Shimon Edelman

More difficult than it sounds: prospects for progress in language science
progress in language science: disappointingly slow
progress in language science: disappointingly slow

why?
progress in language science: disappointingly slow; why?

maybe because formalist / generative ≈ functionalist / usage-based
progress in language science: disappointingly slow; why?

maybe because

formalist / generative  ≈  functionalist / usage-based
questions to consider
questions to consider

❖ what is language for?
questions to consider

❖ what is language for?
❖ what is language like?
questions to consider

❖ what is language for?
❖ what is language like?
❖ what does it mean to know language?
questions to consider

❖ what is language for?
❖ what is language like?
❖ what does it mean to know language?
❖ where has this gotten us?
questions to consider

❖ what is language for?
❖ what is language like?
❖ what does it mean to know language?
❖ where has this gotten us?
❖ where should we go from here?
what is language for?

formalist: structuring thoughts (and communication with others)

functionalist: communication with others (and self)
what is language for?

formalist: structuring thoughts (and communication with others)

functionalist: communication with others (and self)

Human language generates a digitally infinite array of hierarchically structured expressions with systematic interpretations at the interfaces with a sensory–motor (sound/sign) and a conceptual–intentional (meaning) system. Thus, language comprises a system to generate hierarchical syntax along with asymmetric mappings to the interfaces, a basic mapping to the conceptual–intentional interface and an ancillary mapping to the sensory–motor interface. Merge is the basic operation underpinning the human capacity for language, UG, connecting these interface systems.

— Everaert, Huybregts, Chomsky, Berwick, and Bolhuis (2016)
what is language for?

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The forms of natural languages are created, governed, constrained, acquired and used in the service of communicative functions.

— Bates and MacWhinney (1982)

The language faculty evolved in the human lineage for the communication of complex propositions.

— Pinker and Jackendoff (2005)
what is language like?

formalist:  hierarchically structured (trees!)

functionalist:  hierarchically structured (trees!)
what is language like?

formalist: hierarchically structured (trees!)

functionalist: hierarchically structured (trees!)

T. Graf (2011)
Locality and the complexity of Minimalist derivation tree languages
what is language like?

formalist: hierarchically structured (trees!)

functionalist: hierarchically structured (trees!)

A. Goldberg (2003)
Constructions: a new theoretical approach to language
what is language like?

formalist: hierarchically structured (trees!)

functionalist: hierarchically structured (trees!)

Arbib & Lee (2008)
Describing visual scenes: towards a neurolinguistics based on construction grammar
Describing visual scenes: towards a neurolinguistics based on construction grammar
what does it mean to know language?

formalist: to have a grammar that sanctions certain structures

functionalist: to have a grammar that sanctions certain structures
what does it mean to know language?

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where has this gotten us?

**formalist:**  "Whenever I fire a linguist…" (F. Jelinek, 1988)

“I wrote two Stablerian Minimalist Grammars […] modelling the (in)famous German nested and Dutch crossed dependencies, taking what seemed to me to be the core, implementable idea of Koopman & Szabolcsi’s Verbal Complexes. Their analysis is full of remnant movement, so the derivation trees get ugly... fast.”

“Yes, all of that. Sigh… But, it works!”

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A. Cherecheș (2015)
where has this gotten us?

formalist: “Whenever I fire a linguist…” (F. Jelinek, 1988)

Brennan, Stabler, Van Wagenen, Luh, and Hale (2016)
where has this gotten us?

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Brennan, Stabler, Van Wagenen, Luh, and Hale (2016)
where has this gotten us?
The weight of evidence for an extraordinary claim must be proportioned to its strangeness.

~ Pierre-Simon Laplace
where has this gotten us?

formalist: “Whenever I fire a linguist…” (F. Jelinek, 1988)

functionalist: “The soft bigotry of reduced expectations”
where has this gotten us?

functionalist: “The soft bigotry of reduced expectations”
perplexity and precision

**Training corpus:** the first 15,000 utterances (81,370 word tokens) of the Suppes corpus of transcribed child-directed speech, from the CHILDES collection (MacWhinney, 2000; Suppes, 1974). Adult-produced utterances only were used.

**Perplexity:** 40.07.

Control: perplexity of a trigram model (SRILM; Stolcke, 2002):
- Good-Turing smoothing — 24.36;
- Kneser-Ney smoothing — 22.43.

There is a tradeoff between perplexity and precision; the precision of the tri-gram model was much worse (see next).

