Sex, Lies, and the English Auxiliary System

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Pullum’s Law

Never begin a talk with an apology.
Chomsky’s (1955/1957) Analysis of EAS
From Textbooks of the 1970s:

- **Akmajian and Heny (1975, p. 86), in discussing SAI:**
  
  Since there seems to be no way of using such PS rules to represent an obviously significant generalization about one language, namely English, we can be sure that phrase structure grammars [CFGs] *cannot possibly represent all the significant aspects of language structure*. We must introduce a new kind of rule that will permit us to do so. [emphasis added - IAS]

- **Culicover (1976, p. 50), in discussing SAI:**
  
  ...it is **impossible** to capture the observed generalizations in purely phrase structure terms. [emphasis added - IAS]
अग्निमिल्ले पुरोहितिः यज्ञस्य देवं रत्नीजम्।
होतारं रत्नधातमसम्।।
अग्निः पूर्वेभरिषिक्षयो नूतनैरुति।
स देवानेह वक्ष्यति।।
अग्निना र्यमिश्नवतं पोपमेव दवि-दवि।
यश्वम् बीरवत्तमम्।।
अग्ने यं यज्ञमधुवरं वशिवतं: परभिरसि।
स इद्देवेशु गच्छति।।
अग्निरिहोता कवकिरतुः सत्यश्चतिरश्चर्वस्तम्।
देवो देवेभरिः समत।।
यदंगा दाशुपे तत्वमग्ने भद्रं करपियसि।
तवेत तत सत्यमंगगरि।।
उप तवाग्ने दवि-दवि दोपावस्तर्ध्यया वयम्।
नमो भर्नुत एमसि।।
The Problem of English Auxiliaries

- Auxiliaries are optional: They (will) know the answers.
- Auxiliaries precede any main verbs:
  They must have read the book.
- Strict ordering of auxiliary elements:
  *They are having/must ing read the book.
- Discontinuous Dependencies:
  Kim has eaten/*eat/*eating lunch.
  Has Kim eaten/*eat/*eating lunch?
- Mysterious appearance of auxiliary *do*:
  ‘Necessary whenever it’s possible.’
The NICE(R) Properties
(Huddleston 1976, Quirk et al. 1985; Warner 1993)

**Negation:** Lee will not eat apples. /* Kim eats not apples.

**Inversion:** Has Lee eaten apples? /* Eats Lee apples?

**Contraction:** can’t, shouldn’t /* eatn’t,...

**Ellipsis:** Kim will prove a theorem, and Lee will __ , too. /* Kim proves theorems, and Lee proves __ , too.

**Rebuttal:** Kim will so/too see it. /* Kim sees so/too it.

Whenever there is no auxiliary verb, auxiliary *do* must appear:

Kim does not eat apples.

Does Lee eat apples?

Kim didn’t eat apples.

Kim does __ , too.
Human Biology: Structure-Sensitive Operations?

- Chomsky 1968 (Language and Mind), 1971 (Problems of Knowledge and Freedom), Crain & Nakayama 1987, ...

- [[The man] who is speaking] is their friend.
- Is the man who is speaking __ their friend?
- *Is the man who __ speaking is their friend?

- Can eagles that fly eat?
- ‘Constrained Ambiguity’ (Berwick et al. 2011)

- Claim: Structure-sensitive movement operations are a crucial part of the human biological endowment for language.
Goals of this Talk

- Present a new analysis of the English Auxiliary System.
- Show that it answers all the concerns that have been raised about alternatives to classic transformational analyses.
- Moreover, show that it handles idiosyncrasies never properly treated (to my knowledge) in transformational terms.
- Argue that this analysis of the EAS is a plausible candidate for ‘what people know’ about the EAS.
- Analysis has no ‘structure-dependent operations’.
- Hence Chomsky’s famous argument for the Poverty of the Stimulus based on the EAS collapses.
Introduction

- Syntactic Structures (1957) and its Aftermath
- Sign-Based Construction Grammar
- A New Analysis of the English Auxiliary System

Conclusion
The Syntactic Structures Kernel Grammar

\[ S \rightarrow NP \ VP \]
\[ VP \rightarrow \text{Verb} \ NP \]
\[ \text{Verb} \rightarrow \text{AUX} \ V \]
\[ VP \rightarrow V \ NP \ldots \]

\[ M \rightarrow \text{may, will, can, ...} \]
\[ \text{V} \rightarrow \text{walk, love, eat, ...} \]

\[ \ldots \]
\[ \text{AUX} \rightarrow \text{C (M) (have en) (be ing)} \]

(29i): \[ C \rightarrow \begin{cases} s / NP_{sg} \\ \emptyset / NP_{pl} \\ past \end{cases} \]

Diagram:

- **S**
  - **NP**
  - **VP**
    - **Verb**
    - **AUX**
      - **C**
        - **have**
        - **en**
        - **be**
        - **ing**
        - **eat**
      - **v**
    - **s**
    - **Kim**
      - **be**
      - **ing**
      - **eat**
    - **NP**
      - **beans**
Let $Af$ stand for any of the affixes past, $s$, $\emptyset$, en, ing. Let $v$ stand for any M or V, or have or be. Then: $Af + v \rightarrow v + Af$. 

\[
S \rightarrow NP_{sg} \rightarrow VP \rightarrow S \\
NP_{sg} \rightarrow Kim \rightarrow Verb \rightarrow NP \rightarrow AUX \rightarrow V \rightarrow beans
\]

14 / 90
T_q aka ‘SAI’ (crucially ordered before Affix Hopping)

\[\text{NP} \rightarrow \begin{cases} C - V \\ C + M - \\ C + \text{have} - \\ C + \text{be} - \end{cases} \times \ 1 - 2 - 3 \Rightarrow 2 - 1 - 3\]
$T_{not}$ (ordered before $T_Q$)

\[
\text{NP} = \left\{ \begin{array}{l}
C - V \\
C + M - \\
C + \text{have} - \\
C + \text{be} - \end{array} \right\} \times 1 - 2 - 3 \Rightarrow 1 - 2 + \text{n't} - 3
\]

