Advanced issues in cognitive science and linguistics
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Part 3: What You Can Say Without Syntax?
A Hierarchy of Grammatical Complexity
and its Bearing on the Evolution of Language

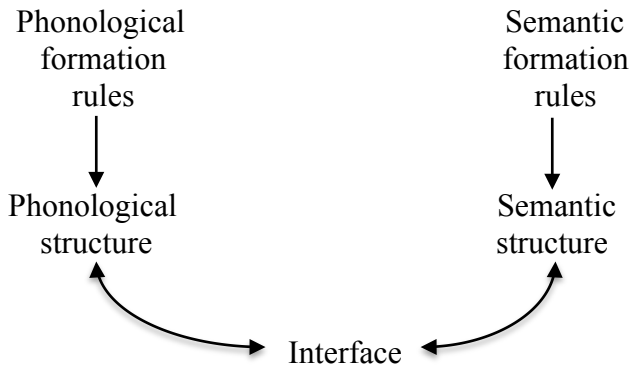
(with Eva Wittenberg)

Introduction

The issue (again): How much of the distribution of forms in language can be predicted from the semantics, and how much has to be a consequence of syntax? Given a choice, favor semantics, because semantics is necessary anyway to drive inference. This is the impulse behind the Parallel Architecture and Simpler Syntax.

PA is an alternative to standard syntactocentric grammar. In standard grammar, all semantic information is derived from syntax, so there's no issue of discovering the balance between them. Everything has to be in syntax.

Question: In PA framework, how much of syntax is necessary? What would language be like with *no* syntax, none of the factors mentioned in Part 2 – just a direct mapping between phonology and semantics?



The game: developing a hierarchy of grammars, from one-word grammars to fully complex natural languages.

Not a hierarchy of formal languages, like the Chomsky hierarchy.
Rather, a hierarchy of grammars that map meanings to sounds – languages useful for communicating ideas.

Assumption: The system of meaning (thought) remains constant across the hierarchy. People think the same thoughts.

Grammars in the hierarchy offer different resources for expressing thought.
Methodology: Assume as little syntax as possible to describe the facts.
Guiding intuition: Simpler (more marginal) grammars put more responsibility for understanding on pragmatics and use of context. More complex grammars reduce ambiguity and dependence on context.

Two ways to understand the hierarchy:
Weaker way: It is a formal tool for describing communication systems, with a continuum of possibilities.
Stronger way: It is an empirical claim: the language faculty contains layers of varying degrees of complexity (challenging standard grammatical theory and received wisdom.) (Received wisdom – languages are all equally complex – is partly politically motivated, e.g. Boas.)

The hierarchy may show up in acquisition, a climb up the hierarchy. And it may give clues about evolution of the language capacity.

Agenda: Lay out hierarchy briefly, then show how these languages interface with meaning.

The hierarchy

One-word grammar: Utterance → Word
Two-word grammar: Utterance → Word (Word)
Linear grammar: Utterance → Word*

Note: No parts of speech or morphology! Interpretation is driven by semantics alone.

Simple phrase grammar:
Utterance → [Word/Phrase]*
Phrase → Word*

One level of embedding only!
Phrases may be either prosodic or (if there are parts of speech) syntactic.

Recursive phrase grammar:
Utterance → [Word/Phrase]*
Phrase → [Word/Phrase]*

Note: each layer of rules in the hierarchy includes all the simpler rules.
Note: Minimalist Program claims that only possible human grammar is a recursive phrase grammar, in which each nonterminal has exactly two constituents. This is only one possibility in our hierarchy.

Morphology – structure inside words
Compounding: Word → Word Word
Affixation: Word → {Word/Stem, Affix} (either order)

Morphology can be introduced anywhere in the hierarchy, but is most useful from linear grammar up.
Other elaborations: functional categories, long-distance dependencies, binding of anaphors, …

Why is this interesting, not just a technical exercise?
Answer: Many phenomena in the literature are described as having:

- No subordination (i.e. no recursion)
- No functional categories
- Little or no morphology
- Semantically-driven word order

In the hierarchy, these phenomena can be described by either linear grammar or simple phrase grammar.

Summing up:

- One-word grammar
- Two-word grammar
- Linear grammar
- Simple phrase grammar with prosodic phrases
- Simple phrase grammar with syntactic phrases
- Recursive phrase grammar

Morphology and syntactic categories are possible from about linear grammar on.

