

15

FORMAL SYNTAX

Andrew Carnie

Introduction

The formal syntactic approach to English grammar (indeed to the study of all languages) involves the algebraic modelling of patterns of sentence structure as revealed by scientific investigation. These investigations involve data both from actual language use and from native speaker judgments of sentential well-formedness. To take a trivially simple example, observe the existence of subsentential units of structure. A declarative English sentence minimally can consist of a noun and a verb as in Example 15.1a. The noun takes the grammatical function of the subject and the verb the predicate. However, we are also allowed to have more complex units in the subject position (Example 15.1b–f). Similarly, we can have more complex items functioning as the predicates as in (Example 15.1g–i). The kinds of items that function as subjects, noun phrases (NPs), can also function as the direct objects in the complex predicates.

These subsentential patterns can be captured mathematically. For example, the whole declarative sentence, represented by the symbol S in the formulas below, minimally consists of something we might call an NP and verb phrase (VP) (Example 15.2a), corresponding to the subject and predicate respectively. The NP minimally consists of a noun (N), but can also include an article (Art), adjectives (Adj), prepositional phrases (PP), and

Example 15.1

- a *Gaius* danced.
- b *The consul* danced.
- c *The consul from Pompeii* danced.
- d *The consul who Caesar despised* danced.
- e *The fat consul from Pompeii who Caesar despised* danced.
- f *Gaius hated the consul.*
- g *Gaius hated the consul with all his soul.*
- h *Gaius always hated the consul with all his soul.*

Example 15.2¹

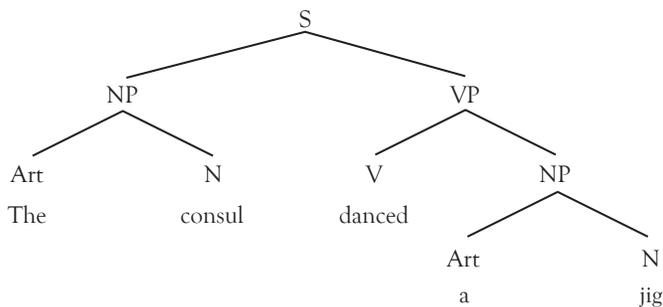
- a $S \rightarrow NP VP$
- b $NP \rightarrow (Art) (Adj) N (S) (PP)$
- c $VP \rightarrow (Adv) V (NP) (PP)$

relative clauses (Example 15.2b). The VP can consist of a simple verb (V), but can also include adverbs (Adv), PPs, subordinate clauses, and object NPs (Example 15.2c). The arrow in the statements in Example 15.2 can be interpreted as “consists of”. The parentheses indicate that the modifier is optional. These descriptions allow us to accurately describe the component parts of a sentence.

These descriptions, also called phrase structure rules, permit the creation of an abstract geometric representation of the structure of the sentence, called a phrase marker or tree. The tree for the sentence “The consul danced a jig” is seen in Example 15.3, which can be generated by the rules in Example 15.2.

Trees capture a basic notion in syntactic theory: some groups of words behave like units and other do not. In Example 15.3, “the” and “consul” are adjacent and they are also both parts of the NP. “Consul” and “dances” are also adjacent, but do not belong to the same phrase; the N is part of the NP and the V is part of the VP. This means that we predict that different pairs of adjacent words will, in fact, behave differently from one another dependent upon what part of the syntactic structure they appear in. This is empirically well founded. We can take the sequence “the consul” and move it to the left (Example 15.4a). We can produce it as the response to a question (Example 15.5a) and we can turn it into a pronoun (Example 15.6a). However, we cannot do any of these things to the sequence “consul danced” (Examples 15.4b, 15.5b and 15.6b).

In Examples 15.4, 15.5 and 15.6, the acceptability of the part a sentences, and the unacceptability of the part b sentences, demonstrates that the tree in Example 15.3

Example 15.3

Example 15.4

- a It was *the consul* that danced a jig.
 b *²It was *consul danced* that the a jig.

Example 15.5

- a Q: Who danced a jig? A: The consul.
 b Q: *Who/what the a jig? A: *Consul danced.

Example 15.6

- a He danced a jig.
 b *The he/did a jig.

correctly groups words together. This geometric/algebraic system means that patterns of observed word order can be characterized in this highly formal way.