**Grammar Tree:**

1. **S**
   - **NP<sub>sg</sub>**
     - **Verb**
       - **AUX**
         - **V**
           - Kim
           - **NP**
             - **AUX**
               - **V**
                 - **be**
                 - **is**
                 - **eat**

2. **S**
   - **NP<sub>sg</sub>**
     - **Verb**
       - **AUX**
         - **V**
           - Kim
           - **NP**
             - **AUX**
               - **V**
                 - **be**
                 - **is**
                 - **eat**
                 - **n't**
T_{do} aka ‘Do-Support’
(cruicially ordered after Word-Boundary Insertion)

\[
X - \# - Af - Y \quad 1 - 2 - 3 - 4 \Rightarrow 1 - 2 - do + 3 - 4
\]
Summary of SS Analysis of EAS

- Auxiliaries are optional: Optionality in PS Rules.
- Auxiliaries precede any main verbs: Order Fixed by PS Rules.
- Strict ordering of auxiliary elements: Order Fixed by PS Rules.
- Discontinuous Dependencies:
  Auxiliaries determine form of following verb: morphemes introduced with AUX element by PS Rules; moved by Affix-Hopping transformation.
  Auxiliary can be moved subsequently by transformation (Subject-Aux Inversion).
- Mysterious appearance of auxiliary *do*: Obligatory Do-Support transformation applies whenever a tense morpheme is ‘stranded’.
Problems with the SS Grammar of EAS

1. AH is not a legal transformation. ‘...the cover symbols v and Af...are neither terminal symbols nor non-terminal symbols; they are ad hoc devices, not sanctioned by the LSLT theory, with the function of enabling 16 different transformations that share most of their structure to be (apparently) collapsed into one.’ [Huddleston 1979; Lasnik 2000; Pullum 2011]

2. Mispredictions re. Negation and SAI:
   Isn’t Kim talking to Lee? (generated)
   Didn’t Kim talk to Lee? (generated)
   Is Kim not talking to Lee? (not generated)
   Did Kim not talk to Lee? (not generated)
Problems with the SS Grammar of EAS

Lasnik 2000:

3. ‘A Under A’ Condition?

4. Movement of non-constituents (e.g. *past be to generate was Kim talking to Lee?*)

5. Overly expressive framework

6. Non-local subcategorization
   (given VP $\rightarrow$ Verb (NP)..., Verb $\rightarrow$ AUX V)

Also:

7. Fails to treat a number of further idiosyncrasies.
   e.g. *Aren’t I allowed? vs. *I aren’t allowed.
   e.g. *Lee will not leave. vs. *Lee might not leave.
Despite these inadequacies....

A weaker, but perfectly sufficient demonstration of inadequacy would be to show that the theory can apply only clumsily; that is, to show that any grammar that can be constructed in terms of this theory will be extremely complex, *ad hoc* and ‘unrevealing’, .... We can gather a good deal of evidence of this sort in favor of the thesis that [Context-Free Grammar - IAS], and the conception of linguistic theory that underlies it, are fundamentally inadequate. [emphasis added -IAS] (Chomsky 1957: 5)
The Aftermath of Chomsky’s Syntactic Structures

- American Structural Linguistics, equated with CFG, was seen as inadequate.
- Generative-Transformational Grammar established as new ‘paradigm’.
- Explicit analysis of wide range of data that had been unanalyzed in previous approaches to grammar.
- Focus of field shifted away from concrete representations to the study of increasingly abstract representations.
- Widely held belief, even today: The existence of discontinuous dependencies and abstract generalizations in the auxiliary system require transformational operations.
- Modern discussions of broader issues, e.g. learnability, are infused with this belief.
Lasnik (2000) on Head Movement Theories

- V-Raising to I (nonmain verbs), I-Raising to C, I-Lowering to V (main verbs).
- Head-Movement Constraint (Relativized Minimality).
- Economy, Do-Support as ‘Last-Resort’, ‘immediate’ trace deletion, ‘Procrastinate’,
- *Kim not likes Sandy.*Kim likes not Sandy.

- Lasnik’s Hybrid Account of Verbal Morphology: Main verbs are introduced ‘bare’ and they later get together with affixes. Auxiliary verbs are introduced fully inflected. (2000: ch. 3).
Introduction
Syntactic Structures (1957) and its Aftermath

▸ Constraint-Based Alternatives
Sign-Based Construction Grammar
A New Analysis of the English Auxiliary System

Conclusion
In the late 1970s, new kinds of generative grammar began to emerge that eliminated transformations. These approaches came to be known as **Constraint-Based Grammar**.

- Generalised Phrase Structure Grammar (GPSG)
- Lexical Functional Grammar (LFG)
- Head-Driven Phrase Structure Grammar (HPSG)
- Categorial Grammar (especially Combinatory CG (CCG))
- Tree-Adjoining Grammar
- Simpler Syntax
Feature Decomposition of Grammatical Categories

- As early as the mid 1960s, Chomsky suggested replacing familiar syntactic categories with feature ‘bundles’, e.g.

\[
\begin{align*}
\begin{bmatrix}
V & + \\
N & - \\
\text{BAR} & 2
\end{bmatrix} &= (S), \\
\begin{bmatrix}
N & + \\
V & - \\
\text{BAR} & 2
\end{bmatrix} &= (NP), \\
\begin{bmatrix}
V & + \\
N & - \\
\text{BAR} & 1
\end{bmatrix} &= (VP), \\
\begin{bmatrix}
N & - \\
V & - \\
\text{BAR} & 0
\end{bmatrix} &= (P)
\end{align*}
\]

- X-Bar Theory, widely adopted within TG and elsewhere
A fundamental claim of GPSG (Gazdar 1981, 1982): the theories of schematization already in use in Generative Grammar can provide perspicuous analysis of many phenomena previously thought to motivate transformations.

E.g. Featural analysis of categories, \( \overline{X} \) theory (including Head Feature Principle)

Minor changes to the theory of CFG can do the rest of the work, allowing transformational operations to be eliminated from the theory of grammar.

