

The Genesis of Generative Grammar

Syntax and Logical Form

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Reflections: Foundations and Developments of Generative Grammar
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The Intellectual Milieu

Middle of the 20th-century: Mid-1950s in philosophy

- Systemization of scientific inquiry
 - Logic and language
- Scientific knowledge
 - Empiricist tradition
- Properties of scientific change

Scientific Revolution

- Conceptual advance
 - Deeper understanding of lawful properties
- Commensurability

The Linguistic Revolution

Noam Chomsky *The Logical Structure of Linguistic Theory* (1955)

- Generative Grammar was a scientific revolution
 - Conceptual advance over prior theories
 - Structural Linguistics
- *Proof*: Unprecedented growth in our understanding of human language, and the continued vitality of generative grammar as broad research program 70+ years later

Two aims of this talk:

- The conceptual advances of *LSLT*
- Syntax/semantics interface
 - Logical Form: *LF*

LSLT

Central goal of linguistic theory: To *define* the notion of language.

- Answer the question: *What is a language?*

Accomplished via a nexus of sub-definitions:

The general theory will ultimately assume the form of a system of definitions, in which “phoneme,” “word,” “sentence,” etc., are defined, and their general properties and interrelations specified. (*LSLT*, 85)

Chomsky: No answer can be deemed fully adequate outside its role in explaining what it is to know a language (descriptive adequacy) and come to have that knowledge (explanatory adequacy).

- *Cf. Aspects of the Theory of Syntax*, ch. 1
- Rejection of empiricism
 - poverty of the stimulus arguments

Definition via Levels

Definition effected by construction of a system of linguistic levels:

Instead of giving a direct definition of these further notions, we can continue to construct systems of representation for sentence tokens, calling these systems “linguistic levels.” A sentence token can be represented as a sequence of phonemes; but it can also be represented as a sequence of morphemes, words and phrases. Thus each sentence token will have associated with it a whole set of representations, each representation being its “spelling” in terms of elements of one linguistic level. (*LSLT*, 99)

Structuralist Linguistics

Where the theory of *LSLT* fractures from its immediate structuralist forbearers is in how the levels are constructed.

- Structuralist linguistics: Starting from the base, each higher level n is constructed from the immediately prior level $n - 1$, such that the lower level elements are the “content” of the immediately next highest level; e.g. morphemes are made up of phonemes.
- Same procedures apply to construction of each level.
 - taxonomic procedures of classification derive a system of categories
- Procedures do not guarantee a unique solution for level $n + 1$, given level n .
 - instrumentalism.

Linguistic Levels

Chomsky's reconceptualization of how levels are related is the breakthrough of *LSLT*:

We need not require that an element on one level have actual “content” on lower levels; e.g., a morpheme need not have any specific sequence of phonemes (or set of such sequences) as its phonemic content, though given a sequence of morphemes that represent an utterance, the grammar must enable us to construct the corresponding sequence of phonemes. Since higher levels are not literally constructed out of lower ones, in this view, we are quite free to construct of a high degree of interdependence (*LSLT*, 100)

Each level is formally defined as a class of *derivations*.

Structure of the completed solution.

Linguistic Representation

Linguistic theory characterizes classes of representations, the representations - *markers* - by which each each level is constituted:

In carrying out linguistic analysis, then, we must construct on each level **L** a set of elements (which we call “**L**-markers”), one of which is assigned to each grammatical utterance. The **L**-marker of a given utterance *T* must contain within it all information as to the structure of *T* on level **L**. The construction of **L**-markers, for each level **L**, is thus the fundamental task in linguistic analysis, and in the abstract characterization of linguistic theory we must determine what sorts of elements appear as markers on each level. (*LSLT*, 107)

L-marker is the representational notion in linguistic theory; they contain the information about an utterance generated at level *L*.

Definitions

A *level* L is a pair (P, R) , where P_L is the set of primes of L , and R_L is a set of rules defined over P_L .