This chapter outlines some of the major themes and contributions of the formal syntactic approach to English studies. After a brief note on the origins of the formal study of English syntax, I focus on two particularly important results of the study of formal syntax: first, the observation that various syntactic and semantic patterns of grammar are dependent upon the kinds of geometric structures that can be constructed by rules like those in Example 15.2 and, second, the observation that these geometric structures are built in stages from the most embedded structure to the least.

Historical perspectives

Although observations about syntactic structure date back to the ancients, most approaches before the 1950s focused on the function (typically semantic or communicative function) of linguistic utterances rather than their form. For example, such approaches often view the difference in function between an agent/subject and an object/theme as being the primary determinant of syntactic structure. Formalist perspectives, by contrast, focus on the structural similarities between these items (i.e. they are typically both NPs).

Formalism – the name of which has a double meaning, referring both to the emphasis on form (i.e. structure) over function and to algebraic formalization – is a descendant of the American structuralist movement of the early twentieth century. Linguists working in the early structuralist tradition focused primarily on phonology and morphology, with very little attention paid to syntactic patterns. It was not until Zellig Harris and

his student Noam Chomsky started working on the issue that real progress was made. Chomsky's (1957) book *Syntactic Structures* made the breakthrough observation that syntactic forms often show relatedness to one another in systematic ways. For example, he noted that constituent questions, also known as wh-questions, show a predictable relationship with declarative clauses. Therefore, in Example 15.7b, the initial phrase "which guy" corresponds semantically to the noun "this guy" in Example 15.7a, and the position occupied by "this guy" in Example 15.7a is systematically empty in sentences such as Example 15.7b. Similarly, the tense inflection that appears on the main verb "ordered" in Example 15.7a systematically shows up in the inverted auxiliary "did" in questions such as Example 15.7b.

Chomsky proposes that these two sentences are related via a series of structure-changing rules called transformations. In the transformational grammar approach (Chomsky 1957, Chomsky 1965), one structure, the deep structure, is built using structure-building rules similar to those in Example 15.2, and those structures are modified by transformations into surface structures, which we hear.

Chomsky (1965) introduced the idea that transformation grammar is essentially a cognitive system. The grammar represents more than a simple description of sentences, and is, in fact, a model of the linguistic engine in the mind. Taking it a step further, he claims that the bones of this system (although not the precise implementation for any given language) are innate. Evidence for this claim comes from certain universal patterns in language, parallel development of language skills among children independent of culture, and the relatively small amount of input data that children have to work with when learning their language. The innateness claim is by no means universally accepted, but the idea that linguistic grammars represent cognitive models is widespread. With the claim that parts of the syntactic system are innate comes the issue of cross-linguistic variation. If syntactic systems are innate, how is it possible that we have such divergent systems as the relatively strict word order of English and the relatively free word orders of languages such as Latin or Australian aboriginal languages? The claim of modern Chomskyan grammar is that the underlying system of language structure is innate, but particular implementation is not. All humans are born with a set of preset options that languages can use. As children are exposed to their maternal language(s), they choose among these preset options. For example, it has been proposed (Travis 1984) that languages differ systematically in whether the object precedes the verb (as in Japanese) or follows it (as in English). Children listen for this detail and then choose the appropriate option. Critically, there are logically possible options that appear to be never used. For example, there are no languages that put objects before both subjects and the verb.³ English plays a critical role in this kind of empirical inquiry. Until the late 1980s, the

Example 15.7

- a Caesar ordered Antonius to arrest **this guy**.
- b **Which guy** did Caesar order Antonius to arrest _____?

majority of work in Chomskyan linguistics had been about English, with some small ventures into German, French, Italian, and Spanish. Thus, the theoretical proposals about human language have been largely shaped by the structure of English – if for no other reason than the fact that the majority of generative syntacticians are native English speakers. On one hand, this has resulted in a nuanced and sophisticated understanding of English syntax; on the other, it has resulted in the critique that the theory is Anglocentric. The challenge now for generative grammarians is two-fold. They have to, first, separate out what parts of theory are English specific and what are really universal and, second, establish the limits of possible variation among languages. (For an accessible attempt at the latter see Baker 2002.)