Interface rules

How are these grammars used to express meaning? In PA , the mechanism is *interface rules*, which establish a mapping between sound, grammatical structure, and meaning.

A *word* is an interface rule that connects a piece of phonology to a piece of meaning and to syntactic features.

Phonology: /kæt/$_1$
Syntax: N_1
Semantics: CAT_1

Combinatorial interface rules: How the meanings of the parts of a constituent are combined into its meaning. Example: The meaning of a prenominal adjective modifies the meaning of the noun it precedes.

A significant result: Many of the same general interface rules apply, whether the constituent is an Utterance, a Phrase, or a Word, and whether its parts are Phrases, Words, or morphemes. (Scaling-up principle)

Interface rules for one-word grammar

Simplest interface rule for one-word grammar: Meaning of word = meaning of utterance

Phonology/syntax: $[_{\text{Utterance}}\ \text{Word}_1\ ]_2$
Semantics: $X_{1,2}$

Even simpler (degenerate form):

Phonology: Utterance_1
Semantics: X_1

This is the grammar for
- Primate calls
- *Hello*, *ouch*, *upsey-daisy,wow*, *oops*, *dammit*, *halleluyah*, *abracadabra*

So even the most marginal grammar has reflexes in fully complex languages. (First example of Scaling-Up Principle)

One-word grammar with pragmatics:

Phonology/syntax: $[_{\text{Utterance}}\ \text{Word}_1\ ]_2$
Semantics: $[F\ (X_1)]_2$

The function *F* is unexpressed; may be derived from linguistic or linguistic context.
Example: Interpretation of child's one-word stage.

Scaling up: Enrichment schema for one-phrase utterances:

Phonology/syntax: $[_{\text{Utterance}}\ \text{Phrase}_1\ ]_2$
Semantics: $[F\ (X_1)]_2$
Examples:
An eagle!!
Some scotch?
[What kind of pizza do you want?] – Pepperoni.

Scaling up: Enrichment schema for coercions:

Phonology/syntax: $[_{\text{Phrase}}\ \text{Phrase}_1\ ]_2$
Semantics: $[F\ (X_1)]_2$
Examples:
Plato [= 'book by Plato'] is on the top shelf, next to Chomsky.
The ham sandwich [= 'person with ham sandwich'] wants more coffee.
(*Sluicing*) Joe ate something, but I don't know what [= 'what he ate'].
(Not deletion from a syntactically fuller underlying form!)

Interface rules for two-word grammars

The new problem: Specifying the relation between the meanings of the two words.
Sample system: English N-N compounds

1. Function-argument schema
2. Modification schema
3. Co-argument schema

Function-argument schema

Morphosyntax: $[_N\ N_1\ N_2\ ]_3$
Semantics: $[F_2\ (X_1)]_3$

Examples:
union member [= 'member of a union']
helicopter attack [= 'attack by helicopter']
No need for further syntax! (Might need a little in other languages)

Modification schema

Morphosyntax: $[_N\ A/N_1\ N_2\ ]_3$
Semantics: $[X_2;\ Y_1]_3$
Examples:
blackbird [= 'bird that is black']
chocolate cake [= 'cake that is chocolate']

Modification schema plus enrichment:
snowman [= 'simulation of man that is made of snow']
garbage man [= 'man who takes away garbage']

Co-argument schema

Morphosyntax: $[_N\ N_1\ N_2]_3$
Semantics: $[F\ (X_1,\ Y_2)]_3$
Example (with enrichment)
seahorse [= 'something that looks like a horse and lives in the sea']

In two-word child language (Roger Brown):
Phonology/syntax: $[_{\text{Utterance}}$ Word Word]

Function-argument schema:
Mommy fix [= 'Mommy should fix it']

Modification schema + enrichment:
Big house [= 'that's a big house']

Co-argument schema:
Mommy pumpkin [= 'Mommy cuts the pumpkin']

The same utterance with different meanings (Brown, citing L. Bloom):
Mommy sock = 'Mommy's sock' (Modification)
Mommy sock = 'Mommy's putting a sock on me' (Co-argument)

Scaling up to phenomena in full languages:

Function-argument schema: Principles for integrating syntactic heads and complements
Modification schema: Principles for integrating syntactic heads with adjuncts
Co-argument schema:
Paratactic conditional
You shoot a cop, you go to jail.
Implicit copula
Everyone out of the car!
John at a baseball game?! (*Mad Magazine sentences*)
[John at a baseball game] is hard to imagine.
No dogs allowed. Refreshments in the kitchen. (*signage*)

Pivot schemas (Martin Braine 1963; Tomasello 2003)

more car, more cereal, more cookie, more fish, etc.
no bed, no down, no fix, etc.
see baby, see pretty, etc.