A *language* $\mathcal{L} =_{df} \{L_1, \dots, L_n\}$, that is, a set of linguistic levels.

A *sentence* $\mathcal{S} =_{df} \{l_1, \dots, l_n\}$, where each l_i is an *L-marker* at level L_i , where there is a unique l_i for each L_i .

For each level L , the rules, via their applications, generate *derivations* on the basis of the primes.

- *L*-markers are representations of these derivations.

An *L*-marker represents a sequential ordering of rule applications that constitute a particular derivation from (a subset of) the primes.

Phrase-Structure

Level **P** of phrases

- Primes: morpheme sequences (words) and the symbols S, N, V, A, P, NP, VP, AP, PP, etc.
- Rewriting rules in Chomsky-normal form defined over the primes.
- A derivation at the level **P** is a sequence of applications of these rules, which is represented by a **P**-marker.

Phrase-Structure Derivation

S
NP VP
Det N VP
Det N V NP
Det N V Det N
the N V Det N
the man V Det N
the man saw Det N
the man saw the N
the man saw the dog

P-marker represents a derivation by the rules $S \rightarrow NP VP$, $VP \rightarrow V NP$, $NP \rightarrow Det N$, etc.

- **P**-marker: Ordered set of strings, each derived from the immediately prior in the “stack” by rewriting.

Another Derivation

Other derivations by the same set of rules may terminate with the same string; e.g.

S	S
NP VP	NP VP
NP V NP	<i>Det N VP</i>
NP V Det N	<i>Det N V NP</i>
Det N V Det N	Det N V Det N
the N V Det N	the N V Det N
the man V Det N	the man V Det N
the man saw Det N	the man saw Det N
the man saw the N	the man saw the N
the man saw the dog	the man saw the dog

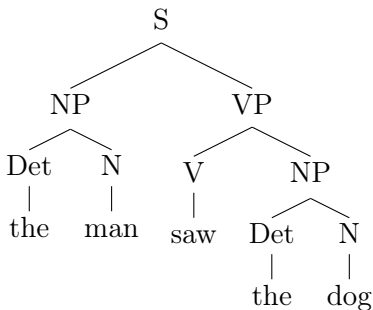
Differ in the steps from line 2 to 3, 3 to 4 and 4 to 5.

Equivalence Classes of Derivations

Derivations represented are distinct, but not significantly so:

. . . these distinct derivations differ only in the order in which the constituents are developed, thus inessentially from the viewpoint of constituent interpretation. (LSLT, 180)

The equivalence class to which these derivations belong is standardly represented by a tree-structure (or equivalent):



Trees are Interpreted

A tree, *qua* **P**-marker, is a representation of an equivalence class of derivations at level **P**, a history of applications of rules at that level.

- “must contain all information as to the structure of T on level **L**”
- All information pertaining to categories of phrases.
 - Everything that is characteristic of the categorial properties of sentences must be recoverable from the representation.

Important: The tree is *fully and completely interpreted*.

- Representational with respect to its informational content.
- No sense in which the tree is in need of any further interpretation.

Formal Valuation of Grammars

The obvious means for selecting among grammars is in terms of the degree of significant generalization that they achieve. In the conventional sense of the term, a generalization is a single rule about many elements. Generalizing this notion, we might measure the degree of generalization attained by a grammar in terms of the formal similarity among its generative rules, the extent to which they say similar things about elements of various sorts. . . . grammars with a greater degree of similarity among rules become, literally, shorter than others which express the same mapping. . . . This system of representation defines a “notational transformation” that assigns to each grammar a number, its length when rules are amalgamated. The system for amalgamating rules expresses a hypothesis as to the relations among rules that constitute linguistically significant generalizations. (*LSLT*, 26 (1975 Introduction))

. . . the more the set of primitives can be reduced without becoming inadequate, the more comprehensively will the system exhibit the network of interrelationships that comprise its subject-matter.