A critical issue in the late 1960s and early 1970s was over the relationship between syntactic structure and the semantics of expressions. Two major approaches emerged: generative semantics proposed that meaning equated to the deep structures, and interpretive semantics claimed that meaning was read off the surface structure. The two perspectives were distinguished by whether or not transformational approaches affected the meaning of sentences. For example, in the theory of the day, passives were derived from actives via a transformational rule. If meanings were established at the deep structure, then transformational processes should never affect the meaning of the expression. Partee (1971) observed that this is not true. Take the classic sentences in Example 15.8 as examples.

Example 15.8a is ambiguous: it could mean either that the manuscript was well written and contained few mistakes or that the editor was not very good at his job or was not paying attention. Example 15.8b, however, only has the second meaning. It can only be interpreted as a situation in which the editor did not do a good job and many mistakes were missed. If meanings are established at the deep structure, then the passive transformation should not limit the meanings in this way. The debate over where meaning was located was acrimonious and divisive in the field. Indeed the time is often referred to as the “Linguistics Wars.” (For a dramatic retelling of the issues and the personalities, see Harris 1995.)

Perhaps the greatest outcome of this theoretical conflict was the emergence of lexicalism. This is the idea that sentence structure manipulates words as atomic units, and nothing smaller. This contrasted with the generative semantics view that syntactic transformations could change the shapes of words. The classic arguments for lexicalism come from Chomsky’s (1970) discussion of the syntactic opacity of nominalizations of verbs, which he claims do not show the properties we expect of syntactic construction. Most practitioners of generative semantics eventually switched into more functionalist approaches. Interestingly, however, many of the insights of generative semantics have become popular again with the development of the theory of distributed morphology

Example 15.8

- | | | |
|---|--|----------------|
| a | The editor didn’t find many mistakes. | <i>active</i> |
| b | Many mistakes weren’t found by the editor. | <i>passive</i> |

(Halle and Marantz 1993). Chomsky's alternative to generative semantics, called interpretive semantics, gave rise to three major theoretical approaches: government and binding theory, also known as principles and parameters theory (Chomsky 1981), and its descendant the minimalist programme (Chomsky 1995), lexical-functional grammar (LFG) (Bresnan and Kaplan 1982), and generalized phrase structure grammar (GPSG) (Gazdar et al. 1985), which eventually developed into head-driven phrase structure grammar (HPSG) (Pollard and Sag 1994).

Within principles and parameters theory, two major trends emerged through the late 1970s, 1980s and early 1990s. The first was a move away from rules that apply to specific constructions. Therefore, instead of having a rule that creates passives from actives, and another that moves *wh*-question phrases to the beginning of the sentence, later approaches suggest that there is a single process of constituent movement, called *move- α* , which is triggered in a variety of environments, typically associated with particular lexical items. This emphasis goes back to the foundations of lexicalism. The trend towards non-construction-specific rules has recently been bucked by sign-based construction grammar (Sag et al. 2003).⁴ This approach holds that constructions (passives, double objects, questions, etc.) – rather than general rules – are the basic building blocks of sentence structure.

The other major trend was the concentration on limiting the computational power of the rule systems. Take the phrase structure rules in Example 15.2 as examples. In principle, anything could appear in such a rule. There are no obvious constraints on what the components of the rule could be. Chomsky (1970) argued that structure-building rules could be constrained so that they obligatorily contain a head word (i.e. the noun is the head of the NP, a verb is the head of the VP, etc.) and that modifiers are grouped by type (complements, adjuncts, and specifiers). This is encoded in *X-bar theory* (see also Jackendoff 1977), which is common to all three of the major formalist theories of the time (principles and parameters, LFG, and HPSG).

The two trends of focusing on constraints on forms and on making grammatical processes simpler go hand in hand and have led practitioners of principles and parameters towards a programmatic goal of reducing the complexity and quantity of theoretical machinery at work in the algebraic system. This approach has come to be known as the minimalist programme (Chomsky 1995). In the minimalist approach to formal syntax, it has been suggested that there is really only one operation, called *merge*. Merge takes two objects and combines them together into a phrase. The challenge in making such a simple process work is to correctly characterize the conditions to which the process applies and those to which it does not. Another goal of the minimalist programme is to develop external explanations for these patterns. The explanations might be genetic, they might be cultural and language specific, or they might even fall out from general mathematical principles of organization (Chomsky 2005).

