

Sex, Lies, and the English Auxiliary System

Ivan A. Sag
Stanford University

Edward Sapir (1884-1939)



Gilmanton Iron Works, NH



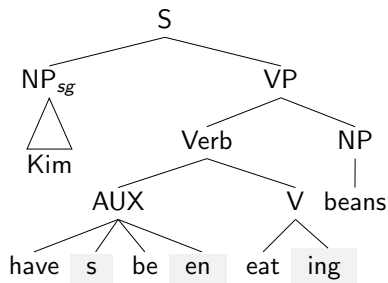
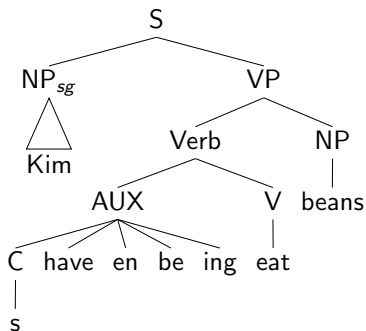
Photographs by Laurence R. Horn

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]

अग्नमीळे पुरोहतिं यज्जस्य देवं रत्वीजम् ।

होतारं रत्नधातमम् ॥

अग्निः पूर्वेभरिर्षभिरीड्यो नूतनैरुत ।

स देवानेह वक्षति ॥

अग्निना रयमिश्नवत् पोषमेव दवि-दवि ।

यशसं वीरवत्तमम् ॥

अग्ने यं यज्जमध्वरं वश्वतः परभूरसि ।

स इद्देवेषु गच्छति ॥

अग्निरिहोता कवक्रितुः सत्यश्चतिरश्रवस्तमः ।

देवो देवेभरि गमत ॥

यदङ्ग दाशुषे तवमग्ने भद्रं करषियसि ।

तवेत तत् सत्यमङ्गरिः ॥

उप तवाग्ने दवि-दवि दोषावस्तरधिया वयम् ।

नमो भरन्त 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/musting 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.
- ▶ Hence Chomsky's famous argument for the Poverty of the Stimulus based on the EAS collapses.

Introduction

- ▶ Syntactic Structures (1957) and its Aftermath

The GPSG (1982) Alternative and its Consequences

Sign-Based Construction Grammar

A New Analysis of the English Auxiliary System

Conclusion

The Syntactic Structures Kernel Grammar

$S \rightarrow NP VP$

$VP \rightarrow Verb NP$

$Verb \rightarrow AUX V$

$VP \rightarrow V NP \dots$

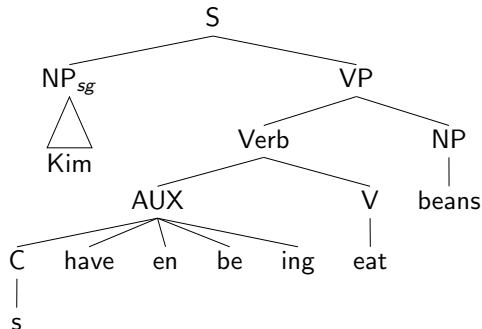
$M \rightarrow \text{may, will, can, ...}$

$V \rightarrow \text{walk, love, eat, ...}$

...

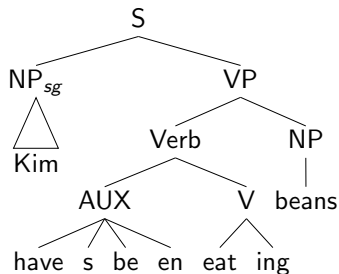
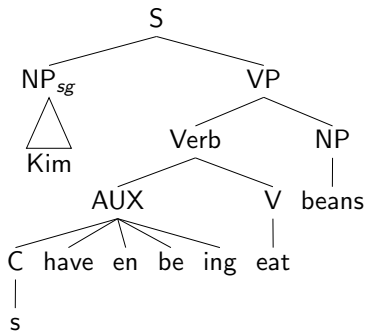
$AUX \rightarrow C (M) (\text{have en}) (\text{be ing})$

(29i): $C \rightarrow \left\{ \begin{array}{l} s / NP_{sg} \\ \emptyset / NP_{pl} \\ past \end{array} \right\}$