Each pivot is a little interface rule, a special case of one of the more general schemas.

Phonology: $[_{\text{Utterance}}\ [_{\text{Word}}\ \text{more}]\ \langle \text{Word}_i \rangle\ ]_j$
Semantics: $[\text{GREATER-QUANTITY-OF}\ (Y_i)\ ]_j$

Scaling up: Pivots in complex language:

Directed epithets: Fuck/Damn/The hell with/Hooray for NP!
Nonsentential utterance types: How about XP? Why not XP?
Forms of address: Mr. X, Ms. Y, Governor Z, Rabbi W, etc.
Complementizers (maybe): [that S], [to VP]
(Some) affixal morphology (maybe): V-ing, un-A

Word order and thematic roles

"chicken eat": Is the chicken eating or being eaten?
"cow horse": Is the cow doing something to the horse, or vice versa?
"cow big horse": Is the cow big, or the horse?

Strategies for dealing with this are found in many languages of the world. No syntax!

Agent precedes Patient (special case of the Co-Argument schema):

Phonology/syntax: $[_{\text{Utterance}}\ \ldots \text{Word}_1\ \ldots\ \text{Word}_2 \ldots]_3$
Semantics: $[F\ (\text{Agent: } X_1, \text{Patient: } Y_2, \ldots)]_3$

Agent > Action (special case of the Function-argument schema; prototype for SV order):

Phonology/syntax: $[_{\text{Utterance}}\ \ldots \text{Word}_1\ \ldots\ \text{Word}_2 \ldots]_3$
Semantics: $[F_2\ (\text{Agent: } X_1, \ldots)]_3$

Action > Patient (prototype for VO order) :

Phonology/syntax: $[_{\text{Utterance}} \ldots \text{Word}_1 \ldots \text{Word}_2 \ldots]_3$
Semantics: $[F_1 (\ldots, \text{Patient: } X_2, \ldots)]_3$

Patient > Action (prototype for OV order):

Phonology/syntax: $[_{\text{Utterance}} \ldots \text{Word}_1 \ldots \text{Word}_2 \ldots]_3$
Semantics: $[F_2 (\ldots, \text{Patient: } X_1, \ldots)]_3$

Choice between last two is arbitrary, but either choice makes message more reliable.

Linear order and information structure:

Topic first

Phonology/syntax: $[_{\text{Utterance}} \text{Word}_1 \ldots]_2$
Information structure: Topic_1

Focus last

Phonology/syntax: $[_{\text{Utterance}} \ldots \text{Word}_1]_2$
Information structure: Focus_1

"chicken eat"
= 'chicken is eating' (Agent > Action)
= 'someone is eating chicken' (Patient > Action, if language has it)
"eat chicken"
= 'chicken is eating' (Focus Last, if language has it)
= 'someone is eating chicken' (Action > Patient, if language has it)

Scaling up to less marginal languages

Agent > Action, Agent > Patient, Action > Patient, Patient > Action are prototypes for SVO and SOV order.
Topic often marked by initial position; focus often marked by final or near-final position.
Conclusion: Simpler principles don't go away as we move up the hierarchy! (Scaling-up principle)

Are these principles "language" or just "habits", "perceptual strategies"? They're mappings between sound and meaning, just less elaborate!

Phenomena from more marginal points in the hierarchy

(Work in progress)

Pidgins: Described as having

- No subordination
- No morphology

- No functional categories
- Free omission of arguments
- Unstable word order with bias toward Agent First, Focus Last.

Any evidence for parts of speech or for phrasal categories? Any phrase structure besides prosody?
Conjecture: Perhaps linear grammars or simple phrase grammars.
Creoles add some features from higher up the hierarchy, especially functional categories and principles for subordination. Not a transition from not-language to language, just incremental additions.

Late second language acquisition (Klein and Perdue):

All learners go through a stage they call Basic Variety. Some improve, some don't.
- No inflectional morphology
- No sentential subordination
- Arguments freely omitted.
- Word order based on semantic roles: Agent first, Focus last.

Conjecture: Linear grammar or simple phrase grammar.

