Genetics and evolution of vocal learning and language

Language Evolution

PART I

What is the faculty of language, that
it may have evolved?

Antecedents

- In 1866, the Linguistic Society of Paris famously banned all discussion of the origins of language.
- The London Philological Society followed suit in 1872.
- More recently, Chomsky has argued that one simply cannot know how language evolved and has even suggested that language may not be the product of natural selection.

So why should we be ready now?

- Genome Project(s) and other developments in molecular biology.
- Biolinguistics program.
- Advances in Artificial Life, archeology and various other sciences whose results seem a priori relevant.
- Plus every generation has to make its own mistakes…

But *WARNING*

- Handle with care! This territory has been plowed (too) many times.
- Be open-minded and inter-disciplinary! The question is too complex to be answered in any simple-minded way.
- Make sure you understand what it is that you're trying to evolve! (You wouldn't want to attempt to evolve Adaptive Immunity without knowing what *that* is…)

The problem here is that…

- Just about everyone has a view on what *their* language is.
- Even if it has nothing to do with what the most basic science tells us it is.
- For instance, it is not clear what it really means to say, in customary fashion, that "A language is a system of communication".
- At the very least, most lasting conditions scientifically unearthed about language have had very little to do with that definition…

At the very least, human language is…

- A natural system (in the sense of Immunity)
- With computational properties
- Somehow connecting “meaning”
- With an explicit form that makes it public
- Which varies within certain parameters
- And which can be acquired by humans in a few months prior to a critical age
- And almost never afterwards (at least perfectly)

For concreteness we'll concentrate on the computational system

- In large part because that looks a priori like the most uniquely human (including *recursion*)
- And the one which is hardest to understand in evolutionary scenarios.
- Irrelevant myth about its 'function': *Syntax is there to avoid ambiguity* –in order to help communication.
- Ambiguity is rampant, and in fact syntax often *creates* even more.
- Known syntactic conditions *impair* communication!

Simple example

- A) Who did you say that Peter knows __ ?
- B) Who did you say __ Peter knows __ ?
- C) Who did you say __ __ knows Mary?
- D) * Who did you say that __ knows Mary?

How can the *inability* to ask the question in (D) (whatever the cause) *increase* your ability communicate anything?

Another simple example

- A) I said that Mary kissed Peter.
- B) Who did you say that Mary kissed __ ?
- C) Why did you say that Mary kissed Peter?

- D) I wonder if Mary kissed Peter.
- E) *Who do you wonder if Mary kissed __ ?
- F) Why do you wonder if Mary kissed Peter?

Some ‘locality’ condition

- Allows question formation ‘long-distance’ across a declarative complementizer like ‘that’
- But prevents a comparable question across a question complementizer like ‘if’ (or ‘whether’, ‘why’, etc.)
- Whatever the ultimate reason is for this condition…
- How can it *increase* communicative abilities if it *reduces* your class of messages?

Alright, but perhaps the stupid condition is there just to…

- Make your message clearer?

  (Why is it clear enough in the case of declaratives and other comparable instances?)

- Make your performance easier?

  (Ditto: why not, then, prevent *all* long distance questions.)

Take an even simpler instance

- *I want to shoot that ball.*
- *I wanna shoot that ball.*
- *I want Coby to shoot that ball.*
- **I wanna Coby shoot that ball.*
- *What do you want to shoot?*
- *What do you wanna shoot?*
- *Who do you want to shoot that ball?*
- **Who do you wanna shoot that ball?*

Another (in)famous example (don't tell anybody…)

- *This is **fan-freaking-tastic**.*
- **This is **fantas-freaking-tic**.*

When did anybody teach you this? How did you figure it out?

Taxi-cab drivers (and other amateurs) like to try theories about all of this

- In turn, professional linguists in the twentieth century have developed pretty elaborate edifices about syntactic structure…
- Some of these, even, address the key question of feasibility: how the assumed apparatus can be acquired by a human infant (and not a cat).
- Although we won't be able to present this in any generality, the overall flavor follows (and you can take a class in Linguistics for details!)

Knowledge of Language

- Is mostly effortless and even unconscious
- Is in place very rapidly (by early childhood)
- Cannot be mastered after a critical age (usually around puberty)
- Can be specifically damaged through injuries to specific brain areas
- Can decay with certain illnesses
- Ca be (partially) absent in instances of genetic defects

Those characteristics are not unique to human language

- Imprinting in, e.g., ducklings.
- Mating songs in, e.g., white-crowned sparrows.
- Seeing in cats and many other mammals.
- Bee dances.
- Etc.