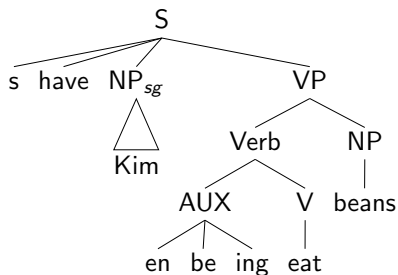
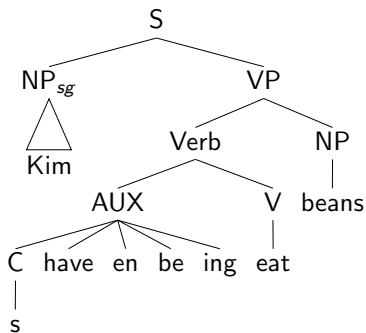
SS (29ii) aka 'Affix Hopping' Transformation

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: $Af + v \rightarrow v + Af$.



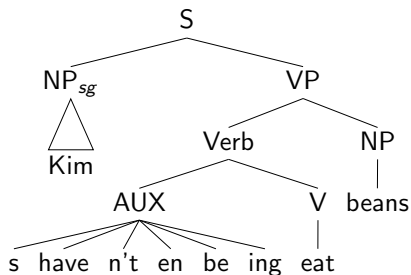
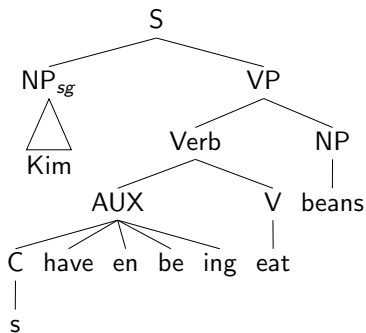
T_Q aka 'SAI' (crucially ordered before Affix Hopping)

$$NP - \left\{ \begin{array}{l} C - V \\ C + M - \\ C + have - \\ C + be - \end{array} \right\} X \quad 1 - 2 - 3 \Rightarrow 2 - 1 - 3$$



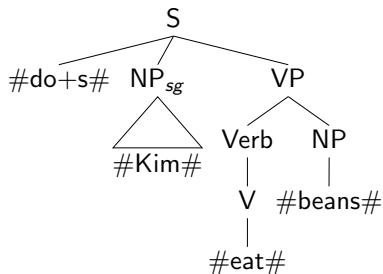
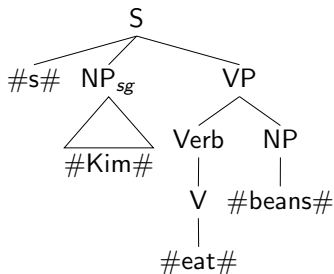
T_{not} (ordered before T_Q)

$$NP - \left\{ \begin{array}{l} C - V \\ C + M - \\ C + have - \\ C + be - \end{array} \right\} X \quad 1 - 2 - 3 \Rightarrow 1 - 2 + n't - 3$$



T_{do} aka 'Do-Support' (crucially 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; Pullum 2011]
2. Mispredictions re. Negation and SAI:
 - Isn't Kim talking to Lee? (not generated)
 - Didn't Kim talk to Lee? (not generated)
 - %Is Kim not talking to Lee? (generated)
 - %Did Kim not talk to Lee? (not generated)

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.

Introduction

Syntactic Structures (1957) and its Aftermath

▶ Constraint-Based Alternatives

Sign-Based Construction Grammar

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Constraint-Based Alternatives

- ▶ 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)
- ▶ Categorical 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.

$$\begin{bmatrix} V & + \\ N & - \\ \text{BAR} & 2 \end{bmatrix} (= S), \quad \begin{bmatrix} N & + \\ V & - \\ \text{BAR} & 2 \end{bmatrix} (= NP),$$

$$\begin{bmatrix} V & + \\ N & - \\ \text{BAR} & 1 \end{bmatrix} (= VP), \quad \begin{bmatrix} N & - \\ V & - \\ \text{BAR} & 0 \end{bmatrix} (= P)$$

