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Tests for constituents: What they really reveal about the nature of syntactic structure

Timothy Osborne[a]

[a] Department of Linguistics, Zhejiang University, tjo3ya@yahoo.com.

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Abstract. Syntax is a central subfield within linguistics and is important for the study of natural languages, since they all have syntax. Theories of syntax can vary drastically, though. They tend to be based on one of two competing principles, on *dependency* or *phrase structure*. Surprisingly, the tests for constituents that are widely employed in syntax and linguistics research to demonstrate the manner in which words are grouped together forming higher units of syntactic structure (phrases and clauses) actually support dependency over phrase structure. The tests identify much less sentence structure than phrase structure syntax assumes. The reason this situation is surprising is that phrase structure has been dominant in research on syntax over the past 60 years. This article examines the issue in depth. Dozens of texts were surveyed to determine how tests for constituents are employed and understood. Most of the tests identify phrasal constituents only; they deliver little support for the existence of subphrasal strings as constituents. This situation is consistent with dependency structure, since for dependency, subphrasal strings are not constituents to begin with.

Keywords: phrase structure, phrase structure grammar, constituency tests, constituent, dependency grammar, tests for constituents

1. Dependency, phrase structure, and tests for constituents

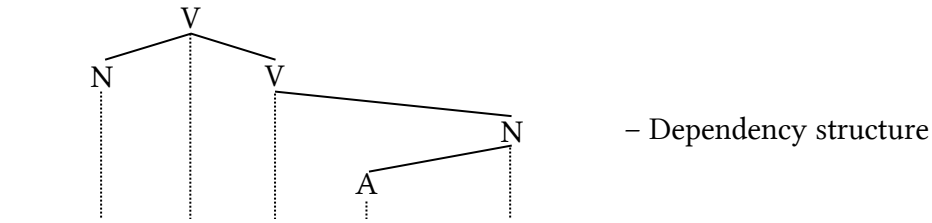
Syntax, a major subfield within linguistics, is of course central to all theories of language. How one approaches syntax can vary dramatically based upon starting assumptions, though. Theories of syntax based on *dependency* view syntactic structures much differently than theories based on *phrase structure*. One of these two broad possibilities, or perhaps a

combination of the two, necessarily serves as a starting point when one begins to develop a theory of natural language syntax, for the syntax community recognizes no third option. The message developed here is that dependency is a plausible principle upon which to build theories of syntax, and in light of the results from widely employed tests for constituents, dependency is in fact more suited than phrase structure to serve as the basis for constructing theories of syntax. This statement is controversial, since phrase structure has been dominant in the study of syntax over the past 60 years.

Grammars that assume dependency are known as *dependency grammars* (DGs), and grammars that assume phrase structure are known as *constituency* or *phrase structure grammars* (PSGs).[1] Phrase structure is familiar to most people who have studied grammar and syntax at the university level, since most university courses on syntax and linguistics take phrase structure for granted. Certainly, most linguistics and syntax textbooks written over the past 50 years assume phrase structure, often not even mentioning dependency as an alternative. The most prominent names in linguistics and syntax from the 20th century took phrase structure for granted, e.g. Bloomfield, Chomsky, etc. In contrast, dependency structure is associated most with the French linguist Lucien Tesnière (1893–1954), whose main oeuvre, *Éléments de syntaxe structurale,* appeared posthumously in 1959.