Nelson Goodman “On the Simplicity of Ideas” (1943)

Formal Valuation of Grammars

Grammar 1: value = 12

VP \rightarrow V

VP \rightarrow V NP

VP \rightarrow V PP

VP \rightarrow V NP PP

Grammar 2: value = 4

VP \rightarrow V (NP) (PP)

Linguist (and a child) will converge on the most highly valued grammar - that which expresses the greatest depth of generalization, given available data.

Whence Semantics?

Rejection of the “appeal to meaning”

- Taxonomic procedure of level construction in structural linguistics
 - Chomsky channeling Quine (*cf.* “The Problem of Meaning in Linguistics” (1953))

Can there be a semantic level of linguistic description as per generative linguistics?

- What would be the primes; what would be the rules?

Semantics is *not* part of the definition of language.

- Our theoretical answer to the question of what a language is does not provide any *direct* answer to the question of what sentences of a language mean

Chomsky on Semantics

. . . we [are] studying language as an instrument or a tool, attempting to describe its structure with no explicit reference to the way in which this instrument is put to use. The motivation for this self-imposed formality requirement for grammars is quite simple—there seems to be no other basis that will yield a rigorous, effective, and “revealing” theory of linguistic structure. The requirement that this theory shall be a completely formal discipline is perfectly compatible with the desire to formulate it in such a way as to have *suggestive and significant interconnections with a parallel semantic theory*. What we have pointed out . . . is that this formal study of the structure of language as an instrument may be expected to provide insight into the actual use of language, i.e., into the process of understanding sentences. (*Syntactic Structures*, 103) (Emphasis added)

Syntax-Semantics Interface

Semantic theory interfaces with theory of linguistic structure

- Syntax “outputs” formal objects that are “inputs” to semantics

Tight interface

- Syntactic structure directly expresses compositional structure
- Structure required for the application of semantic/logical rules

“Anaphora Project” *c.* late 1960’s to late 1980’s

- Unification of pronominal anaphora and syntactic movement
- C-command: central theoretical notion
- Binding Theory
- Notion of linguistic law strongly supporting poverty of the stimulus arguments
 - Proper Binding Condition, Subjacency, etc.
 - abstract - not statements of empirical generalizations.

Logical Form

Logical Form (*LF*): Syntactic level

- Syntax specifies logical structure

QR: Quantifier scope

- *The Grammar of Quantification* (1977)
Logical Form: Its Structure and Derivation (1985)

Meta-theoretical motivations for QR

- No extension of the theory; increase in empirical depth
 - *wh*-movement
- Subject to syntactic conditions governing movement rules
- Notion governing proper movement and anaphora also governs scope
 - *A* has scope over *B* iff *A* c-commands *B*

Motivations for LF

Antecedent contained deletion: Dulles suspected everyone that Angleton did

Relative scope of quantifiers: Everyone saw someone

Bound variable anaphora: Every pilot hit some Mig that chased him

Crossover phenomena

- *Strong:* She saw everyone/Whom did she see
- *Weak:* Her friend saw everyone/Whom did her friend see

Crossing Coreference: Every pilot who shot at it hit some Mig that chased him

Inverse linking: Somebody from every city despises it

Lowering: Every spy is likely to be apprehended

Negative Polarity: No student who ever read anything about phrenology attended any of Gall's lectures

Covert Movement:

- Chinese wh-questions (Huang); Spanish clitics (Jaeggli)

Poverty of the Stimulus

Poverty of the stimulus:

Within a program of research that aims at comprehending the basis of human linguistic knowledge, the properties of LF may be of particular interest, especially if LF-structures differ significantly from S-Structures. For in that case, the remoteness of logical forms from the structures of sentences actually heard will tend to make the relation between the evidence available to the child, on the one hand, and the properties of the system grasped, on the other, so tenuous that we would expect the evidential gap to be closed largely by unlearned principles of grammar. A good working hypothesis would be that the shape of LF is the same for all languages (apart from the meaning of lexical items), and that is the hypothesis that I shall adopt here. (Higginbotham “Logical Form, Binding and Nominals”)

