

Phylogenetics and Biolinguistics

Cedric Boeckx

***iCrea**
INSTITUCIÓ CATALANA DE
RECERCA I ESTUDIS AVANÇATS

b|iologistics
i|nitiative
b|arcelona

 
Universitat
de Barcelona

Focus of this meeting

1. How can the mechanisms of language variation through time and space be investigated and computationally modeled?

2. What does the attested scope of language diversity tell us about the formation, history and movements of different populations, cultures and societies?

3. To what extent does variation in language correlate with variation in other cultural or biological features of human societies?

Noam Chomsky

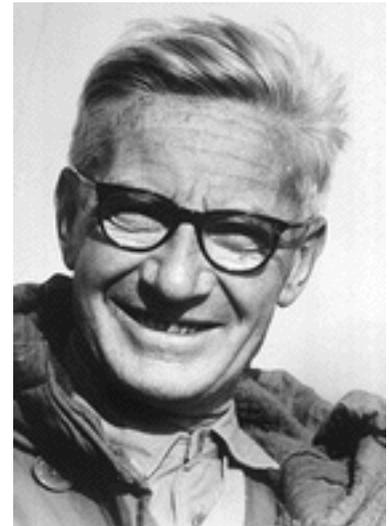
Certain aspects of the thing we call “language” can be studied in a scientific manner, as part of the subject matter of biology --- shedding light on what makes us human
That’s the biological stance in linguistics
 (“biolinguistics”)



- What is knowledge of language?
- How is it acquired?
- How is it put to use?
- How is it implemented in the brain?
- How did it evolve?

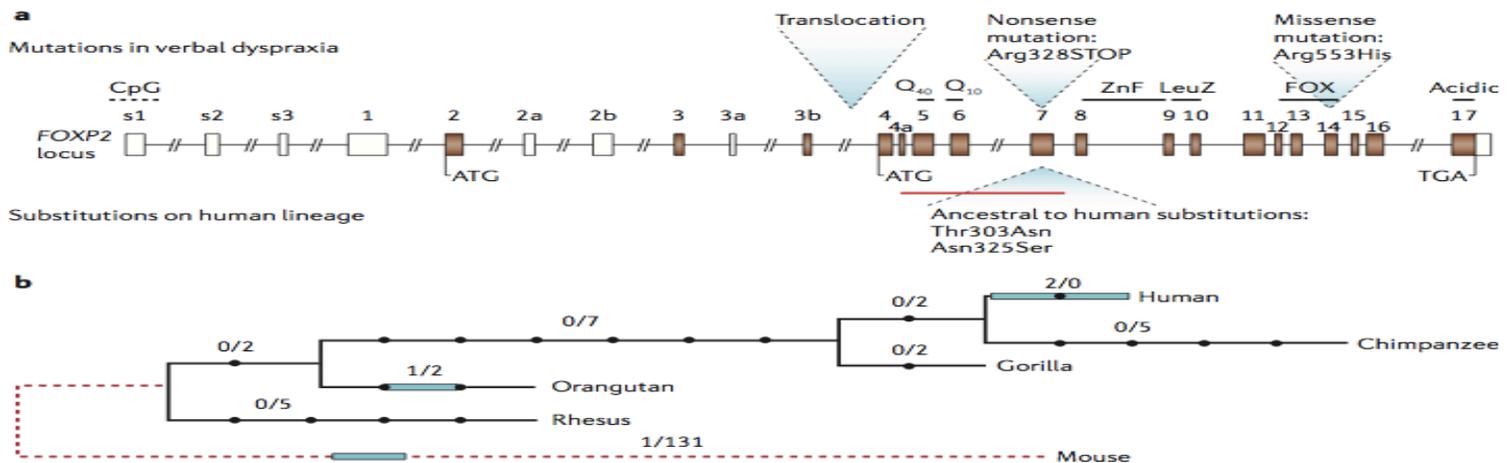
Tinbergen's Research Program to study behavior from a biological perspective

1. Evolutionary (ultimate) causes: how does the behavior impact on the animal's chances of survival and reproduction?
2. Immediate (proximate) causes: what are the stimuli that elicit the response?
3. Development (ontogenesis): how does the behavior develop in the individual?
4. Evolutionary history (phylogenesis): how did the behavior arise in the species, and how does it compare with similar behavior in related species?