Homesign (Susan Goldin-Meadow)

The best case for Poverty of the Stimulus: adult caretakers aren't at all as systematic, don't even fully understand what child is trying to say (Marie Coppola)

- A mixture of points and signs
- Rudimentary morphology (e.g. altering FLY to sign BIRD)
- Arguments freely omitted
- Word order probabilistic, semantically biased
- No parts of speech, no embedding (on our analysis)

Conjecture: Linear grammar with small amount of morphology.

Al-Sayyid Bedouin Sign Language (Aronoff, Meir, Sandler, Padden)

First generation signers: One-word grammar with small amount of two-word.
Older second-generation: Linear grammar with no/little prosodic support.
Younger second generation: Simple phrase grammar with prosodic phrases.
Converging on Agent > Patient > Action and Head > Modifier

Central Taurus Sign Language (Rabia Ergin)

- Some morphology, mostly in younger signers (compounding, some use of classifiers and of agreement with spatial sources and goals)
- Little evidence for syntactic structure (possibly possessives: 'X's brother's wife')
- No evidence for sentential embedding
- Actor-Action order in 1-character sentences
- In 2- and 3-character sentences with animate Agent and inanimate Patient, trending toward Agent > Patient > Action.

- In sentences with two animate characters, tending toward Patient > Agent > Action ("OSV" – rare typologically), and in second cohort, dividing into two predicates:
  (BOY + HIT / GIRL + GET.HIT)

A first-cohort signer:

SELL + GOAT / MONEY.SAVE / BRACELET + MANY

(I) sell (the) goat(s). (I/we) save money. (I/we buy/bought) many bracelets)

A second-cohort signer:

WALK / KNEES.TREMBLE / EVERYBODY + LOOK + POINT (TO HERSELF) / HEART.BEAT / WALK + NO / DANCE

(While we were) walk(ing), (my) knees (were) trembl(ing). Everybody (was look(ing at) me. (My) heart (was) beat(ing), (I could) not walk. (We) danced.

A third-cohort signer

POINT (TO HERSELF) + SIT.ON.DONKEY + TIE + FALL +NOT

(I) sat on (the) donkey. (My grandfather) tie(d me) (so I would) not fall.

The same signer

SHOE + SMALL + STONE + GO.INSIDE / GET.STUCK + WOUND + BLEED + BLEED + BLEED

(A) small stone went inside (my) shoe. (It got) stuck (there). (I got) wound(ed). (It was) bleed(ing) a lot .

Conclusion: Linear grammar + a some morphology -- much like ABSL and earlier Nicaraguan Sign Language. A lot of reliance on enrichment from pragmatics, context, common knowledge

Processing strategies (Townsend & Bever, Ferreira):

People use "interpretive strategies" – semantic principles of word order such as Agent > Patient.
Similar behavior in Broca's aphasics, in normals under stress, and in "garden path" situations.
Similar behavior in comprehension and production by certain populations with Specific Language Impairment (Heather van der Lely)

The literature describes this behavior in terms of "strategies" or "heuristics," separate from language. But they are not "domain-general," they are still mappings between phonology and meaning.

Our conjecture: Language processor has multiple pathways: full syntactic grammar and linear grammar. Latter is still present when former breaks down.
When both systems yield the same answer, e.g. Agent/Subject first, performance is smooth. When the systems yield different answers, e.g. reversible passives and object relatives, where Agent follows Patient, syntax wins, but with more strain on processing.

Languages that fall into more marginal positions in the hierarchy

Riau Indonesian (David Gil):

- No syntactic parts of speech
- Small amount of morphology
- No inflectional morphology

- Only evidence for constituent structure comes from prosody
- Effects expressed in English by subordination are expressed in Riau Indonesian by parataxis and pragmatics
- Mostly free word order, but semantic biases Actor > Action, Head > Modifier

Freedom of interpretation in Riau Indonesian, with extensive use of enrichment:
ayam makan, 'chicken eat' can mean
- '{a/the} chicken(s) {is/are eating/ate/will eat} {something/it}'
- '{something/I/you/he/she/they} {is/are eating/ate/will eat} {a/the} chicken'
- '{a/the} chicken that {is/was} eating'
- '{a/the} chicken that {is/was} being eaten'
- 'someone is eating with/for the chicken'
- 'where/when the chicken is eating'

Conclusion: Riau Indonesian is a simple phrase grammar with only prosodic constituency, with a small amount of morphology, and an enormous amount of pragmatics and enrichment.