Formalist approaches to syntax – in particular Chomskyan views – have been strongly critiqued by linguists in the functionalist tradition. These scholars believe the best approach to discovering the nature of language is to examine its use or function, rather than focusing on form (see, for example, Halliday 2003, Kuno 1987, Langacker 1987, among many others). For example, rather than characterizing a passive in terms of its

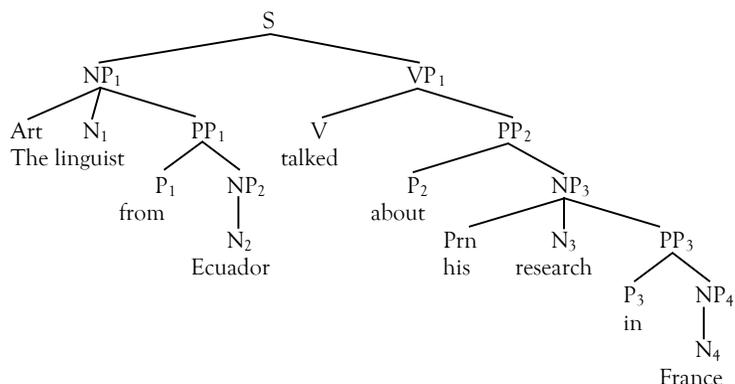
composite pieces (i.e. a *be* auxiliary, a notional object in subject position, and a past participle), functionalists believe one should focus on the fact that it highlights the object and backgrounds the subject by reordering them as part of a larger pattern in which topical information appears earlier in the clause than less important material. Emerging work on syntax, however, often takes the position that this dichotomy in approach is a false one. Most functionalists make use of formal means of representation and most formalists make at least some reference to meaning and communicative function when formulating their hypotheses. Indeed, recent work on the minimalist approach to syntax focuses on explaining linguistic phenomena in terms of biology, physics, and other non-linguistic systems. (For a discussion of the debate between functionalists and formalists, and a discussion of how much in common these approaches really have, see Carnie and Mendoza-Denton 2003.)

Critical issues and current contributions

Rather than trying to summarize the entire empirical and theoretical enterprise in a few thousand words, which is a truly impossible task, instead, I will give some examples of how two results of the formal syntactic approach provide an explanatory account of a variety of phenomena in English grammar. These two theoretical constructs are structure dependence and the cyclic nature of structure building.

Structure dependence

Structure dependence is the idea that rules and constraints on syntactic form are best defined over hierarchical structures such as the one in Example 15.3 rather than over linear strings of adjacent words. We might expect linear order to be the primary, as there is little⁵ in a string of spoken or written words to establish these hierarchical relations. Instead grammatical principles appear to be defined over the invisible structure. The intuition behind structure dependence dates to Chomsky (1957), but we will concentrate on one particular instantiation of it proposed in Reinhart (1976), called *c-command*. *C-command* is a geometric relation among points in the tree. In order to define *c-command*, I need first to define a couple of other relations that hold over trees. Consider the tree in Example 15.9. Labels that appear more than once are marked with subscript numbers in order to distinguish them from one another. Take the relationship between the NP₁ node and the categories that are in it. This relation is known as domination and essentially amounts to containment: NP₁ contains Art, N₁, PP₁, P₁, and the lower NP₂ and N₂, so it dominates them. Another way to think about this is that some node in a tree dominates another if you can trace a continuous line going down the tree. Immediate domination, when there is only one line between the two nodes, is a more local relation. Thus NP₁ immediately dominates Art, N₁, and PP₁, but not P₁, NP₂, or N₂. We can informally refer to some of these relationships using genealogical terminology. Immediate domination is like motherhood. NP₁ is the mother of Art, N₁, and PP₁. Art, N₁, and PP₁ are sisters to one another. We now are in a position to define *c-command*. *C-command* is essentially the combined relationship of sisterhood with aunthood (Carnie 2010). One

Example 15.9

node in the tree *c*-commands all the nodes that either are its sisters or are dominated by its sisters (i.e. its nieces). More formally, it is defined such that a node (A) *c*-commands all the nodes that are dominated by the node immediately dominating A, excluding A itself and its daughters. Therefore in Example 15.9, NP₁ *c*-commands the VP₁ and all the nodes dominated by the VP, but N₁ does not *c*-command VP₁. It only *c*-commands the Art, PP₁, P₁, NP₂, and N₂.