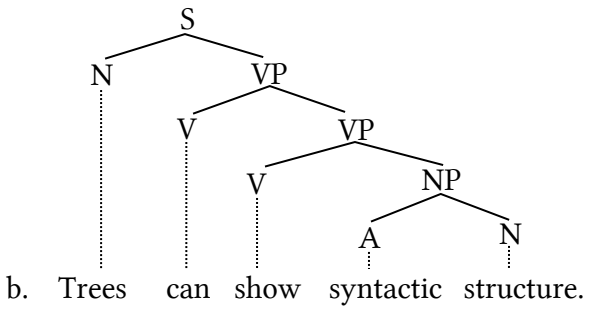
Dependency is both a simpler and more accurate principle upon which to build theories of syntax. A preliminary example is now given to illustrate the point. The example considers two competing analyses of a simple sentence, one analysis in terms of dependency and the other in terms of phrase structure. The validity of these two competing analyses is then evaluated further below by considering the results of three tests for constituents (topicalization, pseudoclefting, and answer fragments). The competing analyses are given next (A=adjective, N=noun, NP=noun phrase, S=sentence, V=verb, VP=verb phrase):

(1)



– Dependency structure

a.



– Phrase structure

b.

[1] The terms *constituency* and *phrase structure* are synonymous in the current context. The term *constituency* is, however, dispreferred in this article in order to avoid confusion associated with the constituent unit. Part of the message presented below is, namely, that dependency grammars and phrase structure grammars alike acknowledge constituents (= complete subtrees).

These trees show syntactic structure according to dependency structure (1a) and phrase structure (1b). Note that the dependency tree is minimal compared to the phrase structure tree, containing many fewer nodes (5 nodes in 1a vs. 9 nodes in 1b).

Standard tests for sentence structure verify aspects of these trees. The trees agree and the tests largely verify that certain words and strings of words should be granted the status of constituents (= complete subtrees). Taking topicalization, pseudoclefting, and answer fragments as example tests, they verify aspects of the two trees—an introduction to these three and the other 12 tests employed and discussed in this article is given in the Appendix. The three tests verify that the string *syntactic structure* is a constituent as shown in both trees:

(2) a. …and **syntactic structure**, trees can show. – Topicalization
b. What trees can show is **syntactic structure**. – Pseudoclefting
c. What can trees show? – **Syntactic structure**. – Answer fragment

They verify that the string *show syntactic structure* is a constituent as shown in both trees:

(3) a. …and **show syntactic structure**, trees can. – Topicalization
b. What trees can do is **show syntactic structure**. – Pseudoclefting
c. What can trees do? – **Show syntactic structure**. – Answer fragment

Two of the three tests verify that *trees* is a constituent as shown in both tree diagrams, whereas the third test, i.e. topicalization, is inapplicable:

(4) a. (Inapplicable) – Topicalization
b. What can show syntactic structure is **trees**. – Pseudoclefting
c. What shows syntactic structure? – **Trees**. – Answer fragment

One or two of the tests even suggest that *syntactic* should be a constituent as shown in both trees:

(5) a. *…and **syntactic**, trees can show structure. – Topicalization
b. The structure that trees can show is **syntactic**. – (Pseudoclefting)[2]
c. Which structure can trees show? **– Syntactic**. – Answer fragment

In sum, the results of these three tests support the analyses of constituent structure shown in (1a) and (1b) regarding the strings *syntactic structure*, *show syntactic structure*, and *trees*.

[2] Example (5b) is technically not an instance of pseudoclefting, but rather a sort of relativization. It has been adapted from the standard pseudoclefting format in order to support the status of the attributive adjective *syntactic* as a constituent. The actual pseudoclefting variant of the sentence is clearly bad: **What structure trees show is syntactic* / **What trees show structure is syntactic*. Since the two trees (1a) and (1b) agree about the status of *syntactic*, altering the pseudoclefting test somewhat to verify *syntactic* as a constituent is not a misrepresentation of the current debate (dependency vs. phrase structure).

Concerning *syntactic*, the results are less clear, but since the two analyses agree insofar as they both view *syntactic* as a constituent, the inconsistency concerning the results of topicalization (and pseudoclefting) on the one hand and answer fragments on the other is a secondary issue.