Pirahã (Dan Everett):
- Lots of morphology, a noun-verb distinction.
- A fairly fixed word order
- No definite and indefinite articles, no plural marker, no inflectional morphology.
- Free omission of arguments; fairly fixed SOV order
- A possible NP constituent – exactly one level of embedding, only two words possible, whatever their semantics.
  my house; *house big*; *house many* (= 'many houses')
  **my house many*; **my house big*; **house big many*

Recursion? We don't think so.
Everything expressed in English by subordinate clauses is expressed by jamming simple sentences together or circumlocution.
No evidence for double embedding: clauses containing clauses containing clauses, even in Nevins/Pesetsky/ Rodrigues critique.
And even the cases cited as embedding are arguably paratactic.

Conclusion: Simple phrase grammar, plus NPs, plus lots of morphology: A syntactically simpler language, but not as simple as Riau Indonesian

Conclusions

Similar grammatical symptoms appear in wide range of scenarios:
- Pidgins
- Child language acquisition
- Second language acquisition
- Home signs
- Village signs
- Normal language processing
- Agrammatic aphasia
- Specific Language Impairment

- Riau Indonesian
- Pirahã

Full languages still display many symptoms of lower levels of hierarchy:
- Word order
- Compounding
- Marginal constructions (e.g. paratactic conditional)

No hard and fast distinction between linear languages and syntactic languages.
Rather:
How much of the grammar makes use of syntax (as well as semantics and linear order)?
vs.
How much of the grammar makes use of semantics and linear order alone?

Conclusion: Linear grammar is robustly entrenched in modern human brains:
- A scaffolding on top of which fully syntactic languages can develop – in individuals (Basic Variety) and in communities (sign languages and creoles)
- A safety net when syntactic grammar is damaged (aphasia and Specific Language Impairment)
- You can say a lot without syntax!

Questions:
- Does this hierarchy of formal languages lay out *logically* necessary stages in building a developed language? Are these stages *dynamically* or *culturally* necessary?
- Does the hierarchy give us plausible stages in the biological evolution of the language faculty?

Evolution of the language faculty

What evolved? The ability to learn a language! Languages are cultural, but the ability to learn them is not.

What aspects of the language capacity in the mind/brain are special for language, and what aspects make use of more general capacities?

Four logical possibilities:
Department 1: Things necessary to language that have required *no* changes from the ancestral genome (e.g. lungs, basic auditory system)
Department 2: Innovations in the human lineage that are essential to language or language acquisition but that serve purposes more general than language (e.g. pointing, imitation, rich Theory of Mind)
Department 3: Aspects of language that are unique to humans, that are used exclusively for language or language acquisition, and that required some alteration or specialization of pre-existing primate structures or capacities (e.g. shape of human vocal tract and neural structures used for controlling it in speech)
Department 4: Aspects of language that require something altogether new and unprecedented in the primate lineage

Departments 1 and 2 = Broad Faculty of Language in the sense of Hauser, Chomsky, & Fitch
Department 4 = Narrow Faculty of Language; Department 3 = ??

Other things being equal, we should prefer a theory of language that puts more in Departments 1 and 2, less in Department 3, and as little as possible in Department 4.

Reverse engineering:
- Attempt to infer UG (the basis for learning) from structure of the modern language capacity
- Correlate this with comparative evidence from other cognitive capacities (not so feasible given present understanding of other capacities)
- Correlate this with comparative evidence from other organisms (even worse)

Departments 3 and 4 might turn out to be null. That would be fine (and a lot of people think so). But I think it's unlikely. Are Departments 1 and 2 alone enough to give us a "language-ready brain"?

Phonology: salient features

Digitization of the auditory signal into sequences of discrete speech sounds grouped into syllables
Digitization of speech sounds into discrete structured space of phonological features

Adaptive for language: makes possible a very large number of distinguishable signals, therefore large vocabulary, an essential feature of human language. (Hockett)

- Could children acquire phonological representations with *no* special capacities in the brain beyond precise vocal imitation? Or do children come specially prepared to detect digitized vocal signals?
- If the latter, are there antecedents elsewhere in human or animal cognition for digitization of sounds either in sequences or in the structuring of the sound repertoire, and if so, how and when did these antecedents arise? (Different conclusions depending on whether analogues are in closely related species or not.)