This extremely abstract relationship, definable only over hierarchical structure, seems to play a critical role in the grammatical constraints and rules discovered by formal syntactic theory. There are numerous examples of this. Let's start with the relationship between negation and certain idiomatic phrases, such as "a red cent". These items are called negative polarity items. They must appear in the same clause as a negator (compare Example 15.10a to Example 15.10b). More critically, that negator must *c*-command the negative polarity item. The negative modifier of the VP in Example 15.10c, as such, does not *c*-command the negative polarity item, which is embedded inside the subject (May 1985).

Similar restrictions hold over the distribution of anaphoric elements such as "himself" and "each other". These elements take their reference from other NPs in the sentence. Therefore, in Example 15.11a, the word "himself" obligatorily refers to Caesar and no one else. We indicate this co-reference with the subscripted index "i" on each of the items with the same reference. Mismatch, indicated by the pair of indices "i" and "k", results in

Example 15.10

- a I didn't have a red cent.
- b *I had a red cent.
- c *The man with a red cent wasn't happy.

Example 15.11

- a Caesar_i admires himself_i.
 b *Caesar_i admires himself_k.

Example 15.12

- a *Caesar_i admires him_i.
 b Caesar_i admires him_k.

Example 15.13

- a *The woman with Caesar_i admires himself_i.
 b The woman with Caesar_i admires him_i.

an unacceptable interpretation (Example 15.11b). Regular pronouns, by contrast, have the opposite property: they typically cannot be co-referent with clausemate NPs (Example 15.12).

However, the sentences in Example 15.13 show that c-command is also at work here. In Example 15.13a, the indexed NP cannot act as an antecedent for the anaphor but *can* be co-referential with a pronoun (Example 15.13b), which is exactly the opposite of the behaviour seen in Examples 15.11 and 15.12.

The cycle

A second important result of formalist theorizing is the idea that syntactic structures are either built or managed in small groups of phrases, typically corresponding to the clause or NP level. These groups are built from the most embedded structure to the least. The idea here dates back to Chomsky's (1957) notion of a "kernel", but found its most important voice in the 1960s and 1970s in what has come to be known as the "strict cycle" (Chomsky 1973). The idea briefly went out of favour in the government and binding era, but has resurfaced in recent work, renamed as the "phase" (not to be confused with "phrase") (Chomsky 2000). The intuition behind the cycle is that one builds a certain amount of hierarchical structure (typically, a whole clause or NP) and, once that structure has been built and undergone transformations, it is no longer available for further computational operations in the sentence.

The evidence for this claim comes from limitations on what otherwise appear to be long-distance relationships. Take, for example, the sentence in Example 15.14. Here a

wh-phrase, “what”, appears to be associated with a missing element several clauses down the sentence, creating a long-distance relationship between the gap and the wh-element. Ross (1967) showed numerous cases in which such long-distance relationships are blocked. For example, if we change “Laura” into another wh-phrase, such as “who”, the sentence becomes bizarre (Example 15.14b).

Ross called restrictions such as the one seen in Example 15.14b “island effects”, where an island is some kind of structure across which you cannot create a long-distance relationship. The approach to such examples in terms of the strict cycle suggests that the apparent long-distance relationship between the wh-phrase and the gap in Example 15.14a is not really a single relationship, but rather a sequence of shorter connections, each bounded by the clause level. Thus sentence Example 15.14a really consists of the sequence of steps shown in Example 15.15. Ignore the fact that some of the intermediate steps are ungrammatical sentences of English – what is important is that the final string be acceptable.

The line in Example 15.15a represents, essentially, the deep structure of the sentence. Example 15.15b shows the movement of the wh-phrase to the beginning of the most embedded clause. In Example 15.15c we cyclically add S₁ as the complement to the verb “bribe” giving us the clause S₂. The wh-phrase, which is at the left edge of S₁, is visible for movement to the front of S₁, giving Example 15.15d. We repeat this process in Examples 15.15e and 15.15f, giving the surface form.

With this cyclic view in mind, the explanation for the island effect in Example 15.14b is straightforward: English only ever allows one wh-phrase at the beginning of a sentence. Therefore, at stage Examples 15.16c there is no room to move the wh-word again. At this level, then, the wh-movement is blocked, explaining why Example 15.14b is ungrammatical. Even though we could add another clause on top of S₂, the material in S₁ including the wh-phrase “what” is rendered unavailable to this higher clause by the strict cycle.