Scope

May (1977)

Ambiguity of “Everyone saw someone”:

i) [_S everyone₁ [_S someone₂ [_S t₁ saw t₂]]]]

ii) [_S someone₂ [_S everyone₁ [_S t₁ saw t₂]]]]

- Different scopes - by c-command
- Bind variables - traces (empty categories)

May (1985)

C-command → M-command

- QR as adjunction is not structure building; structure neutral
- *i)* and *ii)* represent “absolute” scope, not relative scope
 - Quantifier phrases mutually m-command
 - Disambiguation by recursive procedure of semantic quantifier clauses

Disambiguation

- May (1977): Syntactic - inference
- May (1985): Semantic - truth-conditions

... a picture of LF that might be expressed succinctly by saying that LF-representations instantiate the schemata of generalized quantification theory. May's QR is not only the sort of rule we should expect if this picture is approximately correct: it is virtually the only sort of rule available, or needed. (Higginbotham, "Logical Form, Binding and Nominals")

Antecedent Contained Deletion

Dulles suspected everyone, and Angleton did, too

- Dulles suspected everyone & Angleton *suspected everyone*
 - Ellipsis under syntactic identity

ACD: Dulles suspected everyone that Angleton did

- Dulles suspected everyone that Angleton *suspected everyone that Angleton did*
 - No definite, finite syntactic structure

QR: Everyone that Angleton did [Dulles suspected *t*] \implies
 Everyone that Angleton *suspected t* [Dulles suspected *t*]

Deep *theoretical* argument for the existence of LF-movement

Crossing Coreference

Every pilot who shot at it hit some Mig that chased him

- Asymmetry of scope *vs.* symmetry of binding
 - Scope ambiguity; pronouns are both bound regardless of scope

Higginbotham and May: Absorbed, binary quantifiers

Every x, Some y:

x a pilot who shot at y & y a Mig that chased x (x hit y)

Some y, Every x:

x a pilot who shot at y & y a Mig that chased x (x hit y)

May (1985): Absorption subsumed under m-command

- Complex quantifier phrases mutually m-command, allowing for crossed binding

Syntax and Semantics

What we are suggesting is that the notion of “understanding a sentence” will be explained in part in terms of the notion of “linguistic level.” To understand a sentence, then, it is first necessary to reconstruct its analysis on each linguistic level; and we can test the adequacy of a given set of abstract linguistic levels by asking whether or not grammars formulated in terms of these levels enable us to provide a satisfactory analysis of the notion of “understanding.” (*Syntactic Structures*, 87)

Linguistic theory has no “outputs” - formal syntactic objects - that are “inputs” to semantic theory

Syntax is part of linguistic theory - part of the theory defining what a language is

- Mode of representation is to be understood within that context.
 - Syntactic representations are of derivations
 - May involve covert movement but not necessarily to provide objects of interpretation

Linguistic Theory and Semantic Theory

Semantic Theory is distinct from Linguistic Theory

- Question is what sentences mean (*not* what is a sentence)
- Modes of representation appropriate to that context

Within Semantic Theory, notion of sentence is primitive

- No explanation of what sentences are, only explication of their role in the theory
- The explication may be justified by Linguistic Theory (locus of explanation)
 - That sentences have certain syntactic properties

Semantic Theory informationally dependent on linguistic theory

- Aspects of their formal structure as this is pertinent to their interpretation

Theory of Language

Theory of Language:

{Linguistic Theory; Semantic Theory, Psycholinguistic Theory ...}

- Theories are independent
 - each has their own defining questions and methods of research
- What is primitively presupposed may be explicated and justified by explanations within other theories
- Theories may be informationally dependent
 - more labile relations of explanation
- Loose, not tight, interface

Acknowledgments