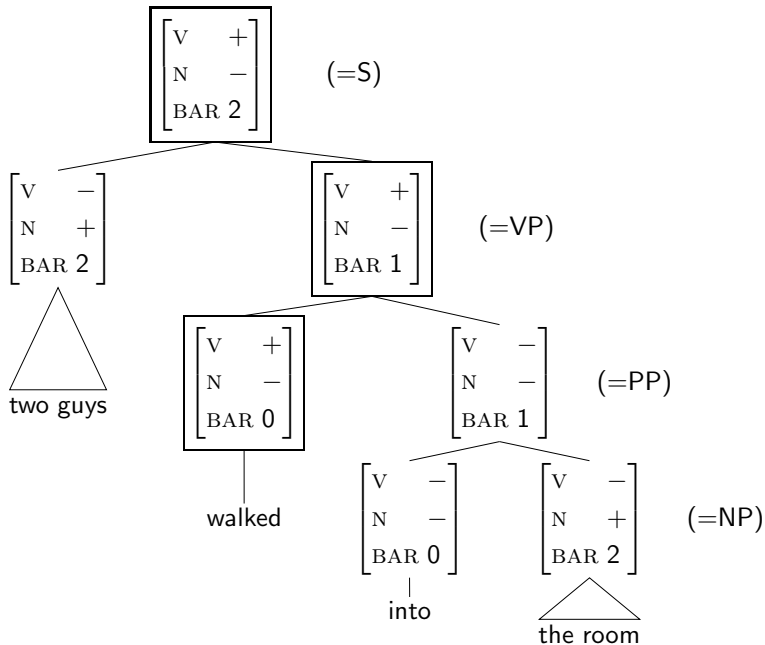
- ▶ X-Bar Theory, widely adopted within TG and elsewhere

GPSG 2

- ▶ 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, \bar{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).



Gazdar, Pullum & Sag (1982) on Auxiliaries¹

$$\begin{matrix} V^1 \\ \left[\begin{matrix} \text{AUX} + \\ \alpha \end{matrix} \right] \end{matrix} \rightarrow V[n] \quad [\beta]^1, \text{ where}$$

n	α	β	MEMBERSHIP
5	FIN+	BSE+	can, may, must, will etc.
6	FIN+	BSE+,AUX-	do
7	ASP+	PSP+	have
8	ASP+,COP+	PRP+	be
9	COP+	PAS+	be
10	INF+	BSE+	to
11	COP+	PRED+	be
...

¹Gazdar, G., G.K. Pullum, and I.A. Sag. 1982 Auxiliaries and Related Phenomena in a Restrictive Theory of Grammar. *Language* 58:591-638.

► **Subject-Auxiliary 'Inversion' Metarule:**

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

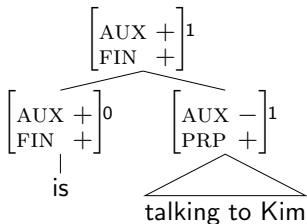
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$$\begin{array}{c} V^2 \\ \left[\text{INV} \quad + \right] \end{array} \rightarrow V[n] [\beta]^2$$

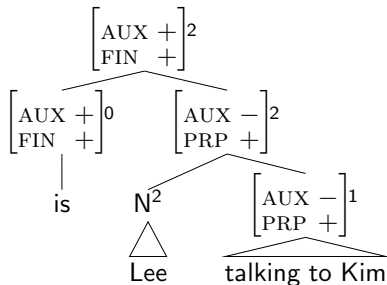
GPS 1982 on Auxiliaries 3

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

n	α	β	MEMBERSHIP
5	FIN+	BSE+	can, may, must, will etc.
6	FIN+	BSE+,AUX-	do
7	ASP+	PSP+	have
8	ASP+,COP+	PRP+	be
9	COP+	PAS+	be
10	INF+	BSE+	to
11	COP+	PRED+	be
...



PROG(talk)(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']

²Proceedings of CogSci 2008: 383.

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.
$$\text{NP} - \left\{ \begin{array}{l} \text{C} - \text{V} \\ \text{C} + \text{M} - \\ \text{C} + \text{have} - \\ \text{C} + \text{be} - \end{array} \right\} \text{X} \quad 1 - 2 - 3 \Rightarrow \dots$$

is redundantly stipulated in at least 6 transformations

2. GPS grammar avoids the rule proliferation masked by the theoretically illegitimate abbreviations **Af** and **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 2010³) 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.

³Clark, A. & S. Lappin. 2010b. Linguistic Nativism and the Poverty of the Stimulus, Wiley-Blackwell, Oxford.

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)
- ▶ Freidin's (2004) 'Morphological Economy' Principle.
- ▶ Morphology competes with (and systematically blocks) syntax.

These Analyses 'Explain' Too Much

- ▶ Dialects where **Kim did 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).
- ▶ ...