By modifying our model’s similarity-based generalization and smoothing parameters, perplexity could be reduced to as low as 34, at a cost to the precision.
Precision: 5.87 out of 7
so, where should we go from here?

В. М. Васнецов (1882)

Налево пойдешь — коня потеряешь.
Направо пойдешь — жизнь потеряешь.
Прямо пойдешь — жив будешь, да себя позабудешь.
so, where should we go from here?

reboot
what language is for

formalist: structuring thoughts (and communication with others)

functionalist: communication with others (and self)

cognitive behavioral ecologist: manipulation of others (and self)
what language is for

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what language is like

formalist: hierarchically structured (trees!)

functionalist: hierarchically structured (trees!)

cognitive behavioral ecologist:
  situated, incremental, dynamically constrained,
  concurrent, multimodal social behavior
what language is like

formalist: hierarchically structured (trees!)

functionalist: hierarchically structured (trees!)

cognitive behavioral ecologist: situated, incremental, dynamically constrained, concurrent, multimodal social behavior
what language is like

situated, social, concurrent, multimodal

M. H. Goldstein, …, & S. Edelman (2010)
General cognitive principles for learning structure in time and space
what language is like

social, dialogic

(27) (Risk SBC024: 299.283–306.456)
1 JENNIFER; Look at ^you being smart.
2 (1.0)
3 DAN; (H) @
4 (0.7)
5 I’m not ~^smart?
6 (0.3)
7 JENNIFER; You’re ^stupid.
8 (0.9)
9 DAN; Don’t ^call me ^stupid.

(28)

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
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</thead>
<tbody>
<tr>
<td>JENNIFER;</td>
<td>look at</td>
<td>^you</td>
<td>being</td>
<td>smart</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I</td>
<td>'m not</td>
<td>^smart</td>
<td>?</td>
</tr>
<tr>
<td>DAN;</td>
<td>you</td>
<td>'re</td>
<td></td>
<td>^stupid</td>
<td></td>
</tr>
<tr>
<td>JENNIFER;</td>
<td>do n’t ^call</td>
<td>me</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

J. W. Du Bois (2014)
Towards a dialogic syntax
what it means to know language: to have influence skills

[[ “The prototypical, contemporary characterization: animal signaling is a process in which evolutionarily specialized morphology or behavior in a signaler is used to encode and convey information to a perceiver, who in turn relies on evolved neural and perceptual processes to decode and recover the information.” ]]}

“Animal signaling is therefore here defined as the use of specialized, species-typical morphology or behavior to influence the current or future behavior of another individual.”

what it means to know language: to have influence skills

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Redefining animal signaling: influence versus information in communication
what it means to know language: to have influence skills

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(1) What language is for
   • manipulation of others and self

(2) What language is like
   • situated, incremental, dynamically constrained, concurrent, multimodal social behavior

(3) What it means to know language
   • to have skills for manipulating behavior and thinking

(4) Where we go from here
   • evolution
   • psycholinguistics
   • computation
   • neurobiology
Signaling: from costly to cheap (Lachmann et al., 2010)

The comparison between the **peacock** tail and the **sparrow** bib leads to the following prediction:

- conventional signals will be used when communicating about
  - (i) coincident interests or
  - (ii) verifiable aspects of conflicting interests;
- costly signals will be used otherwise.
Signaling: from costly to cheap (Lachmann et al., 2010)

The transition from peacock-like costly signals to sparrow-like conventional signals is a prerequisite for the evolution of combinational sentence meaning.

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evolution — psycholinguistics — computation — brain

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In a food-request language, should
cost(“two”) ⪰ cost(“one”)…???

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The transition from peacock-like costly signals to sparrow-like conventional signals is a prerequisite for the evolution of\emph{combinatorial} sentence meaning.

To reap the benefits of building sentences from words, a signaling system must\emph{separate the meaning of a signal from the mechanism that keeps its use honest.} When costs are imposed by the receiver instead of being inherent in the signal, they can be associated with sentences rather than phonemes.

In a food-request language, should\emph{cost(“two”) >> cost(“one”)...??}

What language is for: \textbf{manipulation} of others and self

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In a food-request language, should
\[
\text{cost(“two”) } \gg \text{cost(“one”)…??}
\]

What language is for: manipulation of others and self
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Signaling: from *coded* to *ostensive* (Scott-Phillips & Blythe, 2014)

“[….] *Meaning is not deduced or calculated*, even probabilistically, on the back of associations (be they between signal and meaning, or perhaps between signals, context and meaning), but rather *it is inferred, based on the receiver’s beliefs about the signaller’s intentions.*”

What language is for: *manipulation* of others and self
What language is like: situated, incremental, dynamically constrained, concurrent, multimodal social *behavior*
What it means to know language: to have a set of *skills* for controlling behavior and thinking
“[...] Meaning is not deduced or calculated, even probabilistically, on the back of associations (be they between signal and meaning, or perhaps between signals, context and meaning), but rather it is inferred, based on the receiver’s beliefs about the signaller’s intentions.”