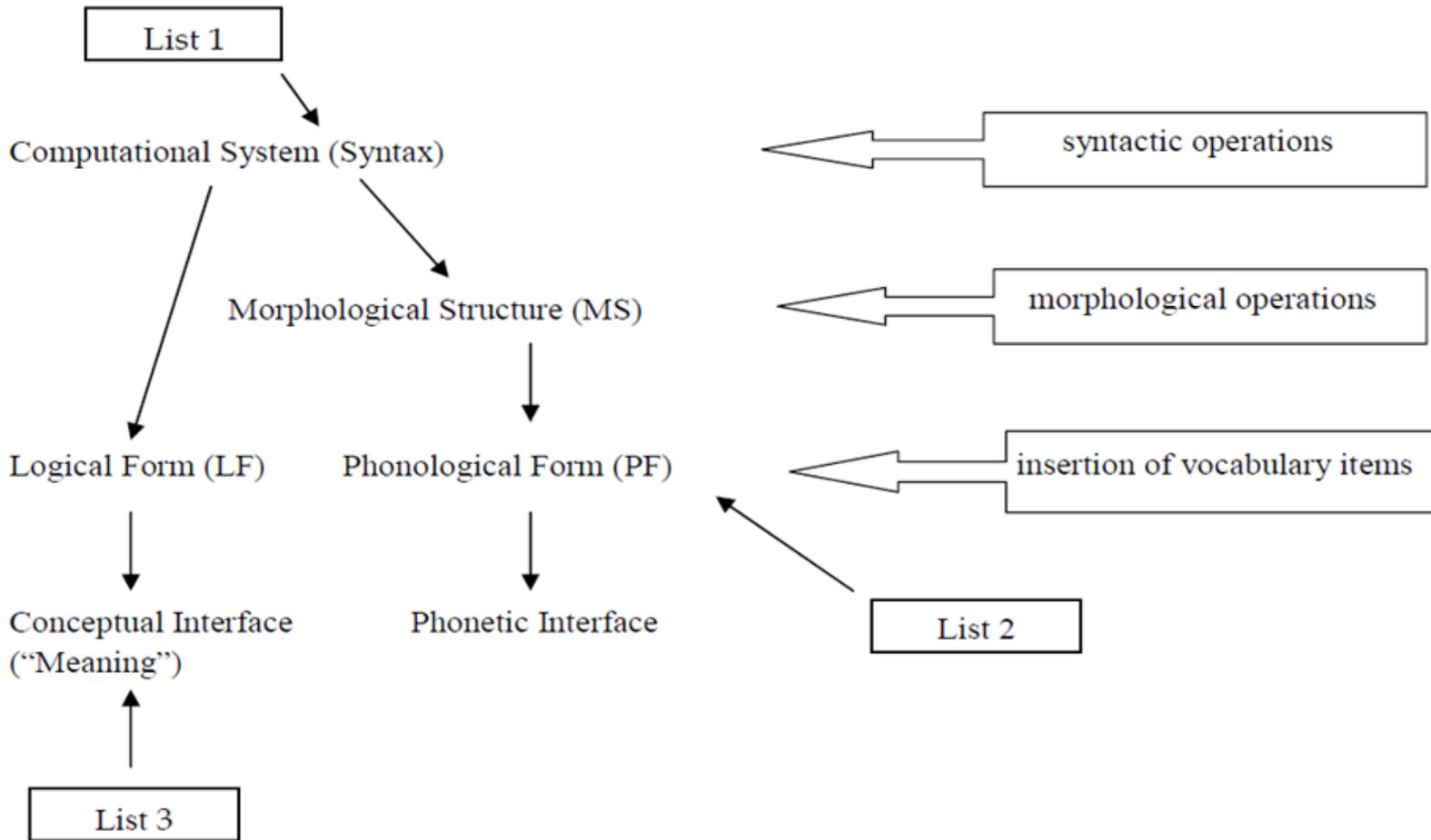
Tinbergen, N., On the aims and methods of ethology. *Zeitschrift fur Tierpsychologie*, 1963. 20: 410-463.

Biolinguistics 2.0



A big result

- Thanks to intensive work over 35 years or so, we now understand that variation in language is confined to specific components of grammar



Variation across phenotypes

- Same loci of variation (Leivada 2013, 2014, 2015)

SLI

- *Tsimpli (2001)*
 - Spontaneous speech from 7 SLI children (and 4 TD controls)
 - “Where such [case] features are included in a lexical item with other features unable to erase (e.g., nouns, “strong” pronouns, genitive clitics, demonstratives, indefinite article), PF-marking is available inconsistently [...]” (p. 446)
 - Phonological salience of features is argued to play an important role in providing an account of crosslinguistic differences across instances of typical and non-typical development

SLI

- *Kambanaros et al. (2013)*
 - 14 children with SLI, 50 controls (30 age matched TDs, 20 language matched TDs) tested on a picture-naming task (Cypriot Object and Action Naming, adapted from Kambanaros 2003) which aims to assess lexical retrieval of object and action names
 - Both groups produced semantic descriptions or circumlocutions for verbs: intact access to the semantic information of the target word, difficulties in accessing its phonological representation

Autism

- *Terzi et al. (2013)*
 - 20 5-8 year old children with ASD and 20 controls (age and language matched) completed a sentence-picture matching, an elicitation, and a judgment task
 - Correct interpretation of reflexives and strong pronouns, but decreased accuracy in comprehension coupled with omission of clitics in terms of production
 - This vulnerable status of clitics in Greek-speaking autistics could be caused by difficulties in the semantics-pragmatics interface or the syntax-phonology interface
 - Terzi et al. (2013) acknowledge both possibilities, however, they focus on the former, due to the fact that their ASD subjects performed lower than their TD controls on the pragmatics baseline task