Introduction

Syntactic Structures (1957) and its Aftermath

Constraint-Based Alternatives

- ▶ Sign-Based Construction Grammar

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Sign-Based Construction Grammar

(Boas and Sag almost 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 embodies Bresnan and Kaplan's (1982) Strong Competence Hypothesis.
- ▶ 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):

▶ $sign_0 \rightarrow sign_1 \dots sign_n$

▶
$$\begin{bmatrix} \text{PHON} & [\dots] \\ \text{SYN} & [\dots] \\ \text{SEM} & [\dots] \end{bmatrix} \rightarrow \begin{bmatrix} \text{PHON} & [\dots] \\ \text{SYN} & [\dots] \\ \text{SEM} & [\dots] \end{bmatrix} \dots \begin{bmatrix} \text{PHON} & [\dots] \\ \text{SYN} & [\dots] \\ \text{SEM} & [\dots] \end{bmatrix}$$

Signs Look Like This:

	<i>word phrase</i>		
PHON	<i>phon-obj</i>		
FORM	<i>morph-obj</i>		
ARG-ST	<i>list(sign)</i> [only for lexical signs]		
SYN	CATEGORY	<i>noun verb adj...</i>	
		VFORM <i>fin prp ...</i> [verbals only]	
		AUX <i>boolean</i> [verbals only]	
		INV <i>boolean</i> [verbals only]	
		CASE <i>nom acc</i> [nouns only]	
	VALENCE	<i>list(sign)</i>	
SEM	<i>sem-object</i>		
CNTXT	<i>context-obj</i>		

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 τ must satisfy D),

where either:

- τ is a subtype of *lexical-sign*
(**Lexical Class Construction**), or
- τ is a subtype of *construct*
(**Combinatory Construction**)

Feature Decomposition of Grammatical Categories 3

- ▶ Also in the mid-1960s, Chomsky suggested providing words with features specifying their combinatoric potential.
(Cf. Ajdukiewicz 1935)

LEXEME	VALENCE List	Example
LAUGH	$\langle \text{NP} \rangle$	<i>Kim laughs</i>
WALK	$\langle \text{NP} (, \text{PP}) \rangle$	<i>Kim walked (into a bar)</i>
LOVE	$\langle \text{NP}, \text{NP} \rangle$	<i>Kim loved Lee</i>
GIVE	$\langle \text{NP}, \text{NP}, \text{NP} \rangle$	<i>They gave Pat a watch</i>
GIVE	$\langle \text{NP}, \text{NP}, \text{PP}[\text{to}] \rangle$	<i>They gave a watch to Pat</i>
KEEP	$\langle \text{NP}, \text{VP}[\text{prp}] \rangle$	<i>They kept coming</i>
CONTINUE	$\langle \text{NP}, \text{VP}[\text{inf}] \rangle$	<i>I continue to doubt</i>

Two Combinatoric Constructions

Subject-Predicate Construction:

$$[\text{SYN} [\text{VAL} \langle \rangle]] \rightarrow \mathbf{X} \quad \mathbf{H}: \left[\begin{array}{c} \text{SYN} \left[\begin{array}{c} \text{CAT} \left[\begin{array}{c} \text{VF} \quad \textit{fin} \\ \text{AUX} \quad - \\ \text{INV} \quad - \end{array} \right] \\ \text{VAL} \quad \langle \mathbf{X} \rangle \end{array} \right] \end{array} \right]$$

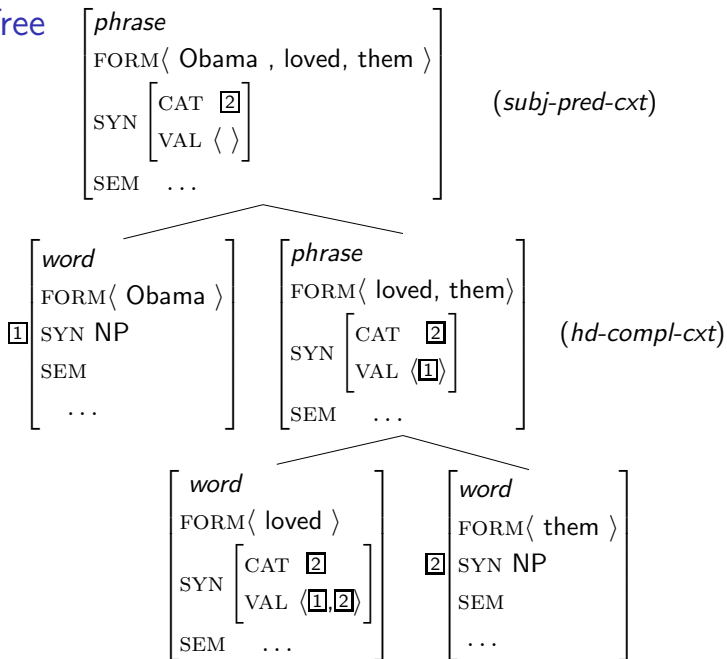
(A valence-saturated phrase may consist of an expression followed by its head, where the latter is a finite, AUX —, and INV — expression selecting the former as its only valent.)