What might be unique:

- Creativity
- Remoteness
- Plasticity

If so, we must understand the nature of these…

Syntactic Boundary Conditions

a. Syntactic dependencies arrange themselves in terms of formal objects that can be quite *high within the Chomsky Hierarchy*.

b. Context-sensitive dependencies are generally *triggered*, *structure-dependent*, and limited by *locality* considerations.

c. Semantic dependencies are determined by syntactic dependencies and obey definite mapping principles.

d. Morphological variation, of the sort patent across languages, in many instances involves *uninterpretable* elements.

e. Core language acquisition involves the fixation of a few fixed, normally morphological, *syntactic options* ('parameters').

a. *high within the Chomsky Hierarchy.*

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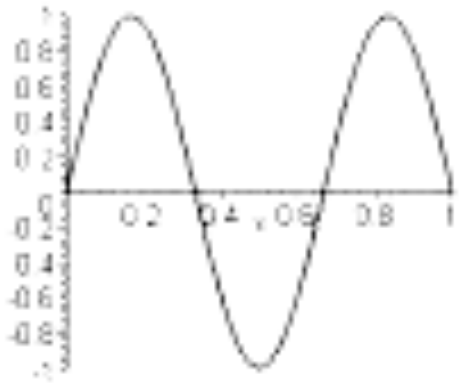
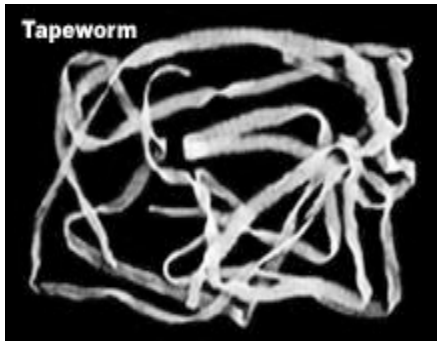
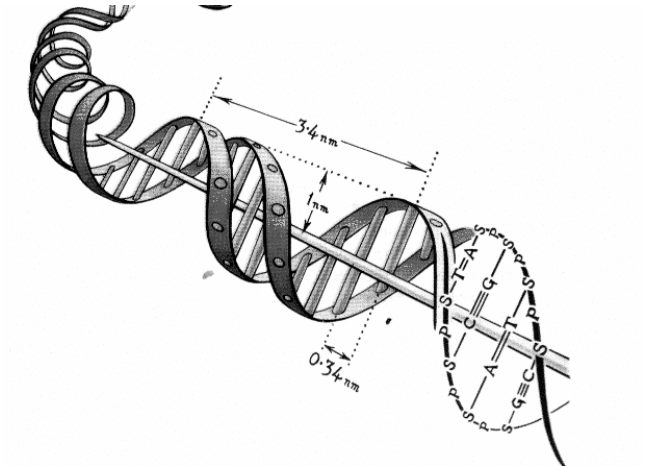
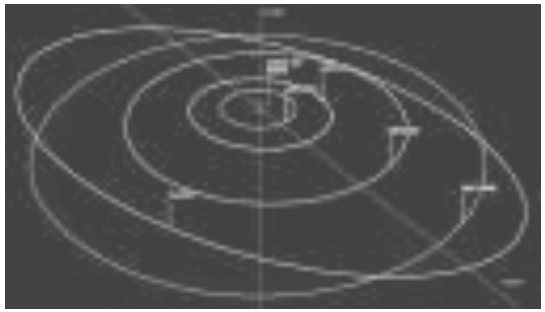
Intuitively: Strings