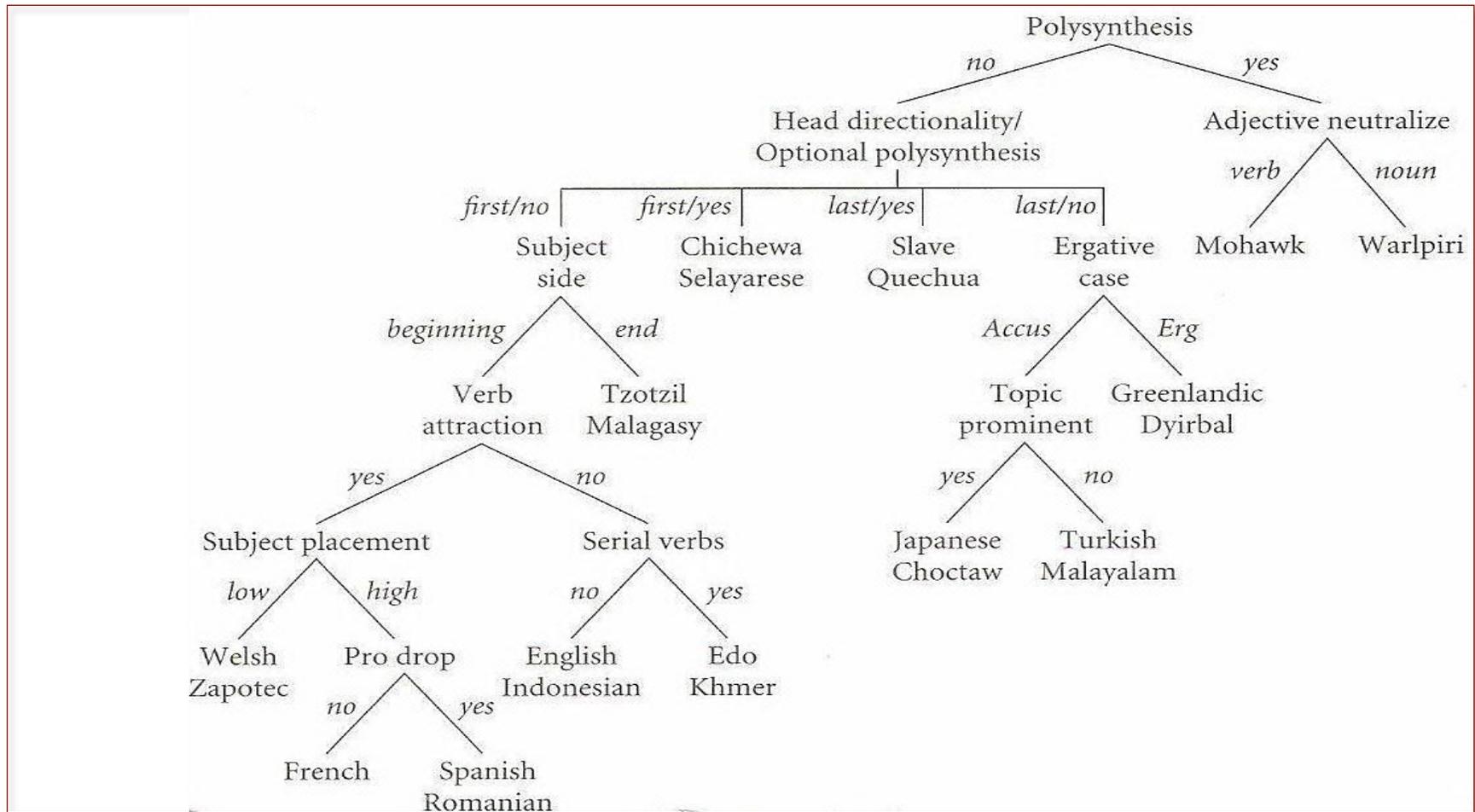
Down syndrome

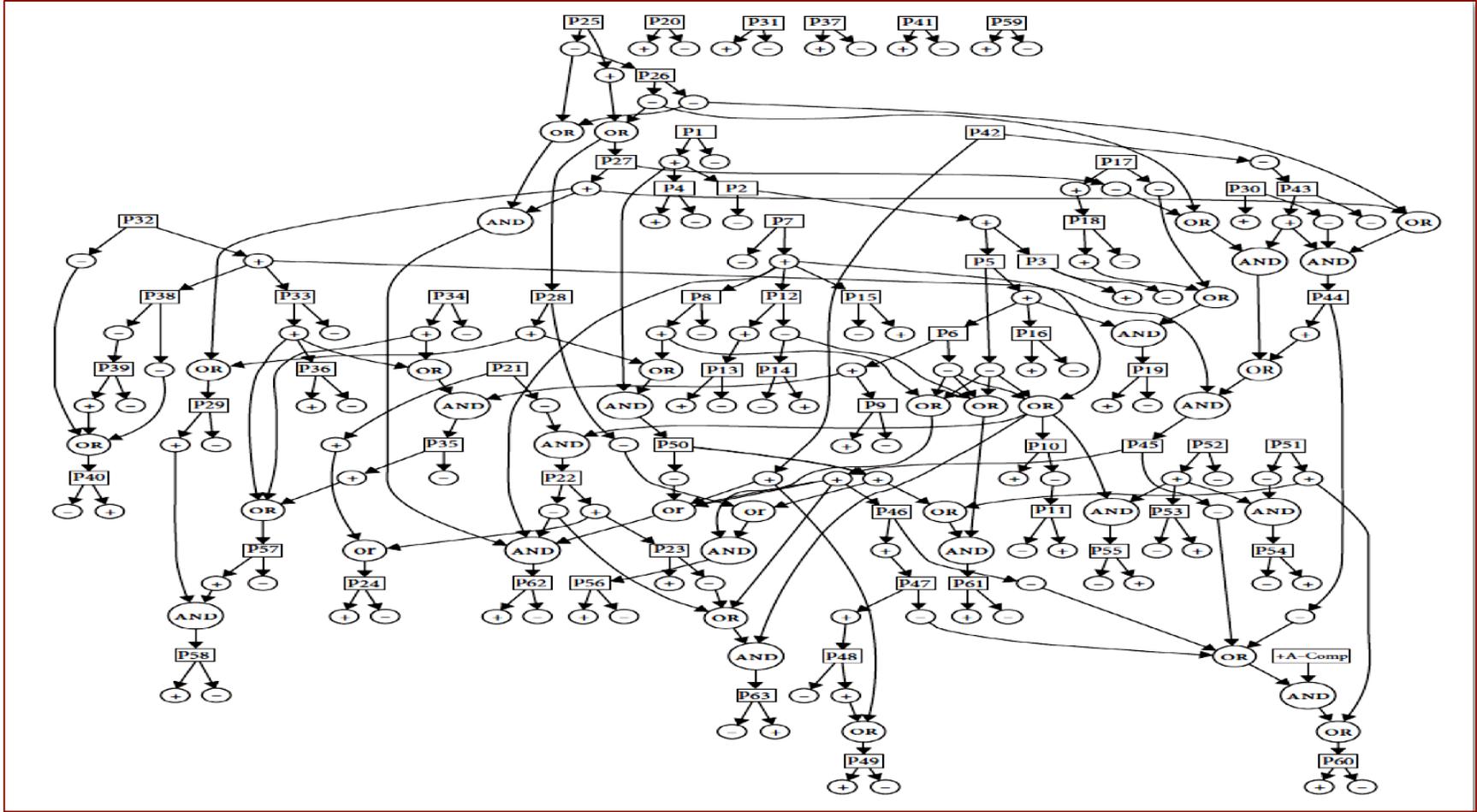
- *Christodoulou (2011)*
 - Linguistic abilities of 16 Cypriot Greek speaking adults with DS (aged 19;0 to 45;11) and 17 TD children (7;0 to 8;11)
 - Morphological mismatches are the result of failure to retrieve the most specified form: “the competition between a phonetic exponent that includes (i) all feature values