Syntax, semantics, and lexicon

Child can't be expected to learn overall architecture of language faculty. That has to be given! (Paradox of Language Acquisition: We linguists are arguing about the architecture, but kids don't have to discover it!)

Two contrasting architectures:
Syntactocentric architecture, assumed by mainstream generative grammar
Parallel architecture

Syntactocentric architecture
Generative capacity of language is localized in syntactic component
Lexical items are embedded in syntactic structures in the course of derivation

Combinatorial properties of sound and meaning are derived from different levels of syntactic derivation
No possible direct correspondences of phonology to semantics

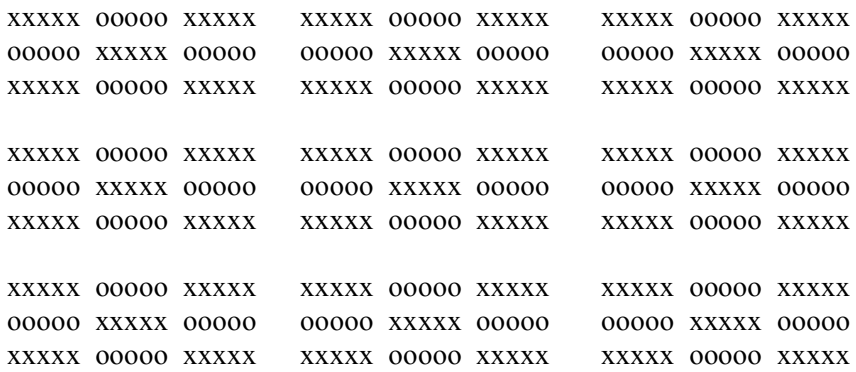
Parallel architecture
Independent principles of combinatoriality in phonology, syntax, and semantics
Structures linked together by *interface rules*
Lexical items act as interface rules, helping to correlate the three structures
Possibility of direct interface linkages from phonology to semantics

What are the implications of these diverging theories for evolution of language?

Syntactocentric architecture
Combinatorial structure of human thought is derived from combinatoriality of syntactic structure
Syntactic structure is what makes thought/reasoning possible
Syntax provides the vehicle for connecting thought with vocalization

Hard to think of preadaptation on top of which such a system could evolve, hence it makes most sense to try to treat evolution of language as a single step. What good would syntax be without words and meanings?

Hauser/Chomsky/Fitch: The single step was insertion of recursion into pre-existing nonlinguistic system. Recursion belongs to Department 4 or possibly Department 3.
Simpler Syntax: Recursion belongs to Department 3, as it occurs also in visual cognition.



Evolutionary source of lexicon?
Phonological features appear to be in Department 3 or 4.
Syntactic features such as *transitive verb* appear to be in Department 4.
Are these all part of the single step? (Recent Chomsky: They're externalization, so exempt from consideration in evolution of language. Terminological sleight of hand!)

Parallel Architecture
Semantic/conceptual structure is the product of independent combinatorial capacity, permitting possibility of combinatorially structured thought in nonlinguistic organisms (for which there is plenty of evidence).

Combinatorial thought is a preadaptation for evolution of combinatorial expression. Language is combinatorial in order to be able to express combinatorial thought.

Possibility of direct phonology-semantics correspondence, (grammars lower on the hierarchy), permitting possibility of nonsyntactic proto-lexicon

Possibility of nonsyntactic use of linear order to code semantic relations, as in systems we've just explored – Bickerton's *protolanguage*

Syntactic structure as capstone innovation, providing more regimented way to encode semantic relations among words

We've just discussed evidence that linear grammar is still present in modern human brain and (a) appears in situations where modern language is impaired or when it is acquired beyond the sensitive period, (b) exerts pressure on modern grammars (e.g. animacy and definiteness hierarchies), (c) appears in corners of modern grammars where syntax is less comprehensive (e.g. compounding and adjunct systems); (d) is involved in normal processing.

In other words, Parallel Architecture offers scenarios for incremental evolution of the language capacity. It can't *prove* that the language capacity evolved this way, but it offers a more plausible route than a sudden mutation that created recursion. Maybe genetics will tell us someday.

Crucial questions:

Do other animals exhibit combinatorially structured thought, e.g. in spatial cognition, action planning, social cognition?

Are there analogues in human or animal cognition for the lexicon? If so, do they work more like the lexicon in the syntactocentric architecture or that in the parallel architecture? (Discussion of this coming up!)

How you expect these to come out depends in part on what you think language is like.