Head-Complement Construction:

$$[\text{SYN} [\text{VAL} \langle \mathbf{X} \rangle]] \rightarrow \mathbf{H}: \left[\begin{array}{c} \textit{word} \\ \text{SYN} [\text{VAL} \langle \mathbf{X} \rangle \oplus \mathbf{L}] \end{array} \right] \quad \mathbf{L}$$

(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



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'.

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Auxiliary Verb Forms (Palmer 1968: 19)

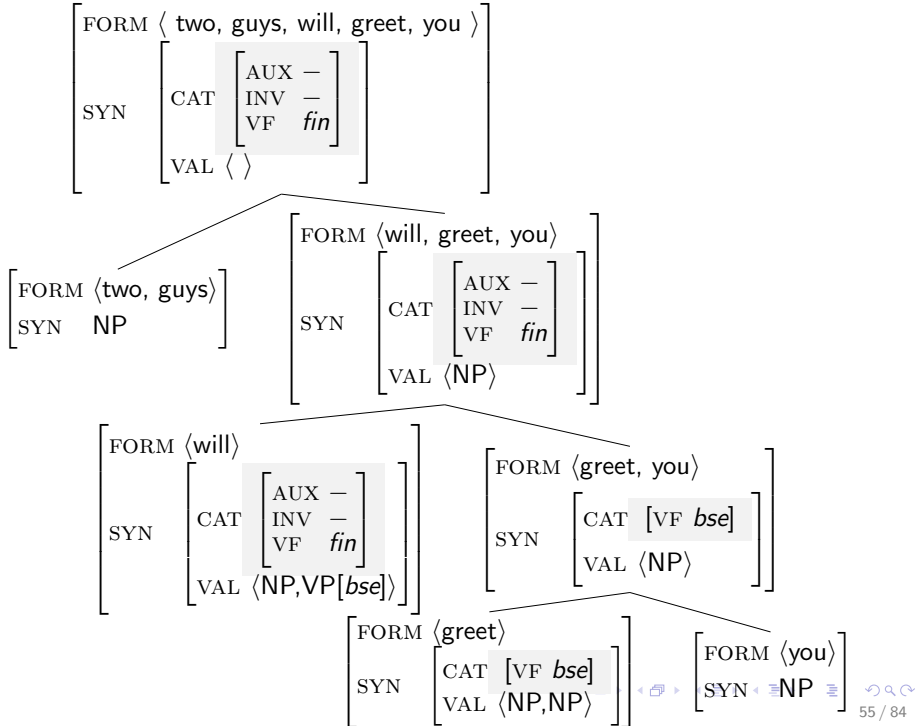
LEXEME	finite	non-finite
BE	<i>is, are, am, was, were</i>	<i>be, being, been</i>
HAVE	<i>has, have, had</i>	<i>have, having</i>
DO	<i>do, does, did</i>	
WILL	<i>will, would</i>	
SHALL	<i>shall, should</i>	
CAN	<i>can, could</i>	
MAY	<i>may, might</i>	
MUST	<i>must</i>	
OUGHT	<i>ought</i>	
DARE	<i>dare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

The Valence of Auxiliary Verbs

LEXEME	Value of VALENCE
BE	$\langle \text{NP}, \text{XP} \rangle$
HAVE	$\langle \text{NP}, \text{VP}[\textit{psp}] \rangle$
all modals	$\langle \text{NP}, \text{VP}[\textit{bse}] \rangle$
'modal' IS	$\langle \text{NP}, \text{VP}[\textit{inf}] \rangle$