resulting from the syntactic derivation, and (ii) a subset of the features, but no contrasting features, fails to be resolved in favor of the most specified form”
 - Full-word and phoneme omissions can be taken to suggest a difficulty with vocabulary or sound insertion, which may be rooted in short-term memory limitations

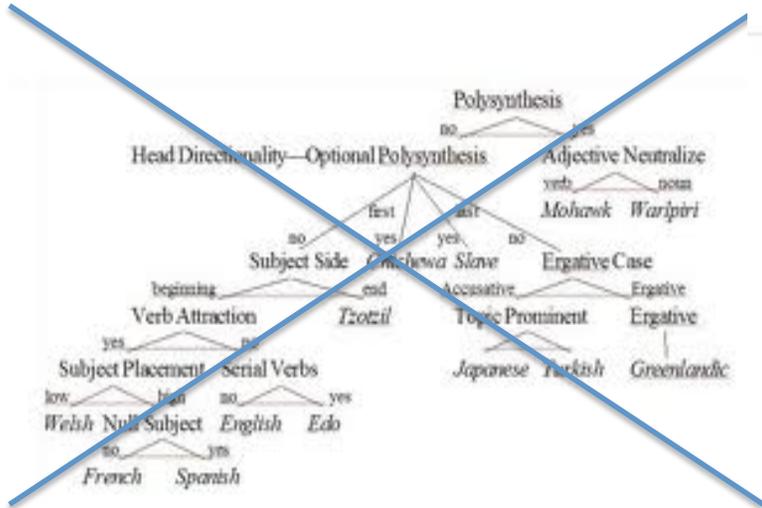
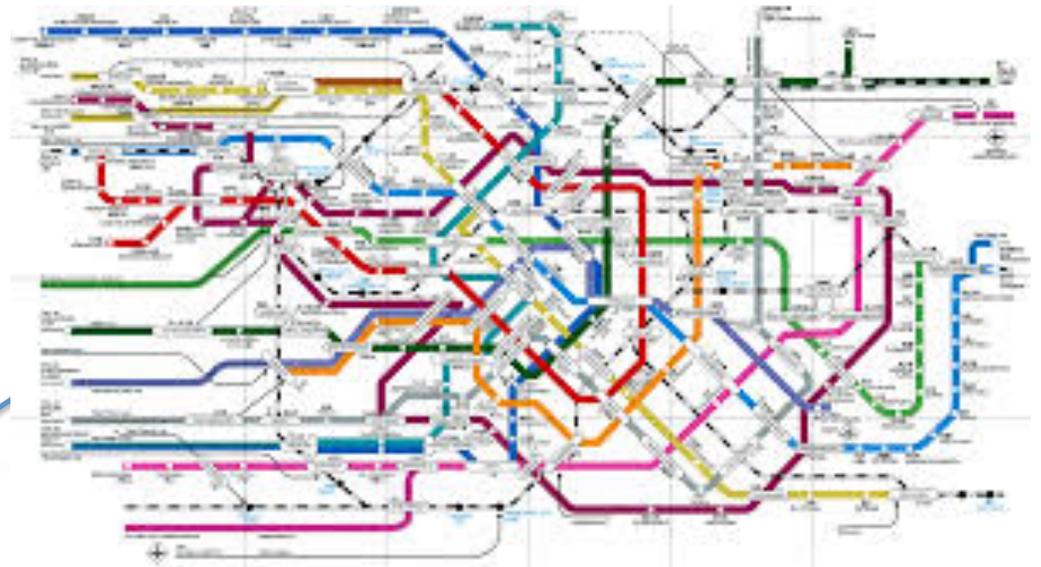
Schizophrenia