The effect of the cycle is seen in other domains as well. Recall the discussion above

Example 15.14

- a What did Jeff ask *Laura* to bribe the guard to do _____?
 b *What did Jeff ask *who* to bribe the guard to do _____?

Example 15.15

- a [_{S₁} The guard did what.]
 b [_{S₁} what did the guard do?]
 c [_{S₂} Laura bribed [_{S₁} what the guard to do.]]
 d [_{S₂} what (did) Laura bribe [_{S₁} the guard to do?]]
 e [_{S₃} Jeff asked [_{S₂} what Laura bribed [_{S₁} the guard to do?]]]
 f [_{S₃} what Jeff asked [_{S₂} Laura bribed [_{S₁} the guard to do?]]]

Example 15.16

- a [s₁ The guard did what.]
- b [s₁ what did the guard do?]
- c [s₂ *who* bribed [s₁ what the guard to do.]]

Example 15.17

*Louise_i said that Bill loves herself_i.

about anaphoric pronouns. Not only must they be *c*-commanded by the NP they receive their reference from, that antecedent must be a clausemate,⁶ as shown in Example 15.17 (Langacker 1969).

This clausemate condition follows directly if anaphors are viewed as finding their *c*-commanding antecedent within the cycle. In Example 15.17, the anaphor “herself” must find an antecedent at the time when the sentence consists only of the embedded clause “Bill loves herself” and before “Louise” is added into the structure. As no antecedent can be found in such a cycle, the sentence is rendered uninterpretable, even though a potential antecedent can be added at a later stage.

Again, what we have with the cycle is a condition that holds over an abstract algebraically defined hierarchical structure, which is not obvious when looking at the surface string of words. Such a result can best be derived if we allow a formal description of sentence structure.

Future directions

By giving a few examples of the kinds of structural conditions (such as *c*-command and cyclicity) that English seems to observe, I hope to have illuminated the kinds of insights that the abstract algebraic approach of formal syntax brings to the table in explaining the grammatical properties of English and other languages. Of course, I have barely scratched the surface of the empirical richness and theoretical complexity of the discipline, but I hope that I have at least hinted at the directions for further work, and the kinds of results formal syntax can bring to the interdisciplinary field of English studies.

Notes

- 1 Before proceeding, it is worth observing that the rules in Example 15.2 are by no means complete descriptions of the structures involved. Indeed, it will not take a native speaker of English more than a few seconds to find sentences that cannot be described using these statements, and to identify ungrammatical forms that could be described using the rules in Example 15.2. Indeed 60 years of study have shown that the rules in Example 15.2 could be construed only as a gross oversimplification.

I present these statements here merely to illustrate what I mean by an algebraic characterization of the structure of English sentences, even though these particular example rules are incomplete for explanatory purposes.

- 2 An asterisk marks a sentence that is unacceptable to a native speaker of English.
- 3 There is one exception to this claim: the language Hixkaryana might have OVS order (Derbyshire 1985). (For a discussion of this putative exception, see Dryer 2007.)
- 4 There are also a number of functionalist construction-based approaches (see Croft 2001, Goldberg 1995).
- 5 Except of course relatively shallow cues such as prosodic intonation or punctuation, which hint at hierarchical structure but underdetermine it.
- 6 There are exceptions to this generalization, which turn out to have systematic explanations following from what is known as the control theory (for discussion, see Landau 2000).

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Further reading

- Baltin, M. and Collins, C. (2003) *The Handbook of Contemporary Syntactic Theory*, Oxford: Wiley-Blackwell.
This book contains a number of accessible chapters on major subfields in formal syntactic theorizing.
- Carnie, A. (2013) *Syntax: A Generative Introduction*, 3rd edn, Oxford: Wiley-Blackwell.
This textbook provides a step-by-step introduction to the major ideas in Chomskyan syntactic theory.
- Carnie, A. (2011) *Modern Syntax: A Coursebook*, Cambridge: Cambridge University Press.
This textbook takes a non-traditional approach to syntactic theory, blending Chomskyan minimalism with major ideas from head-driven phrase structure grammar and lexical-functional grammar.