E.g. Metarules (inductive definition of the grammar).
two guys walked into the room

\[
\begin{bmatrix}
V + \\
N - \\
\text{BAR 2}
\end{bmatrix}
\begin{bmatrix}
V + \\
N - \\
\text{BAR 1}
\end{bmatrix}
\begin{bmatrix}
V - \\
N - \\
\text{BAR 0}
\end{bmatrix}
\begin{bmatrix}
V - \\
N - \\
\text{BAR 0}
\end{bmatrix}
\begin{bmatrix}
V - \\
N + \\
\text{BAR 1}
\end{bmatrix}
\begin{bmatrix}
V - \\
N + \\
\text{BAR 2}
\end{bmatrix}
\]

(=S) (=VP) (=PP) (=NP)
Gazdar, Pullum & Sag (1982) on Auxiliaries

\[ V^1 \]

\[
\begin{array}{c}
\text{AUX} + \\
\alpha
\end{array}
\rightarrow
\begin{array}{c}
V[n] \\
[\beta]^1,
\end{array}
\text{where}
\]

<table>
<thead>
<tr>
<th>n</th>
<th>(\alpha)</th>
<th>(\beta)</th>
<th>MEMBERSHIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>FIN+</td>
<td>BSE+</td>
<td>can, may, must, will etc.</td>
</tr>
<tr>
<td>6</td>
<td>FIN+</td>
<td>BSE+, AUX−</td>
<td>do</td>
</tr>
<tr>
<td>7</td>
<td>ASP+</td>
<td>PSP+</td>
<td>have</td>
</tr>
<tr>
<td>8</td>
<td>ASP+, COP+</td>
<td>PRP+</td>
<td>be</td>
</tr>
<tr>
<td>9</td>
<td>COP+</td>
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<td>be</td>
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<tr>
<td>10</td>
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<td>BSE+</td>
<td>to</td>
</tr>
<tr>
<td>11</td>
<td>COP+</td>
<td>PRED+</td>
<td>be</td>
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<td>…</td>
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Subject-Auxiliary ‘Inversion’ Metarule:

\[ V^1 \quad \left[ \begin{array}{c} \text{AUX} \\ \text{FIN} \end{array} \right] + \rightarrow V[n] \ [\beta]^1 \]

\[ \Downarrow \]

\[ V^2 \quad [\text{INV} +] \rightarrow V[n] \ [\beta]^2 \]
GPS 1982 on Auxiliaries 3

\[
\begin{bmatrix}
V^2 \\
\text{AUX} + \\
\text{INV} + \\
\alpha
\end{bmatrix} \rightarrow V[n] \ [\beta]^2, \text{ where}
\]

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</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
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</tbody>
</table>
is talking to Kim

PROG(talk)(Kim)

is N^2 talking to Kim

QUES(PROG(talk)(Kim)(Lee))
Universal Grammar: Ts as Structure-Sensitive Operations?

- Chomsky 1968 (Language and Mind), 1971 (Problems of Knowledge and Freedom), Crain & Nakayama 1987, ...

- [[The man] who is speaking] is their friend.
- Is the man who is speaking ___ their friend?
- *Is the man who ___ speaking is their friend?

- Can eagles that fly eat?
- ‘Constrained Ambiguity’ (Berwick et al. 2011)
[in response to various recent positive learnability results for CFGs]

... these challenges have no bearing whatsoever on the AFP and the related POS argument, appearances to the contrary. Indeed, such work does not even address the AFP as originally posed, since the original formulation employs the notion ‘front’, i.e., ‘move’, not a part of the CFGs or alternatives used in these recent challenges. CFGs must be immensely and unnecessarily complicated to replicate such phenomena before we can even state the (A) vs. (B) choice properly.

[NB: A = ‘Move the first aux in the sentence to the front’; B = ‘Move the highest aux in the sentence to the front’]
Response to Berwick and Chomsky

- This misses the point of the GPS (1982) CFG analysis.
- The point was that the generalization of SAI is expressed without a movement operation.
- The relevant generalization is expressed by the SAI Metarule, which expands the set of basic PS Rules in a principled way.
The GPS Context-Free Grammar of Auxiliaries

- Provides a superior account of negation.
- Expresses the relevant generalizations about the NICE(R) properties,
- Deals with exceptions which seem hard to reconcile with the SS grammar (e.g. exceptions to SAI),
- Avoids the redundancies of the SS grammar:

1. \[ NP \rightarrow \begin{cases} C - V \\ C + M - \\ C + \text{have} - \\ C + \text{be} - \end{cases} \times X \quad 1 - 2 - 3 \Rightarrow ... \]

is redundantly stipulated in at least 6 transformations

2. GPS grammar avoids the rule proliferation masked by the theoretically illegitimate abbreviations \textbf{Af} and \textbf{v} required for the affix ‘hopping’ analysis to work.
It is unclear in what sense...

- direct-generation grammars like GPSG are inadequate for English.
- They aren’t redundant.
- Current work in Learnability Theory (see Clark and Lappin 2010\(^3\)) provides positive learnability results for CFG and certain extensions thereof.
- Current work on indirect negative evidence (cited approvingly by Chomsky (1981), a.o.) is extending these results.

---

Blocking *Kim dǐd leave.

- The one possible defect of the GPS analysis of the EAS: *Kim dǐd leave.

- Blocking by Maxim of Quantity/Manner (Kim 2000; Newmeyer 2006)
  Kim left.