- *Kambanaros et al. (2010)*
 - A comparison of object and action naming in 20 adult patients diagnosed with schizophrenia
 - Findings suggest a retrieval issue
 - The absence of dissociation in comprehension of action and object names coupled with semantic errors in naming is taken to suggest “intact conceptual-semantic stores, but difficulties with mapping semantics onto the lexicon”, that is, access/retrieval problems

Topology







Big data helped

OPEN  ACCESS Freely available online

 PLOS ONE

Entangled Parametric Hierarchies: Problems for an Overspecified Universal Grammar

Cedric Boeckx^{1,2}, Evelina Leivada^{2*}

¹ICREA, Barcelona, Spain, ²Universitat de Barcelona, Barcelona, Spain

But is it all culture?

A lesson still to assimilate ...



A role for relaxed selection in the evolution of the language capacity

Terrence W. Deacon¹

Department of Anthropology, University of California, Berkeley, CA 94720

The case for the **domain-general**ity of Vocal
Learning

(Gonzalo Castillo and Elizabeth Zhang)

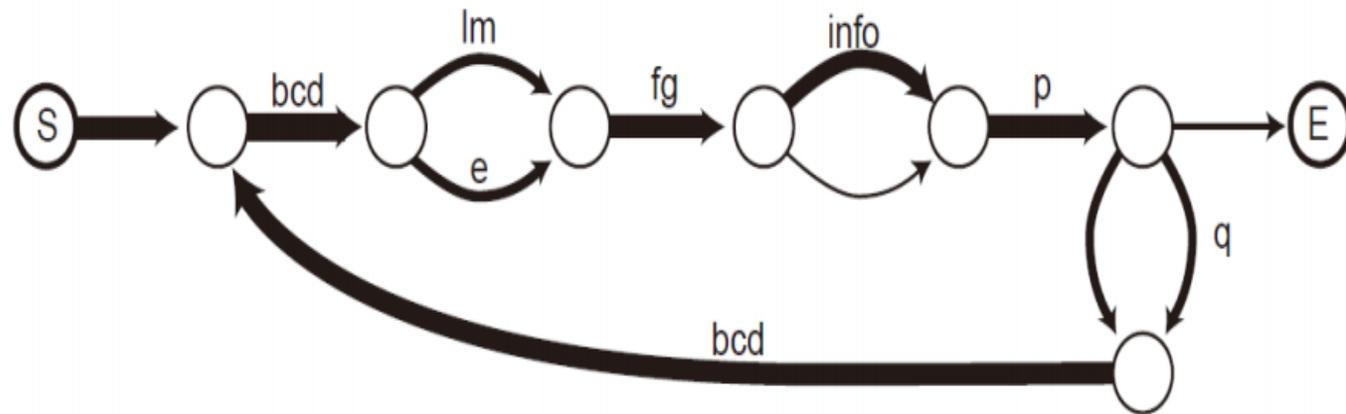
Are vocal learners better learners?

- **Okanoya (2012):**

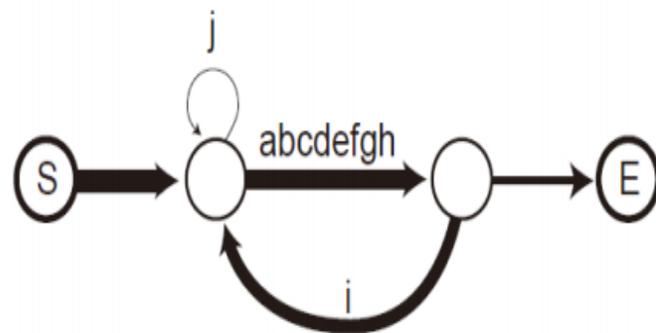
- **Bengalese finches** are the domesticated strain of **white-rumped munias**.
- Finches court females by rendering a species-specific song **as accurately as possible**.
- Bengalese finches produce **more transitional variability** in their vocalizations than their wild counterparts, the white-rumped munias.



Bengalese Finch



White-Backed Munia



Parrots and corvids: a case of relaxed selection



- Complex tool users, have the highest diversity of feeding behaviors, and are excellent problem solvers.
 - Live in complex social structures.
 - At the top of the food pyramid.
- > **Advanced learning capacities.**



Parrots and corvids: a case of relaxed selection

- **Heterospecific vocal imitation:**

The ability to use the vocal learning component to acquire vocalizations characteristic of other species.