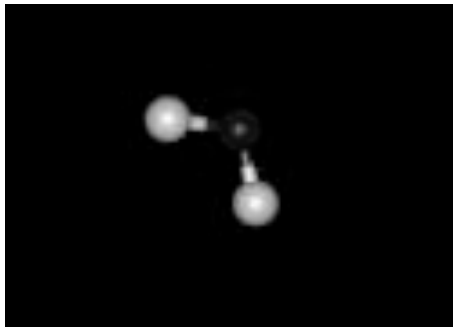


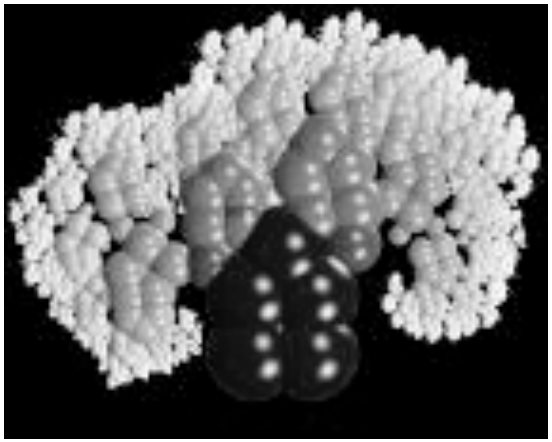


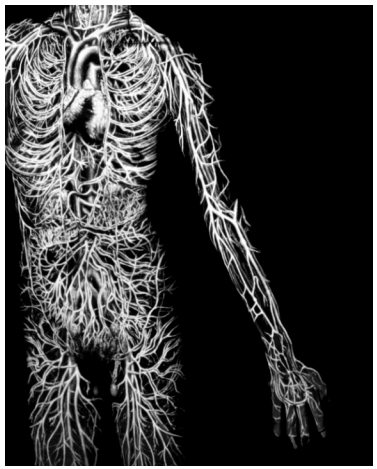


Intuitively: Hierarchically organized

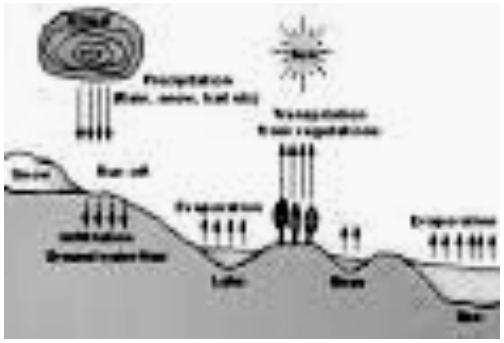


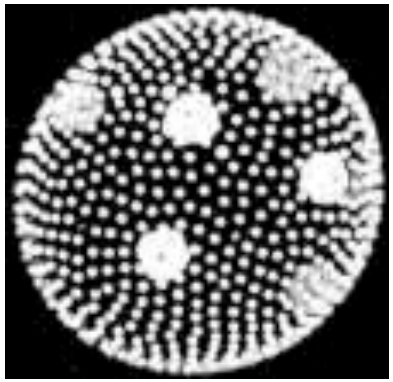


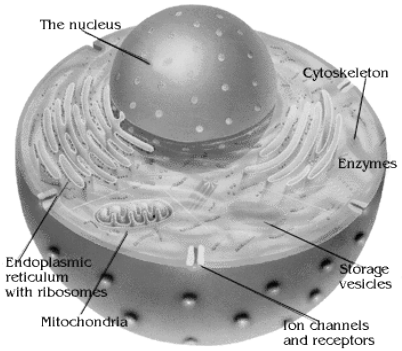




Intuitively: Entangled Structures







All generative models start from a computational approach

- Involving a *logical processor* writing on an *unlimited memory tape*,
- Two components that interact until the system halts.
- Depending on how algorithms implementing a given grammar access memory, different possibilities emerge.

Structures thus generated imply one another

- Properties described by more intricate devices presuppose those generated by lesser ones.
- Chomsky demonstrated how natural languages are positively context-free, and arguably context-sensitive systems.
- But let's see some examples…