- Falk 1984 (Bresnan’s ‘Economy of Expression’ Principle)

- OT account (Grimshaw 1997, Vikner 1999, Bresnan 2000)


- Morphology competes with (and systematically blocks) syntax.
These Analyses ‘Explain’ Too Much

- Dialects where **Kim dǐd leave** and **Kim left** both exist and are equivalent. (Palmer 1968, Klemola 1998, Schütze 2004)
- We thought they would (cf. they’d) accept our offer.
- I will not (cf. won’t) put up with this.
- I know (that) she’s right.
- Pat prefers (for) them to go first.
- The Red Cross helped them (to) get back on their feet.
- Kim went to the store before Sandy went to the store (cf. ...before Sandy (did).)
- They’re more likely to go to Paris than they are to go to Rome. (cf. They’re more likely to go to Paris than (to) Rome).
- ...
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Sign-Based Construction Grammar
(Boas and Sag in press)

- Synthesis of **Berkeley Construction Grammar**
  (Fillmore, Kay and O’Connor 88, Kay and Fillmore 99, ...)
  and

  **Head-Driven Phrase Structure Grammar**
  (Pollard and Sag 1994, Ginzburg and Sag 2000, ...)

- Constraint-Based
- Declarative
- Monotonic
- Lexicalist
- Based on notion of **Sign**
Psycholinguistically Plausible


- **SBCG** Grammars fit naturally in a processing regime where partial meanings are constructed incrementally. [Tanenhaus et al. in *Science*, 1995; Sag and Wasow, 2011]

- Makes sense of Fodor, Bever, and Garrett’s (1974:276) conclusions that linguistic representations are experimentally confirmed, but not the transformational processes that were supposed to relate them.

- **Stochastic SBCG**: The constraints can be associated with weights and integrated into a psycholinguistic model where the effects of frequency, priming, and inhibition can be taken into account.
Sign-Based Construction Grammar

A Grammar is a Recursive System of Constructions (Constraints that license signs):

- $sign_0 \rightarrow sign_1 \ldots sign_n$

- $\begin{bmatrix}
  \text{PHON} & [...] \\
  \text{SYN} & [...] \\
  \text{SEM} & [...] \\
\end{bmatrix} \rightarrow \begin{bmatrix}
  \text{PHON} & [...] \\
  \text{SYN} & [...] \\
  \text{SEM} & [...] \\
\end{bmatrix} \ldots \begin{bmatrix}
  \text{PHON} & [...] \\
  \text{SYN} & [...] \\
  \text{SEM} & [...] \\
\end{bmatrix}$
Signs Look Like This:

```
| word | phrase |
| PHON | phon-obj |
| FORM | morph-obj |
| ARG-ST | list(sign) [only for lexical signs] |

SYN

- CATEGORY
  - noun | verb | adj...
  - VFORM
  - AUX
    - boolean [verbals only]
  - INV
    - boolean [verbals only]
  - CASE
    - nom | acc [nouns only]

- VALENCE
  - list(sign)

SEM

- sem-object

CNTXT

- context-obj
```
Sign-Based Construction Grammar

- Every feature structure is assigned a type.
- Feature structures, including signs and constructs, are cross-classified via a type hierarchy.
- A grammar is a set of constraints defining the properties of these FSs in terms of the type hierarchy.
- Allows general constraints, idiosyncrasies, and intermediate-level constraints to be stated.
- Well-formedness involves simultaneous satisfaction of all relevant constraints.
- Sign well-formedness is defined with respect to a set of listemes and a set of constructions.
An *sbcg* Grammar

- A set of listemes (sign descriptions)
- A set of constructions of the form:

  \[ \tau \Rightarrow D \]  
  (Every FS of type \( \tau \) must satisfy \( D \)),

where either:

  a. \( \tau \) is a subtype of *lexical-sign*  
     (*Lexical Class Construction*), or
  b. \( \tau \) is a subtype of *construct*  
     (*Combinatory Construction*)
Also in the mid-1960s, Chomsky suggested providing words with features specifying their combinatoric potential. (Cf. Ajdukiewicz 1935)

<table>
<thead>
<tr>
<th>LEXEME</th>
<th>VALENCE List</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAUGH</td>
<td>⟨ NP ⟩</td>
<td>Kim laughs</td>
</tr>
<tr>
<td>WALK</td>
<td>⟨ NP (, PP) ⟩</td>
<td>Kim walked (into a bar)</td>
</tr>
<tr>
<td>LOVE</td>
<td>⟨ NP, NP ⟩</td>
<td>Kim loved Lee</td>
</tr>
<tr>
<td>GIVE</td>
<td>⟨ NP, NP, NP ⟩</td>
<td>They gave Pat a watch</td>
</tr>
<tr>
<td>GIVE</td>
<td>⟨ NP, NP, PP[to] ⟩</td>
<td>They gave a watch to Pat</td>
</tr>
<tr>
<td>KEEP</td>
<td>⟨ NP, VP[prp] ⟩</td>
<td>They kept coming</td>
</tr>
<tr>
<td>CONTINUE</td>
<td>⟨ NP, VP[inf] ⟩</td>
<td>I continue to doubt</td>
</tr>
</tbody>
</table>
Two Combinatoric Constructions

Subject-Predicate Construction:

\[
\text{[SYN [VAL } \langle X \rangle \rangle] } \rightarrow X \quad H: \begin{bmatrix}
\text{syn} & [\text{cat} \begin{bmatrix}
\text{VF} & \text{fin} \\
\text{AUX} & - \\
\text{INV} & - \\
\end{bmatrix}]
\text{VAL} & \langle X \rangle
\end{bmatrix}
\]

(A valence-saturated phrase may consist of an expression followed by its head, where the latter is a finite, AUX -, and INV - expression selecting the former as its only valent.)

Head-Complement Construction:

\[
\text{[SYN [VAL } \langle X \rangle \rangle] } \rightarrow H: \begin{bmatrix}
\text{word} & \text{syn} \begin{bmatrix}
\text{VAL} & \langle X \rangle \oplus L
\end{bmatrix}
\end{bmatrix} L
\]

(A phrase selecting a single valent may consist of a lexical head whose VALENCE list consists of that valent followed by its sister signs.)
An Analysis Tree

\[
\text{phrase} \quad \text{FORM}(\text{Obama, loved, them}) \quad (\text{subj-pred-cxt})
\]

\[
\begin{array}{ll}
\text{word} & \text{phrase} \\
\text{FORM}(\text{Obama}) & \text{FORM}(\text{loved, them}) \\
\text{SYN NP} & \text{SYN CAT 2} \\
\text{SEM} & \text{SEM VAL } \langle 1 \rangle \\
\end{array}
\]

\[
\begin{array}{ll}
\text{word} & \text{word} \\
\text{FORM}(\text{loved}) & \text{FORM}(\text{them}) \\
\text{SYN CAT 2} & \text{SYN NP} \\
\text{SEM VAL } \langle 1, 2 \rangle & \text{SEM} \\
\end{array}
\]
Three Principles of SBCG

- **Lexical Encoding:**
  Words encode category and valence information.