- Open-ended learners.
 - Frequent vocalizers.
- } Decreased selective pressure

Parrots and corvids: a case of relaxed selection

- **More flexible functionality** of the vocal component.
- Heterospecific vocal imitators have **less sexual dimorphism**.

What can all of this tell us about language?

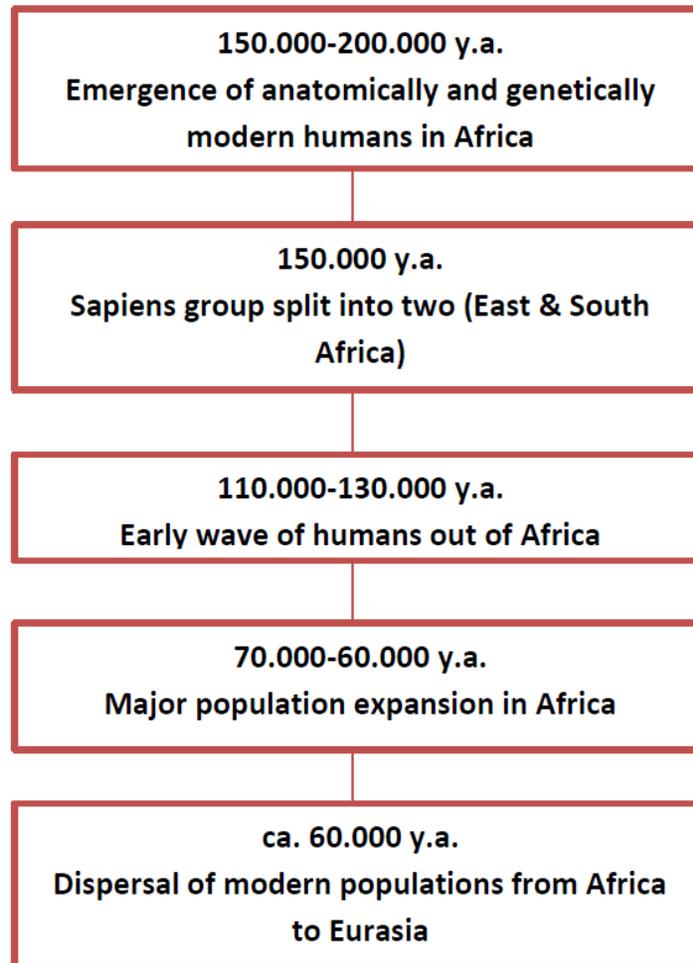
- **Speech is probably a domain-general capacity** (which can therefore connect with language) **as a side effect of the evolutionary changes that led to the development of more complex cognition.**
- Even if the evolution of speech required **selective pressures** (like sexual selection) that enhanced the vocal component, the story could not be complete unless we recognized a role for **relaxed selection.**

More on the role of the environment
(Pedro Tiago Martins and Evelina
Leivada)

Important landmarks

- Around 150 000 y.a., the sapiens group split into two (East and South Africa), only to re-unite 100 000 years later
- There was an early wave of humans out of Africa, around 110/130 000 y.a.
- Some linguistic, 'symbolic' capabilities had to be available to Neanderthals, before the speciation of Sapiens, only to be externalized as full-edged language after intense socio-cultural interaction took place (Zilhao 2011)

Important landmarks



Human dispersal from Africa (adapted from Mellars 2006: 9384)

The role of the environment

- Environmental triggers are of key importance in deriving certain (design) characteristics of language
- For example, Wray & Grace (2007) suggest that the communicative context affects the (surface) structure of language: A language develops semantic transparency and rule-based regularity depending on the need to facilitate exoteric, inter-group communication
- In Bolender (2007), the link between exoteric communication and enhanced linguistic complexity is related to syntax
- Bolender suggests that the increase of inter-group communication, due to population expansion, is what triggered the realization of an up to then dormant linguistic operation: syntactic movement, or, as it is now called, ‘internal merge’

The role of the environment

▪The role of environmental influences on the emergence of complex aspects of language was acknowledged in Chomsky's writings early on:

“It is entirely conceivable that some complex structures just aren't developed by a large number of people, perhaps because the degree of stimulation in their external environment isn't sufficient for them to develop. That wouldn't be too surprising” (Chomsky 1980: 176)

▪In the absence of an adequate degree of environmental stimulation, the early languages of anatomically modern humans may have lacked certain design characteristics (some of them, in Hockett's 1960 sense) such as:

- 1) duality of patterning,
- 2) sentential complementation (i.e. Bolender's 'internal merge'), and
- 3) complexity in terms of fine-grained grammatical markers

