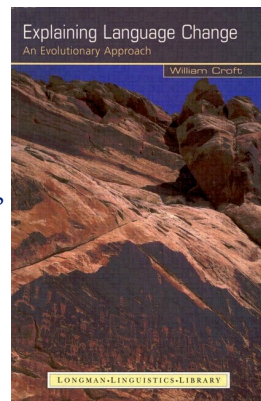
- Comparing modes of evolution



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## Inspiration versus analogies

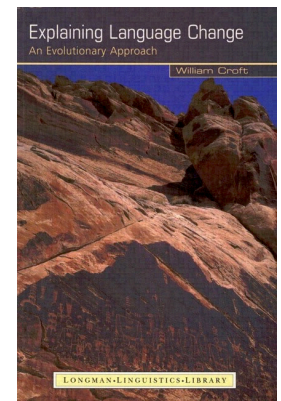
- Croft (2000: 39)
  - “In biology, an organism is described as having a phenotype [...] which is [...] at least partially determined by its genotype, the genes in its DNA. In linguistics, we say that a grammar generates an utterance, or that a speaker expresses an utterance”
- Biology: replicator/genotype ‘produces’ interactor/phenotype
- Linguistics: interactor/phenotype ‘produces’ replicator/genotype
- “disanalogy”, “false analogy”
  - Give rise to “Grammars are the linguistic replicators (replicated in acquisition)”



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## Inspiration versus analogies

- Following Croft (2000):
  - Linguistic replicators (“linguemes”)
    - phonological patterns (phonemes, phonotactic rules)
    - constructions (symbols – lexical, grammatical)
  - Linguistic interactors
    - speakers
    - producing utterances, i.e. structured sets of linguemes
      - in the process selecting them
  - Language: other ‘network’ of causal processes involving replicators and interactors than biology
    - esp. eukaryotic organisms – immune system is different

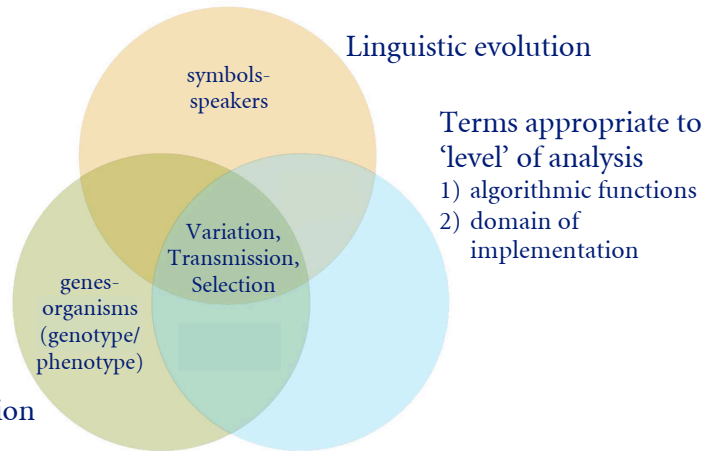


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## Comparing modes of evolution

- Replicators?
- Interactors?



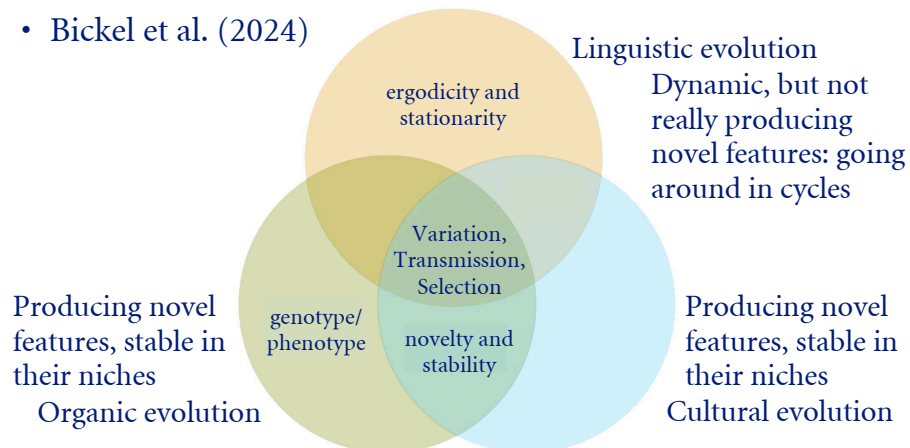
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## 3. IMPLEMENTING THE EVOLUTIONARY ALGORITHM

### B. Comparing modes of evolution

## Languages and the language faculty

- Bickel et al. (2024)



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## Ergodicity vs. novelty/stability?