- **Head Feature Principle:**
  CATEGORY information projects upward from the head.

- **Valence Principle:**
  Phrasal structure obeys a regime of VALENCE ‘cancellation’.
Introduction

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Constraint-Based Alternatives
Sign-Based Construction Grammar

- A New Analysis of the English Auxiliary System

Conclusion
# Auxiliary Verb Forms (Palmer 1968: 19)

<table>
<thead>
<tr>
<th>LEXEME</th>
<th>finite</th>
<th>non-finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>is, are, am, was, were</td>
<td>be, being, been</td>
</tr>
<tr>
<td>HAVE</td>
<td>has, have, had</td>
<td>have, having</td>
</tr>
<tr>
<td>DO</td>
<td>do, does, did</td>
<td></td>
</tr>
<tr>
<td>WILL</td>
<td>will, would</td>
<td></td>
</tr>
<tr>
<td>SHALL</td>
<td>shall, should</td>
<td></td>
</tr>
<tr>
<td>CAN</td>
<td>can, could</td>
<td></td>
</tr>
<tr>
<td>MAY</td>
<td>may, might</td>
<td></td>
</tr>
<tr>
<td>MUST</td>
<td>must</td>
<td></td>
</tr>
<tr>
<td>OUGHT</td>
<td>ought</td>
<td></td>
</tr>
<tr>
<td>DARE</td>
<td>dare</td>
<td></td>
</tr>
<tr>
<td>NEED</td>
<td>need</td>
<td></td>
</tr>
<tr>
<td>USED</td>
<td>used</td>
<td></td>
</tr>
</tbody>
</table>
The Valence of Auxiliary Verbs

<table>
<thead>
<tr>
<th>LEXEME</th>
<th>Value of VALENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>⟨NP, XP⟩</td>
</tr>
<tr>
<td>HAVE</td>
<td>⟨NP, VP[psp]⟩</td>
</tr>
<tr>
<td>all modals</td>
<td>⟨NP, VP[bse]⟩</td>
</tr>
<tr>
<td>‘modal’ IS</td>
<td>⟨NP, VP[inf]⟩</td>
</tr>
</tbody>
</table>
My Theory of the EAS

- Auxiliary verbs project structure just like other verbs (cf. Ross 1969, GPS 1982, and others)

- Subject-Predicate Construction and Head-Complement Construction
Featural Analysis of Auxiliaries

- The feature $\text{AUX}$ is not used to distinguish auxiliary verbs from main verbs.
- Rather, $\text{AUX}$ distinguishes the auxiliary-restricted environments (e.g. the NICE constructions) from unrestricted environments.
- A syntactic environment restricted to auxiliary verbs is specified as \([\text{AUX} +]\).
- $\text{INV}$: A clause that is verb-initial is specified as \([\text{INV} +]\) (in English, only auxiliary verbs can be \([\text{INV} +]\)).
- Auxiliary verbs are lexically unspecified for $\text{AUX}$ and $\text{INV}$.
- Hence they are compatible with the following combinations:
  \[
  \begin{align*}
  \text{AUX} & \quad + & \text{AUX} & \quad + & \text{AUX} & \quad - & \text{AUX} & \quad - \\
  \text{INV} & \quad - & \text{INV} & \quad + & \text{INV} & \quad - & \text{INV} & \quad + 
  \end{align*}
  \]
- Main (nonauxiliary) verbs are lexically specified as \([\text{AUX} - \text{INV} -]\).
Two Kinds of Negation in English (Klima, 1964)

Constituent Negation:

- VP \([\text{nonfin}]\)
  - Adv
  - VP \([\text{nonfin}]\)
    - not

Finite Negation:

- VP \([\text{fin}]\)
  - V \([\text{fin}]\)
  - Adv
  - Complements
    - not

&Kim can not do that.

Kim cannot [not take advantage of that offer].
The Variable Scope of Modals and Negation

• &Sandy must accept nothing.
• &Sandy will accept nothing.

• &Nobody must visit Pat.
• &Nobody in the room will visit Pat.
The Fixed Scope of Modals and Not

Zwicky and Pullum (1983):

- My parents can’t accept that. \([\neg M]\)
- Chris won’t do that, will she? \([\neg M]\)
- Hilary mustn’t accept the offer. \([M \neg]\)
- They shouldn’t have been drinking. \([M \neg]\)

- My parents cannot accept that. \([\neg M]\)
- Chris will not do that, will she? \([\neg M]\)
- Hilary must not accept the offer. \([M \neg]\)
- They should not have been drinking. \([M \neg]\)
Some modals must outscope \text{not}; others must be outscoped by \text{not} (unless \text{not} functions as constituent negation).

These facts can only be partly predicted on semantic grounds (Warner 2000):

- \text{can}, \text{could}, \text{need}, \text{dare}, \text{will}, \text{would} [\text{Epistemic: } \neg M]
- \text{must}, \text{shall}, \text{ought}, \text{should} [\text{Deontic: } M \neg]

But \text{may} (epistemic), \text{might} (epistemic) [M \neg]

and \text{may} (deontic) [\neg M]