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

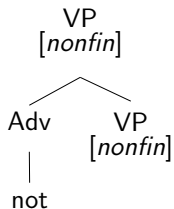
- ▶ The feature *AUX* is not used to distinguish auxiliary verbs from main verbs.
- ▶ Rather, *AUX* distinguishes the auxiliary-restricted environments (e.g. the NICE constructions) from unrestricted environments.
- ▶ A syntactic environment restricted to auxiliary verbs is specified as $[AUX +]$.
- ▶ *INV*: A clause that is verb-initial is specified as $[INV +]$ (in English, only auxiliary verbs can be $[INV +]$).
- ▶ Auxiliary verbs are lexically unspecified for *AUX* and *INV*.
- ▶ Hence they are compatible with the following combinations:

$$\begin{bmatrix} AUX & + \\ INV & - \end{bmatrix} \quad \begin{bmatrix} AUX & + \\ INV & + \end{bmatrix} \quad \begin{bmatrix} AUX & - \\ INV & - \end{bmatrix} \quad \begin{bmatrix} AUX & - \\ INV & + \end{bmatrix}$$

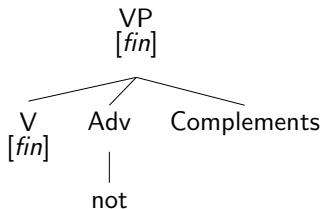
- ▶ Main (nonauxiliary) verbs are lexically specified as $\begin{bmatrix} AUX & - \\ INV & - \end{bmatrix}$

Two Kinds of Negation in English (Klima, 1964)

Constituent Negation:



Finite Negation:



&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]

A Lexical Analysis of Finite Not

- ▶ Some modals must outscope **not**; others must be outscoped by **not** (unless **not** functions as constituent negation).
- ▶ These facts can only be partly predicted on semantic grounds (Warner 2000):

can, could, need, dare, will, would [Epistemic: \neg M]

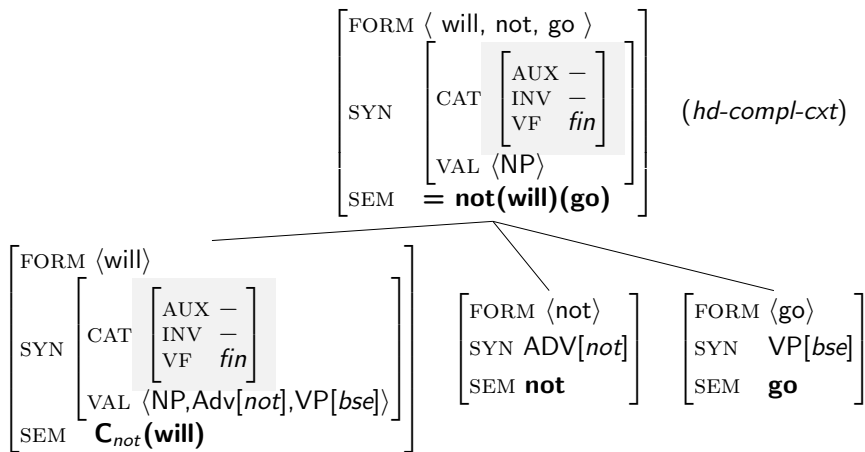
must, shall, ought, should [Deontic: M \neg]

But **may** (epistemic), **might** (epistemic) [M \neg]

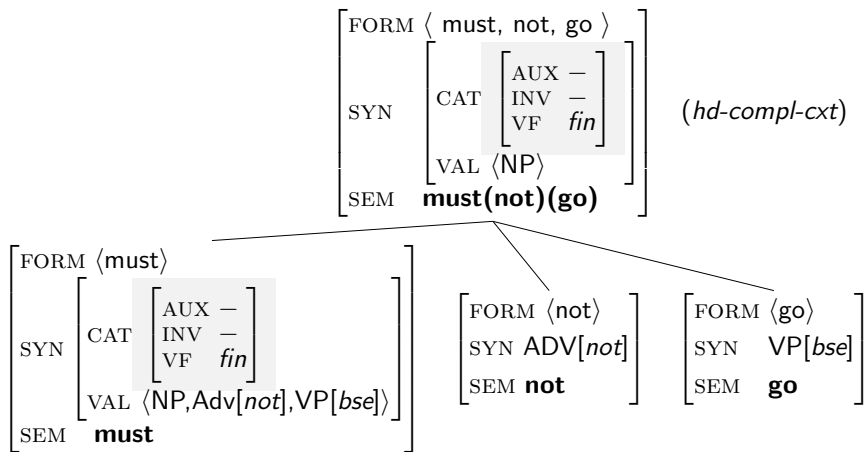
and **may** (deontic) [\neg M]

- ▶ Finite [AUX+]-compatible verbs may select **not** as a complement.