“One consequence of this difference is that human ostensive communication, including linguistic communication, is inherently prone to ambiguity. This is generally seen as a defective quality, because it can, on occasion, lead to misunderstanding and other failures of communication. However, it also allows communication to be used in flexible, creative and open-ended ways—and these ways include the combination of already existing signals.”

Signaling: from coded to ostensive (Scott-Phillips & Blythe, 2014)

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Structured dependencies: the “syntactic islands” (Pearl & Sprouse, 2013)

Syntacticians often describe *wh*-dependencies as *unbounded* or *long-distance* dependencies.

(1)  
- a. What does Jack think ___?  
- b. What does Jack think that Lily said ___?  
- c. What does Jack think that Lily said that Sarah heard ___?  
- d. What does Jack think that Lily said that Sarah heard that David stole ___?

Though it is true that *wh*-dependencies are unconstrained by length, they are not entirely unconstrained. Linguists have observed that if the gap position of a *wh*-dependency appears within certain syntactic structures, the resulting sentence will be unacceptable (Chomsky 1965; Ross 1967; Chomsky 1973; Huang 1982; and many others):

(2)  
- a. *What did you make [the claim that Jack bought ___]?  
- b. *What do you think [the joke about ___] offended Jack?  
- c. *What do you wonder [whether Jack bought ___]?  
- d. *What do you worry [if Jack buys ___]?  
- e. *What did you meet [the scientist who invented ___]?  
- f. *What did [that Jack wrote ___] offend the editor?  
- g. *What did Jack buy [a book and ___]?  
- h. *Which did Jack borrow [___ book]?

What language is for: **manipulation** of others and self  
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Structured dependencies: the “syntactic islands” (Pearl & Sprouse, 2013)

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Structured dependencies: the “syntactic islands” (Pearl & Sprouse, 2013)

Complex NP islands
a. Who __ claimed that Lily forgot the necklace?
b. What did the teacher claim that Lily forgot __?
c. Who __ made the claim that Lily forgot the necklace?
d. *What did the teacher make the claim that Lily forgot __?

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evolution — psycholinguistics — computation — brain

Production: competitive queueing (Ward, 1992)
— concept borrowed from theories of motor control / decision-making

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What language is for: **manipulation** of others and self
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* regions typically associated with
* network overlaps
* regions have the capacity to engage in
* regions were sensitive to
* regions were sensitive to
* mediated by
* brain regions mediating encoding
* strongly overlap with those typically taken to mediate
* regions are not generally implicated in
* the networks implicated in
* regions may be involved in
* have an important role in
* regions are also associated with
* brain regions associated with
* a specific network related to
* greater activity in a set of ... regions
* network ... tracked to
* a stronger EEG response [!!!]
* was sensitive to
* This has been taken to suggest a role for this area in
* the areas that are involved in ... are different from those
typically associated with
* areas ... are activated by
* rely on distinct neurocognitive substrates
* has implicated ... regions in
* the neurocognitive separability of
* have been implicated in
* not frequently implicated in
* often implicated in
* regions linked to
* correlations have been interpreted as indicating that these
regions experience common activation [!!!]
* regions to show ... activity
* regions ... can be linked to or support
* which brain regions are associated with language processing

computation — brain

Right Hemisphere

overlap without coupling
comprehension-production coupling (CPC)

behavior
Brain activation in production & comprehension
(Silbert, Honey, Simony, Poeppel, & Hasson, 2014)

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Brain activation in production & comprehension
(Silbert, Honey, Simony, Poeppel, & Hasson, 2014)

“The results indicate that production of a real-life narrative is not localized to the left hemisphere but recruits an extensive bilateral network, which overlaps extensively with the comprehension system.”

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parting comment #1: the coyote and the chuckwalla

a whole bag of tricks
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a whole bag of tricks
parting comment #1: the coyote and the chuckwalla

a whole bag of tricks
parting comment #2: the spine and the snowflake

realistic

perfect
parting comment #2: the spine and the snowflake
in conclusion: new horizons beckon