Finite [\text{AUX+}]-compatible verbs may select \text{not} as a complement.
A Lexical Analysis of Finite Not

\[
\text{FORM} \langle \text{will, not, go} \rangle
\]

\[
\text{SYN}
\]

\[
\text{CAT}
\]

\[
\text{VAL} \langle \text{NP} \rangle
\]

\[
\text{SEM} = \text{not(will)(go)}
\]

\[
\text{FORM} \langle \text{will} \rangle
\]

\[
\text{SYN}
\]

\[
\text{CAT}
\]

\[
\text{VAL} \langle \text{NP,Adv[not],VP[bse]} \rangle
\]

\[
\text{SEM} C_{\text{not}}(\text{will})
\]

\[
\text{FORM} \langle \text{not} \rangle
\]

\[
\text{SYN}
\]

\[
\text{ADV[not]}
\]

\[
\text{SEM} \text{not}
\]

\[
\text{FORM} \langle \text{go} \rangle
\]

\[
\text{SYN}
\]

\[
\text{VP[bse]}
\]

\[
\text{SEM} \text{go}
\]
A Lexical Analysis of Finite Not

\[
\begin{align*}
\text{FORM} & \langle \text{must, not, go} \rangle \\
\text{SYN} & \\
\text{CAT} & \begin{bmatrix} \text{AUX} - \\ \text{INV} - \\ \text{VF} \end{bmatrix} \\
\text{VF} & \text{fin} \\
\text{VAL} & \langle \text{NP} \rangle \\
\text{SEM} & = \mathbf{must}(\mathbf{not}(\mathbf{go})) \\
\end{align*}
\]

\[
\begin{align*}
\text{FORM} & \langle \text{must} \rangle \\
\text{SYN} & \\
\text{CAT} & \begin{bmatrix} \text{AUX} - \\ \text{INV} - \\ \text{VF} \end{bmatrix} \\
\text{VF} & \text{fin} \\
\text{VAL} & \langle \text{NP, Adv[not], VP[bse]} \rangle \\
\text{SEM} & = \mathbf{must} \\
\end{align*}
\]

\[
\begin{align*}
\text{FORM} & \langle \text{not} \rangle \\
\text{SYN} & \text{ADV[not]} \\
\text{SEM} & = \mathbf{not} \\
\end{align*}
\]

\[
\begin{align*}
\text{FORM} & \langle \text{go} \rangle \\
\text{SYN} & \text{VP[bse]} \\
\text{SEM} & = \mathbf{go} \\
\end{align*}
\]
Contraction (Lexical)

**Contraction Construction:**

\[
\begin{align*}
\text{FORM} & \quad \langle F_{\text{Contr}}(Y) \rangle \\
\text{SYN} & \quad \begin{bmatrix}
\text{CAT} & X \! [\text{AUX } \text{bool}] \\
\text{VAL} & \langle \text{NP}, \ldots \rangle
\end{bmatrix} \\
\text{SEM} & \quad Z
\end{align*}
\]  \rightarrow  \begin{align*}
\text{FORM} & \quad \langle Y \rangle \\
\text{SYN} & \quad \begin{bmatrix}
\text{CAT} & X \\
\text{VAL} & \langle \text{NP}, \text{ADV[not]}, \ldots \rangle
\end{bmatrix} \\
\text{SEM} & \quad Z
\end{align*}
Consequences

- **Not** is a complement of the finite auxiliary verb.
- Therefore, **not** is ordered after the finite verb.
- In finite negation, **not** does not form a constituent with the following VP (and hence never fronts with the following material).
- **Not** participates in lexical idiosyncrasy (scope variation) only with finite auxiliaries.
- No iteration of complement **not**.
- This formulation blocks *Will not he laugh?*, but allows Won’t he laugh?.
- **Will he not laugh?** is allowed only as constituent negation.
Expanded Grammar

Subject-Predicate Construction:

\[ [\text{SYN} \ [\text{VAL} \langle \rangle]] \rightarrow \mathbf{X} \quad H:\begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{VF} \ fin \end{bmatrix} \\ \text{AUX} & - \\ \text{INV} & - \end{bmatrix} \\ \text{VAL} & \langle \mathbf{X} \rangle \end{bmatrix} \]

Head-Complement Construction:

\[ [\text{SYN} \ [\text{VAL} \langle \mathbf{X} \rangle]] \rightarrow H:\begin{bmatrix} \text{word} \end{bmatrix} \begin{bmatrix} \text{SYN} & [\text{VAL} \langle \mathbf{X} \rangle \oplus \mathbf{L}] \end{bmatrix} \mathbf{L} \]

Aux-Initial Construction:

\[ [\text{SYN} \ [\text{VAL} \langle \rangle]] \rightarrow H:\begin{bmatrix} \text{word} \end{bmatrix} \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{AUX} & + \end{bmatrix} \\ \text{INV} & + \end{bmatrix} \\ \text{VAL} & \mathbf{L} \end{bmatrix} \mathbf{L} \]

(A valence-saturated clause may consist of a lexical head specified as \text{AUX} + and \text{INV} + followed by all its valents.)
The Family of Aux-Initial Constructions:  
(Fillmore 1999; Ginzburg & Sag 2000)

<table>
<thead>
<tr>
<th>Exclamatives:</th>
<th>Boy, [was I stupid]!</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wow, [can she sing]!</td>
</tr>
<tr>
<td>Conditionals:</td>
<td>[Were they here now], we’d…</td>
</tr>
<tr>
<td></td>
<td>[Should there be a storm], we’d…</td>
</tr>
<tr>
<td>‘Magic’:</td>
<td>May they live forever!</td>
</tr>
<tr>
<td></td>
<td>May all your teeth fall out!</td>
</tr>
<tr>
<td>Interrogatives:</td>
<td>Were they involved?</td>
</tr>
<tr>
<td></td>
<td>We won’t go, [will we]?</td>
</tr>
<tr>
<td>Declaratives:</td>
<td>So [can I]!</td>
</tr>
<tr>
<td></td>
<td>Never [would I do such a thing].</td>
</tr>
<tr>
<td>…</td>
<td></td>
</tr>
</tbody>
</table>
A Polar Interrogative Construct

\[
\text{FORM } \langle \text{am, I, invited} \rangle
\]

\[
\text{SYN
\begin{bmatrix}
\text{CAT}
\end{bmatrix}
\text{verb fin}
\begin{bmatrix}
\text{INV + AUX +}
\end{bmatrix}
\text{VAL } \langle \rangle
\]
\]

\[
\text{word
\begin{bmatrix}
\text{FORM } \langle \text{am} \rangle
\end{bmatrix}
\}
\]

\[
\text{SYN
\begin{bmatrix}
\text{CAT}
\end{bmatrix}
\text{verb fin}
\begin{bmatrix}
\text{INV + AUX +}
\end{bmatrix}
\text{VAL } \langle 1, 2 \rangle
\]
\]

1

\[
\text{FORM } \langle \text{I} \rangle
\]

\[
\text{SYN
\begin{bmatrix}
\text{NP}
\end{bmatrix}
\]

2

\[
\text{FORM } \langle \text{invited} \rangle
\]

\[
\text{SYN
\begin{bmatrix}
\text{VP[bse]}
\end{bmatrix}
\]

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Motivating INV: Some Irregularities of SAI

- Some auxiliary verbs, e.g. first person aren’t, only appear in inverted environments (Langendoen 1970):
  *I aren’t invited to the party.
  Aren’t I invited to the party?
  These are lexically specified as [INV +].