A Lexical Analysis of Finite Not



A Lexical Analysis of Finite Not



Contraction (Lexical)

Contraction Construction:

$$\left[\begin{array}{l} \text{FORM} \quad \langle F_{\text{Contr}}(Y) \rangle \\ \text{SYN} \quad \left[\begin{array}{l} \text{CAT} \quad X \text{ ! [AUX } \textit{bool}] \\ \text{VAL} \quad \langle \text{NP}, \dots \rangle \end{array} \right] \\ \text{SEM} \quad Z \end{array} \right] \rightarrow \left[\begin{array}{l} \text{FORM} \quad \langle Y \rangle \\ \text{SYN} \quad \left[\begin{array}{l} \text{CAT} \quad X \\ \text{VAL} \quad \langle \text{NP}, \text{ADV}[\textit{not}], \dots \rangle \end{array} \right] \\ \text{SEM} \quad Z \end{array} \right]$$

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 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 he not laugh?** and ***Will not he laugh?**, but allows **Won't he laugh?**

Expanded Grammar

Subject-Predicate Construction:

$$[\text{SYN} [\text{VAL} \langle \rangle]] \rightarrow \mathbf{X} \quad \mathbf{H}: \left[\begin{array}{c} \text{SYN} \\ \text{VAL} \end{array} \left[\begin{array}{cc} \text{CAT} & \left[\begin{array}{cc} \text{VF} & \textit{fin} \\ \text{AUX} & - \\ \text{INV} & - \end{array} \right] \\ \langle \mathbf{X} \rangle & \end{array} \right] \right]$$

Head-Complement Construction:

$$[\text{SYN} [\text{VAL} \langle \mathbf{X} \rangle]] \rightarrow \mathbf{H}: \left[\begin{array}{c} \textit{word} \\ \text{SYN} [\text{VAL} \langle \mathbf{X} \rangle \oplus \text{L}] \end{array} \right] \text{L}$$

Aux-Initial Construction:

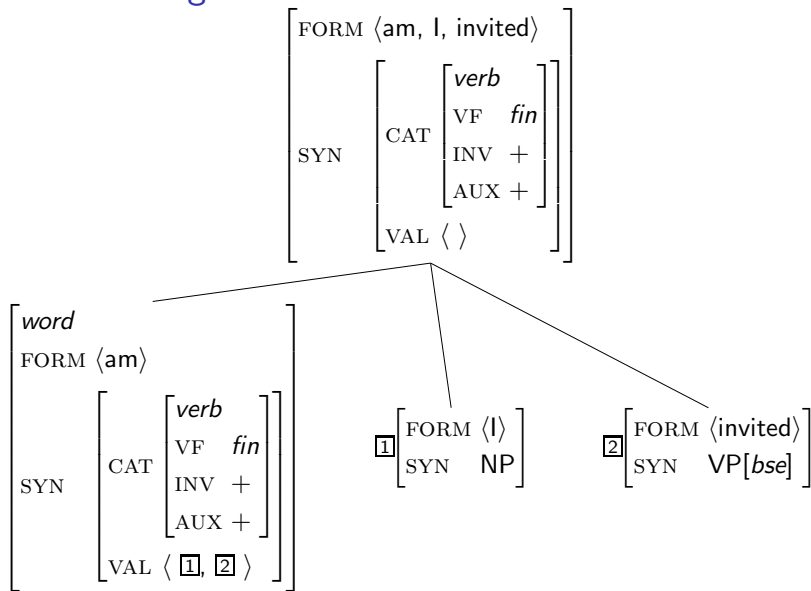
$$[\text{SYN} [\text{VAL} \langle \rangle]] \rightarrow \mathbf{H}: \left[\begin{array}{c} \textit{word} \\ \text{SYN} \\ \text{VAL} \end{array} \left[\begin{array}{cc} \text{CAT} & \left[\begin{array}{cc} \text{AUX} & + \\ \text{INV} & + \end{array} \right] \\ \text{L} & \end{array} \right] \right] \text{L}$$

(A valence-saturated clause may consist of a lexical head specified as AUX + and INV + followed by all its valents.)