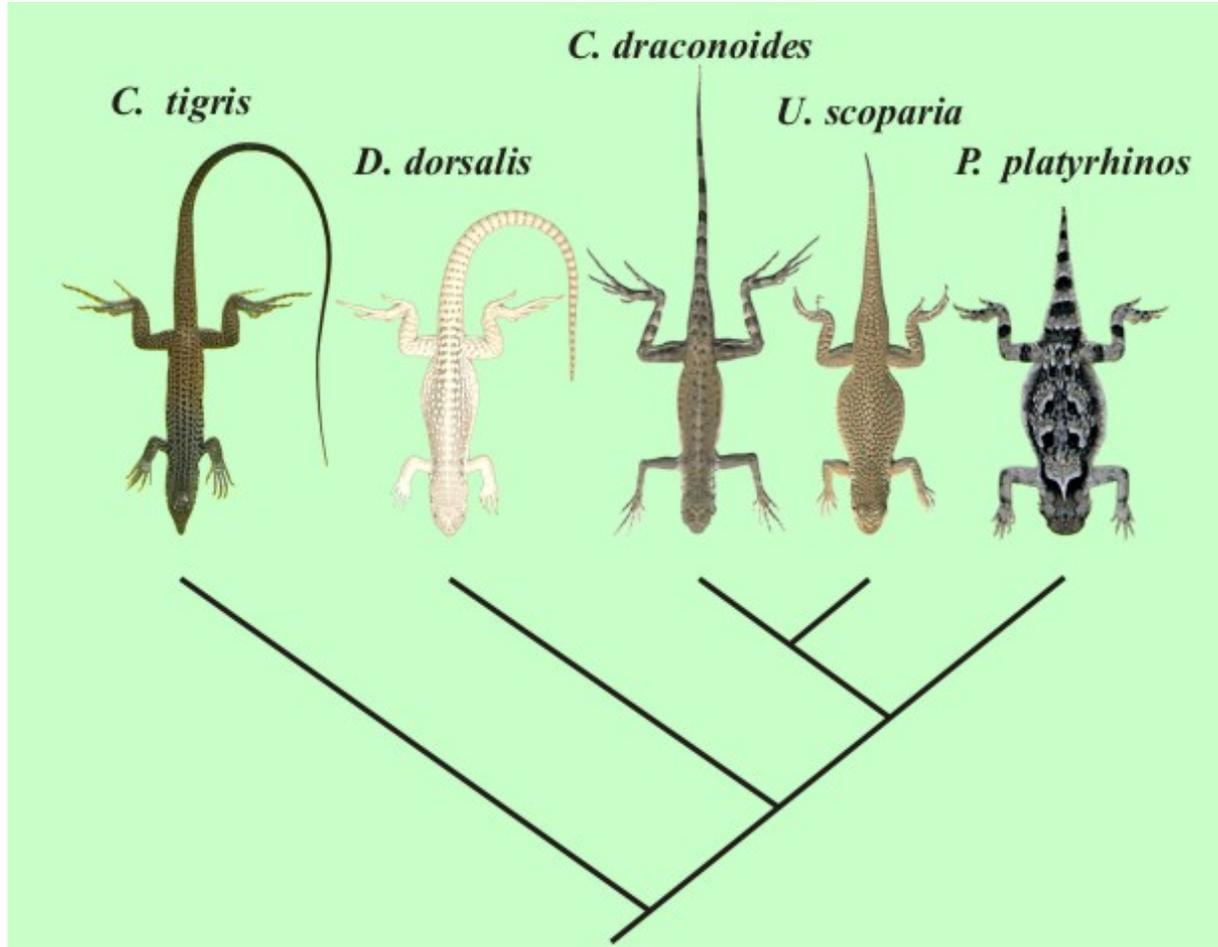
▪All these properties would arise gradually and as a response to environmental, externalization-related needs

From cultural to cognitive phylogenies

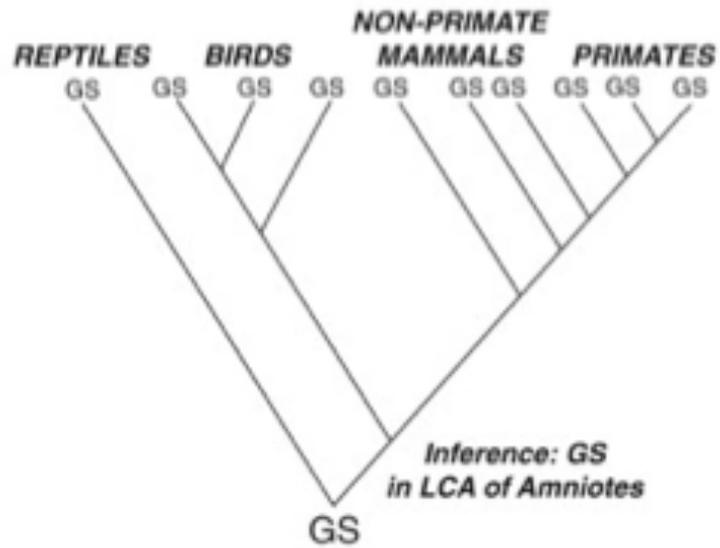


is a tinkerer.