- Some auxiliary verbs, e.g. better, only appear in noninverted environments (GPS 1982):
  *Better you not cry?
  You better not cry.
  These are lexically specified as [INV −].

- Cf. also I shall go downtown vs. Shall I go downtown? (due to Emonds, as cited by Chomsky (1981: 209))

- These remain unaccounted for in transformational analyses.
Kim hasn’t read that, but I have ___.

Are they talking to the dean? - They must be ___.

Lee left before Sandy did ___.

**VP-Ellipsis Construction:**

\[
\text{SYN} \begin{bmatrix}
\text{CAT} & \text{X} ! [\text{AUX} \text{ bool}] \\
\text{VAL} & \langle \text{NP} \rangle \\
\text{SEM} & \text{V'} (\text{Variable})
\end{bmatrix} \rightarrow 
\text{SYN} \begin{bmatrix}
\text{CAT} & \text{X} : [\text{AUX} +] \\
\text{VAL} & \langle \text{NP}, \text{XP} \rangle \\
\text{SEM} & \text{V'}
\end{bmatrix}
\]
VP-Ellipsis
Interactions of VP-Ellipsis

- **VP-Ellipsis** feeds **Negation** and **Contraction**:
  Sandy will not __.
  Sandy won’t __.

- **VP-Ellipsis** feeds **The Aux-Initial Construction**:
  Has Lee __?

- **VP-Ellipsis** feeds **Negation**, **Contraction**, and **The Aux-Initial Construction**:
  Hasn’t Lee __?

- Lexical scope restrictions are preserved in **VP-Ellipsis**:
  Pat will not __. vs. Pat must not __.
  Pat won’t __. vs. Pat mustn’t __.
Rebuttal

We will so/too attend. We will attend. We won’t attend.

Rebuttal Construction:

\[
\begin{align*}
\begin{bmatrix}
\text{FORM} & \langle F_{\text{Rebut}}(Y) \rangle \\
\text{SYN} & X ! [\text{AUX } - ] \\
\text{SEM} & Z \bullet \text{Rebut}(\text{Spkr}_u,\text{Addr}_u,u)
\end{bmatrix}
\rightarrow
\begin{bmatrix}
\text{FORM} & \langle Y \rangle \\
\text{SYN} & X : \begin{bmatrix}
\text{AUX} & + \\
\text{VF} & \text{fin}
\end{bmatrix} \\
\text{SEM} & Z
\end{bmatrix}
\end{align*}
\]

where

1. If \( Y = F_{\text{contr}}(X) \), then \( F_{\text{Rebut}}(Y) = Y' \), and
2. Otherwise, \( F_{\text{Rebut}}(Y) = Y', Y + \text{too}, \) or \( Y + \text{so} \).

\(^4\)‘\( \bullet \)’ is a Pottsian composition operator functioning as ‘expressive glue’.
\[
\text{FORM } \langle \text{will+so} \rangle
\]

\[
\text{SYN}
\begin{bmatrix}
\text{CAT} & \begin{bmatrix}
\text{VF} & \text{fin} \\
\text{AUX} & -
\end{bmatrix} \\
\text{VAL} & \langle \text{NP, VP[bse]} \rangle
\end{bmatrix}
\]

\[
\text{SEM } \text{will } \bullet \text{Rebut(Spkr}_u,\text{Addr}_u, u) \]

\[
\text{FORM } \langle \text{will} \rangle
\]

\[
\text{SYN}
\begin{bmatrix}
\text{CAT} & \begin{bmatrix}
\text{VF} & \text{fin} \\
\text{AUX} & +
\end{bmatrix} \\
\text{VAL} & \langle \text{NP, VP[bse]} \rangle
\end{bmatrix}
\]

\[
\text{SEM } \text{will}
\]
Summary of Analysis of EAS

- Auxiliaries are optional: A clause is headed by a finite verb, which may be an auxiliary verb or a nonauxiliary verb.
- Auxiliaries precede any main verbs: Some auxiliaries have only finite lexical forms and hence must precede all other verbs because they head a finite clause.
- Strict ordering of auxiliary elements: Order Fixed by semantic constraints and/or feature incompatibilities.
- Discontinuous Dependencies:
  Auxiliaries determine form of following verb: Work is done by lexical selection and the Head Feature Principle.
  (This derives the effects of the Head Movement Constraint without head movement!)
Auxiliary Do

- Generalization: $Do$ appears only in $[\text{AUX } +]$ environments.
- Analysis: $Do$ is lexically specified as $[\text{AUX } +]$.

- Hence,

*Kim $\text{dões}$ walk into a bar*, but

- $Kim$ does not walk into a bar,
- $Kim$ does so walk into a bar,
- $Kim$ DOES walk into a bar,
- Did $Kim$ walk into a bar?,
- $Kim$ did ___ , etc.
... it appears that any theory with the following features fails to attain explanatory adequacy:

- Optional vs. obligatory rules
- Extrinsic ordering in rules
- Complicated structural analyses (...)
- Complicated structural changes (...)

Lasnik (2000: 119) on Syntactic Structures
Lasnik (2000: 123) on Syntactic Structures

In other words, the rules [of SS - IAS] describe, but don’t capture the following overwhelming generalization:

(169) A stranded affix is no good.

My analysis derives this generalization directly from the strong form of lexicalism it embraces: Inflectional affixes cannot be autonomous syntactic entities.
Human Biology: Ts as Structure-Sensitive Operations?

- Chomsky 1968 (Language and Mind), 1971 (Problems of Knowledge and Freedom), Crain & Nakayama 1987, ...