The faculty of language [...] evolved once as a novel trait fitting into the specific niche of human communication, sociality, and biology. It is a stable trait: no matter which language we look at, the faculty of language enables open-ended communication, creative cognition, and richly structured cooperation, it can be learned and processed by any human (pathologies aside), and it operates under similar physical and anatomical conditions. [...]

At the same time, the language faculty is fundamentally dynamic. Within the state space defined by its niche, language is subject to relentless diversification into varieties (dialects, sociolects, etc.) and new languages. We refer to this intrinsic dynamic of the language faculty as **linguistic evolution**, as opposed to its biological evolution. Linguistic evolution follows from the social function of language: languages diversify in response to social clustering, providing ubiquitous, continuously updated identity markers and creating a sense of belonging. (Bickel et al. 2024: 213, references omitted)

- What is the *faculty* of language?
  - not what enables cooperation, not what is learned, ...
- What is *the* faculty of language?

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## Language vs. the language faculty?

**Language:** either (i) a system of conventions governing the structure, composition, expression, and interpretation of meaningful signals, used by specific people at a specific time in a specific place, or (ii) the faculty for any such system, as a phenotypic trait of the human species. We refer to (ii) as the **language faculty** (understood in the broad sense [Hauser, Chomsky & Fitch 2002]).  
(Bickel et al. 2024: 212; Box 1, Glossary)

- Scientific terms should not deliberately be defined ambiguously

- Population thinking!
  - Conventions are population level phenomena (Lewis 1969, Verhagen 2021)
    - Emerging through recurrent cooperative interactions between members of a community
- Talk about a faculty “for” a system of conventions basically reduces the latter to an individual level phenomenon
  - a faculty for traffic rules, for rules of board games, for money, ...?

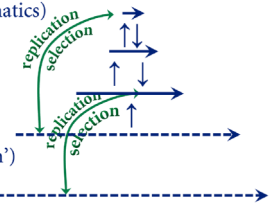
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- Deeper issue:

- Talk about a faculty “for” a system of conventions basically reduces the latter to an individual level phenomenon
  - a faculty for traffic rules, for rules of board games, for money, ...?
- Communicative interaction (pragmatics)
  - Text, conversation (microgenesis)
- Acquisition, processing, memory (ontogeny)
- Language community, conventions (history, ‘system’)
- Genetic evolution
- No *direct* link between linguistic and organic evolution



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## 4. CONCLUSION

### Goal: explanation Overlap in properties of different domains should follow, not be stipulated

- Inspiration
    - inclusive fitness
  - joint replication
  - ...
- Organic evolution

genotype/phenotype, DNA, ...

Linguistic evolution

symbols (form/meaning), utterances, imitation, ...

Scientific evolution

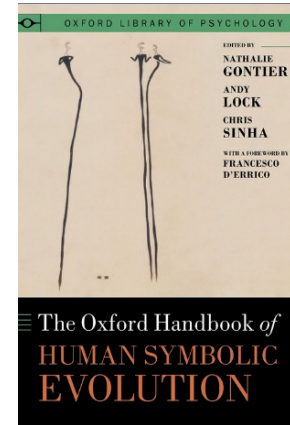
theories, publishing/teaching, ...
- Variation, Transmission, Selection  
vertical transmission?
- x?      y?
- Does replicating a construction related to X make the replication of X more likely?
  - Are items belonging to the same style/genre replicated together?
  - ...

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## Goal: explanation

- Tasks in each domain of evolutionary research
  - identify functional entities (replicators, interactors), including variation
    - specific properties of implementation (DNA, utterances, publications, ...)
  - establish population dynamics
  - establish factors causing differential replication, esp. selection pressures
  - show how these together produce change over a series of replications
- Complicated!
  - Points are partly dependent on each other
  - Inspiration may be sought in any other domain
  - “Population thinking” remains hard – but worthwhile!
- Terminology
  - Minimal: awareness of polysemy; in theories: “plain signification”

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Gontier, Lock, Sinha (eds.), 2023

(30% discount with prompt ASPROMP8 at global.oup.com)

SLE 2023 presidential address:

<https://www.arieverhagen.nl/research/presentations/>

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