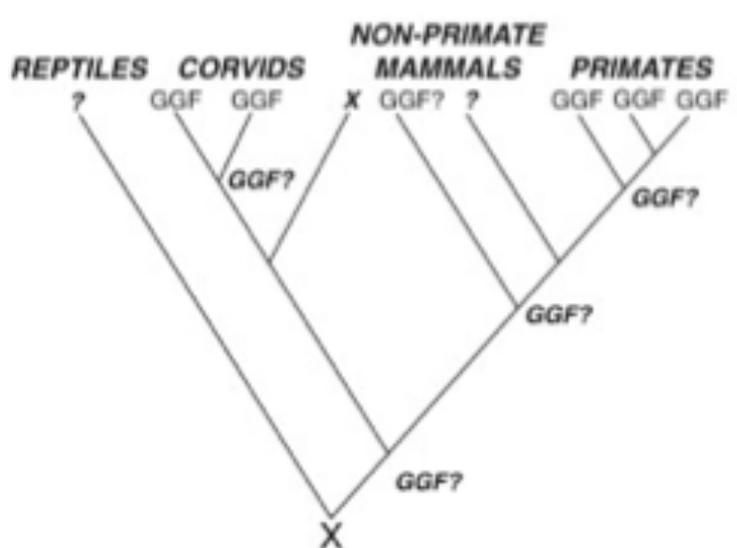
- François Jacob

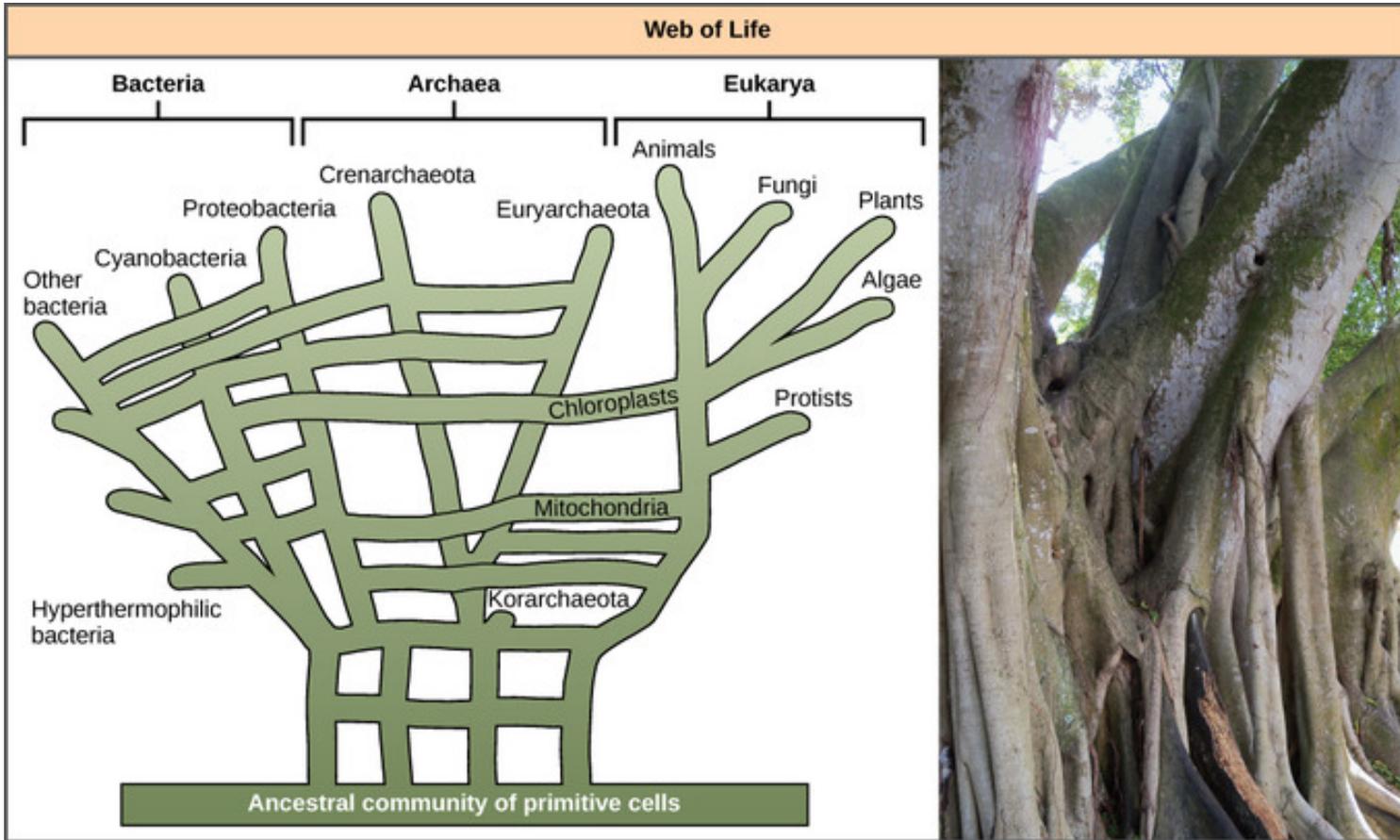


A Gaze Sensitivity



B Geometrical Gaze Following





(a)

(b)

Also true of cognitive phylogenies



Even “worse”
(thanks to
Constantina Theofanopoulou)

Quite likely, we cannot draw adequate cognitive phylogenies

- Not only 'entanglement' problem
- Nature of the nodes (old FLN/FLB problem)

- But if we cannot draw cognitive phylogenies, can we confidently claim that we can draw linguistic/cultural phylogenies?

Thanks to