The Family of Aux-Initial Constructions: (Fillmore 1999; Ginzburg & Sag 2000)

Exclamatives:	Boy, [was I stupid]!
	Wow, [can she sing]!
Conditionals:	[Were they here now], we'd...
	[Should there be a storm], we'd...
'Magic':	May they live forever!
	May all your teeth fall out!
Interrogatives:	Were they involved?
	We won't go, [will we]?
Declaratives:	So [can I]!
	Never [would I do such a thing].
...	

A Polar Interrogative Construct



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.

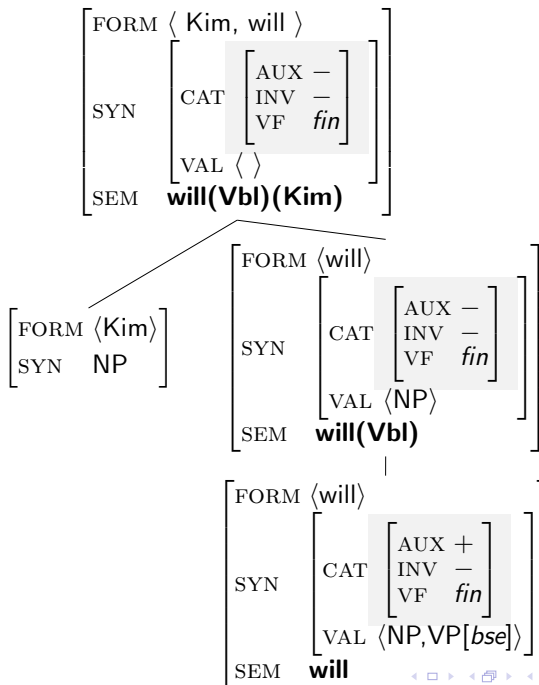
VP-Ellipsis

- ▶ 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:

$$\left[\begin{array}{l} \text{SYN} \\ \text{SEM} \end{array} \left[\begin{array}{l} \text{CAT} \quad X ! [\text{AUX} \quad \textit{bool}] \\ \text{VAL} \quad \langle \text{NP} \rangle \\ \mathbf{V'(\text{Variable})} \end{array} \right] \right] \rightarrow \left[\begin{array}{l} \text{SYN} \\ \text{SEM} \end{array} \left[\begin{array}{l} \text{CAT} \quad X : [\text{AUX} \quad +] \\ \text{VAL} \quad \langle \text{NP}, \text{XP} \rangle \\ \mathbf{V'} \end{array} \right] \right]$$

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:**⁴

$$\left[\begin{array}{l} \text{FORM} \quad \langle F_{Rebut}(Y) \rangle \\ \text{SYN} \quad X ! [\text{AUX} -] \\ \text{SEM} \quad Z \bullet \text{Rebut}(\text{Spkr}_u, \text{Addr}_u, u) \end{array} \right] \rightarrow \left[\begin{array}{l} \text{FORM} \quad \langle Y \rangle \\ \text{SYN} \quad X : \left[\begin{array}{l} \text{AUX} \quad + \\ \text{VF} \quad \textit{fin} \end{array} \right] \\ \text{SEM} \quad Z \end{array} \right]$$

where

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

⁴'•' is a Pottsian composition operator functioning as 'expressive glue'.

$$\left[\begin{array}{l} \text{FORM } \langle \text{will+so} \rangle \\ \text{SYN } \left[\begin{array}{l} \text{CAT } \left[\begin{array}{l} \text{VF } \textit{fin} \\ \text{AUX } - \end{array} \right] \\ \text{VAL } \langle \text{NP}, \text{VP}[\textit{bse}] \rangle \end{array} \right] \\ \text{SEM } \textbf{will} \bullet \textbf{Rebut}(\text{Spkr}_u, \text{Addr}_u, u) \end{array} \right]$$

$$\left[\begin{array}{l} \text{FORM } \langle \text{will} \rangle \\ \text{SYN } \left[\begin{array}{l} \text{CAT } \left[\begin{array}{l} \text{VF } \textit{fin} \\ \text{AUX } + \end{array} \right] \\ \text{VAL } \langle \text{NP}, \text{VP}[\textit{bse}] \rangle \end{array} \right] \\ \text{SEM } \textbf{will} \end{array} \right]$$

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.

Auxiliary Do

- ▶ Generalization: *Do* appears only in [AUX +] environments.
- ▶ Analysis: *Do* is lexically specified as [AUX +].

▶ Hence,

**Kim dōes 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.*

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'

Berwick and Chomsky, 2008

[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/and 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 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!

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