- [[The man] who is speaking] is their friend.
- Is the man who is speaking ___ their friend?
- *Is the man who ___ speaking is their friend?

- Can eagles that fly eat?
- ‘Constrained Ambiguity’
[in response to various recent positive learnability results for CFGs]

... these challenges have no bearing whatsoever on the AFP and the related POS argument, appearances to the contrary. Indeed, such work does not even address the AFP as originally posed, since the original formulation employs the notion ‘front’, i.e., ‘move’, not a part of the CFGs or alternatives used in these recent challenges. CFGs must be immensely and unnecessarily complicated to replicate such phenomena before we can even state the (A) vs. (B) choice properly.

[NB: A = ‘Move the first aux in the sentence to the front’; B = ‘Move the highest aux in the sentence to the front’]
... adding such rules [e.g. metarules -IAS] threatens to enrich the role of [innate, language-specific factors - IAS]. Moreover, adding meta-rules threatens massive over-generation, as outlined in e.g., Uszkoreit and Peters (1987) or Ristad (1986). For us, the issue is whether PTR’s model of such acquisition makes it plausible that a similar model - with similar stress on general learning as opposed to domain-specific constraints - can capture the constrained ambiguity facts.
Response

- BPYC’s concern about meta-rules has no relevance for evaluating the GPSG proposals discussed earlier: GPSG grammars involve finite closure under metarules; The Uszkoreit/Peters results all turn on metagrammars that allow infinite grammars.

- The analysis of the EAS I have presented here uses no ‘meta-rules’. Aux-initial structures are directly generated from the lexical specifications of auxiliary verbs.

- As noted by Clark and Lappin (2010: Ch. 2), a grammar that directly generates aux-initial structures answers BC’s objections to learnability results for nontransformational grammars. See their discussion for an optimistic assessment of learnability for grammars like SBCG.
...the alternative proposals [for learning CFG-like grammars of the EAS without rich UG - IAS] cannot be extended to generate the attested broader patterns of correct and incorrect pairings. Moreover, even with regard to the basic examples, we think the alternatives suffer from either or both of two serious defects: they do not aim to specify the correct structures for interpretation (along with correct pairings...), and so they fail to capture what speakers know about the basic examples; or they do aim to capture the right pairings, at least implicitly, but fail to do so.
Response

- The **SBCG** grammar presented here answers BPYC’s concern that adequate grammars must account for the ‘constrained ambiguity’ data.

- This grammar does so in a principled way: compositionality is local because semantics is included in the sign and the sign recursion is local (in the sense of CFG).

- Moreover, the analysis handles the full range of semantic data associated with the EAS, as well as idiosyncrasies never properly treated (to my knowledge) in transformational terms.

- **SBCG**, formalized within a constrained version of **HPSG**, provides a superior account of the EAS without positing any movement operations.

- This analysis also satisfies psycholinguistic considerations, since it facilitates the incremental computation of partial meaning. (sign-based design; direct generation architecture)
Penultimate Conclusions

- Therefore, the \textsc{sbcg} analysis of the EAS is a plausible candidate for ‘what people know’ about the EAS.
- Assuming this, the grammar of the EAS involves no movement; structures are directly generated without loss of generalization or semantic adequacy.
- Since there is no movement rule in the grammar of the EAS, the issue of whether such a movement rule is structure sensitive or not is irrelevant to the larger goal of understanding what innate, domain-specific factors contribute to human knowledge.
- There is hierarchical structure, but this is not specific to the domain of language (cf. Jackendoff and Pinker, 2005).
Ultimate Conclusions

- Hence the famous argument for the POS based on the EAS collapses (v. Clark and Lappin 2010, Ch. 2).
- Linguists have been overzealous in drawing conclusions about the nature of language.
- The transformational bias has led to incorrect conclusions about the nature of language and about human language learning.
- There is obviously something extremely impressive about humans’ ability to learn language, ...
- but the English Auxiliary System provides no evidence that it turns on a rich language-specific biological endowment.
Thank You!

Farrell Ackerman, Emily Bender, Rajesh Bhatt, Bob Borsley, Joan Bresnan, Alex Clark, Ann Copestake, Hana Filip, Chuck Fillmore, Dan Flickinger, Gerald Gazdar, Jonathan Ginzburg, Jane Grimshaw, Paul Hirschbühler, Dick Hudson, Paul Kay, Jongbok Kim, Paul Kiparsky, Tibor Kiss, Shalom Lappin, Bob Levine, Sally McConnell-Ginet, David Pesetsky, Carl Pollard, Eric Potsdam, Geoff Pullum, Peter Sells, Anthony Warner, Tom Wasow, and Arnold Zwicky.
Embick and Noyer (2001) discuss a situation of putative ineffability created by constituent negation which suffices to block affix lowering, but is not enough to trigger do-support:

▶️*You always not do that.

cf. You can always not do that.

▶️*You dŏ always not do that.

▶️ You DO always not do that.

---

5Embick, David. Noyer, Rolf, Movement Operations after Syntax, Linguistic Inquiry 32.4, Fall 2001
One might object that Lasnik’s analysis does as well and is independently motivated by Warner’s (1986) observation:

- John left and Mary will leave, too.
- *John was here and Mary will be here, too.
But

- Modal/negation scope variation is not analyzed.
- No treatment of inversion idiosyncrasies.
- More stipulative (e.g. Stranded Affix Filter).
- No account of Embick/Noyer contrasts.
Lasnik’s account of Warner’s observation incorrectly rules out:
Ms Sanford, whose husband had cheated on her, has said that even if he had asked her to be there, she would not have been there. [NYTimes, Political Memo, June 19, 2011]
I don’t deny that he can be a little quirky... He always has been a little quirky. [The Sopranos. Season 3]
He hasn’t been known for his back-hand serve in the past, but he will be known for his back-hand serve, once he’s taken Mike’s advanced class. [constructed]
[I’m] pretty good at being invisible when I need to be invisible. [CSI:NY 3.11.11]
That guy’s in more trouble than he has a right to be in much trouble. [Movie, Aug 6, 2003]