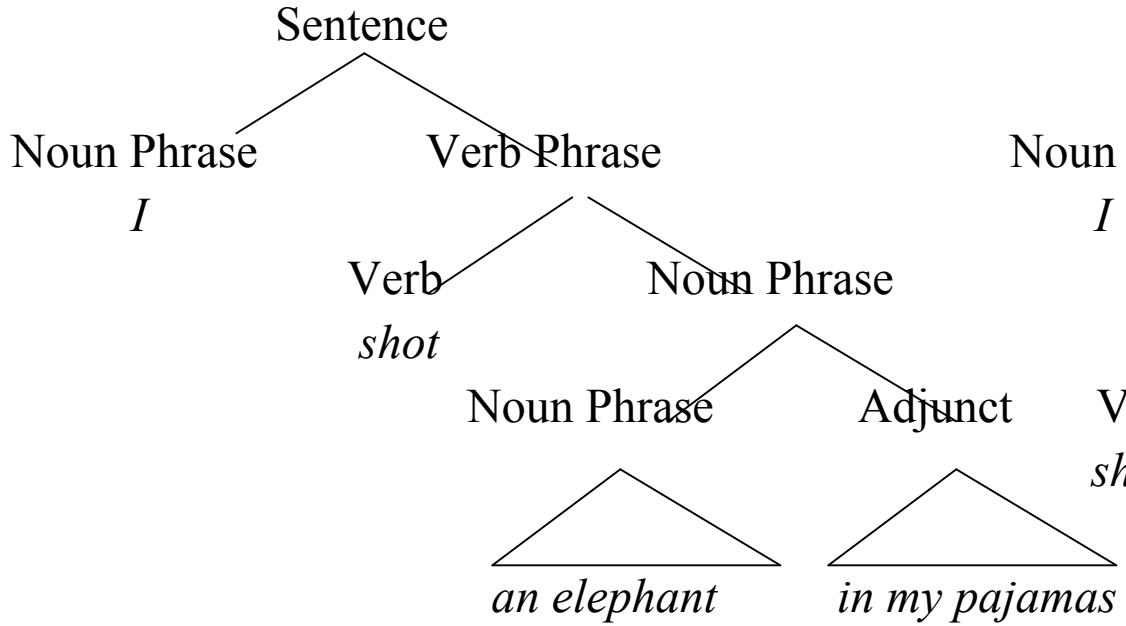
Finite-state structures

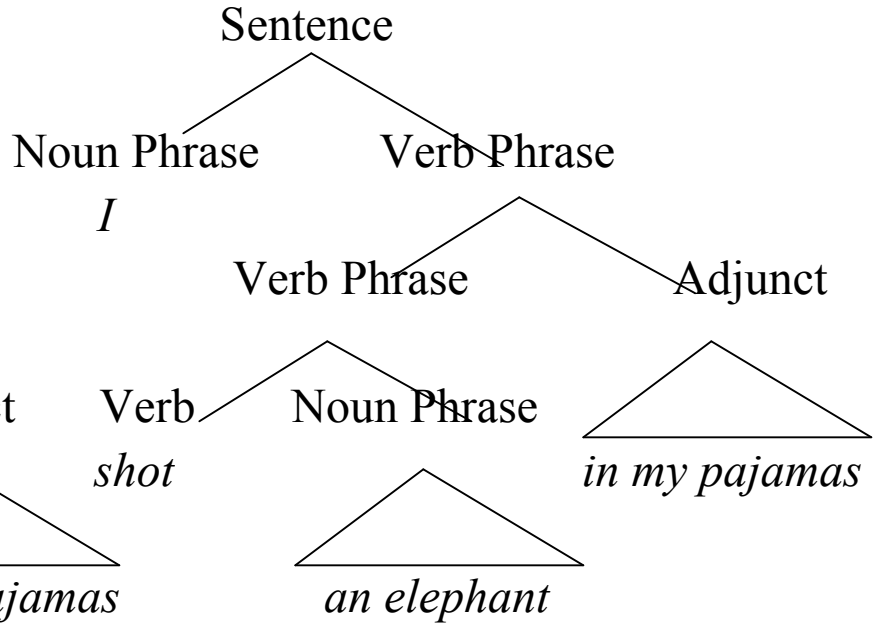
- *No, no, no, no!* (King Lear, V, 3).
- *Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday…*

- Partial: I'm *very very very* tired.
- Partial: *Never, never, never surrender!*

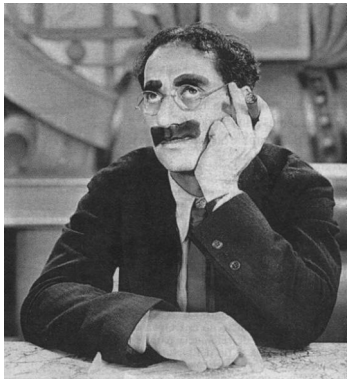
Standard Push-Down Automata or PDA (phrasal) structures:

- 'I shot an elephant on my pajamas!'





'How he ever got into my pajamas, I'll never know…'



But obviously there's more…

Examine these sentences:

(1) *Jack was arrested (by the police).*

cf. *The police arrested Jack.*

(2) *Will you handle this problem?*

cf. *You will handle this problem.*

(3) *This problem, you will handle.*

cf. *You will handle this problem.*

(4) *Peter loves Mary and so does Bill (*i.e. *love Mary).*

Faced with that situation

- In 1955 Chomsky made the brave move of suggesting that human sentences are ‘entangled’, context-sensitive structures.
- That is, a sentence is not just a collection of phrases.
- It is, rather, a collection of phrase-collections, one in particular relating ‘basic’ structures to ‘derived’ structures.

Context-sensitive operations:

- Movement:

  I can handle this → Can I __ handle this?

  I can handle this → This I can handle __

- Deletion:

  Peter [loves Mary] & so does Bill love Mary

Note: Context-sensitivity is signaled by the arrows in each instance

On the reality of ‘movement’ gaps

- Remember the ‘*wanna* contraction’ contrast between (1) and (2)?

- (1) *I wanna shoot the ball.*

- (2) **Who do you wanna shoot the ball?*

Now we have a possible explanation for the contrast

- Who do you want __ to shoot that ball?

By hypothesis: the item *who* has been displaced from the subject of *to shoot* to the beginning of the sentence. We have found evidence to think, however, that in some sense it has left some 'trace' there.