The primary issue for the analyses given as trees (1a) and (1b) concerns the points of disagreement. The phrase structure tree (1b) shows the strings *can*, *show*, *structure*, and *can show syntactic structure* as complete subtrees, whereas these strings are not given as complete subtrees in the dependency tree (1a). The three tests agree that these strings should not be granted the status of complete subtrees. The tests reveal that *can* should not be taken as a constituent:

(6) a. *…and **can** trees show syntactic structure. – Topicalization
(Unacceptable as a declarative statement)

b. *What trees show syntactic structure is **can**. – Pseudoclefting

c. *What about trees showing syntactic structure? – **Can**. – Answer fragment

The tests reveal that *show* should not be viewed as a constituent:

(7) a. *…and **show** trees can syntactic structure. – Topicalization

b. *What trees can do about syntactic structure is **show**. – Pseudoclefting

c. *What can trees do about syntactic structure? – **Show**. – Answer fragment

The tests reveal that *structure* should not be deemed a constituent:

(8) a. *…and **structure** trees can show syntactic. – Topicalization

b. *What trees can show syntactic is **structure**. – Pseudoclefting

c. *Syntactic what can trees show? – **Structure**. – Answer fragment

And the tests reveal that *can show syntactic structure* should not be construed as a constituent:

(9) a. *…and **can show syntactic structure**, trees.[3] – Topicalization

b. *What trees do is **can show syntactic structure**. – Pseudoclefting

c. What can trees do? – ***Can show syntactic structure**. – Answer fragment

[3] Concerning example (9a), an anonymous reviewer comments as follows:

> (9a) is odd because matrix VPs do not topicalize in English in general, only complement VPs can do that (e.g. *Win this war, you never will!* or *I can win this war, and win this war I shall* or *Fooled you, didn't I?*).

The reviewer's examples here support the point being developed, namely that nonfinite VPs (or complement VPs), which are constituents on both analyses (cf. *show syntactic structure* in 1a and 1b), are verified as such by topicalization. Topicalization delivers no evidence, however, for the status of finite VP as a constituent, e.g. **Will win this war, you never!*, **Shall win this war, I!*, **Didn't fooled you, I.*

Note that many of these examples are difficult to formulate in a way that is appropriate for testing the status of the indicated string, and this difficulty is already a signal that the string should not be viewed as a constituent.

The data just examined speak strongly in favor of the dependency tree (1a) over the phrase structure tree (1b). The dependency tree is congruent with the strings that the three tests reveal as constituents and nonconstituents, whereas the phrase structure tree is incongruent with the results concerning four of the strings. The problem facing phrase structure can be understood in terms of phrasal and subphrasal constituents. The exploration of this issue below demonstrates that the tests generally identify phrasal strings as constituents, whereas they often fail to identify subphrasal strings as constituents. This situation speaks in favor of dependency syntax, since the constituents that are taken to be subphrasal in phrase structure syntax are not complete subtrees in dependency syntax to begin with. The goal of this article is to develop this insight in detail by examining a wide variety of the tests for constituents that are commonly employed in linguistics, syntax, and grammar books and textbooks.

This article is organized as follows: Section 2 presents some background information on the dependency vs. phrase structure distinction. Section 3 lists texts that employ tests for constituents, documenting the extensive use of these tests. Section 4 repeats the main message established above with examples (1–9), but it does so more extensively. Section 5 examines the inconsistency between what phrase structure grammars predict concerning constituent structure and what most tests for constituents actually reveal. Section 6 considers the reasons why phrase structure grammars have not acknowledged and probed the lack of evidence for the existence of subphrasal strings as constituents. Section 7 scrutinizes three widely employed tests for constituents that do in fact seem to support the existence of subphrasal strings as constituents. Section 8 provides some brief comments about the use and importance of the tests for languages other than English. Section 9 gives a concluding statement.[4]

2. Dependency vs. phrase structure

Dependency syntax has a rich tradition (e.g. Kern 1883; Tesnière 1959/2015; Hays 1964; Robinson 1970; Matthews 1981; Mel'čuk and Pertsov 1987; Mel'čuk 1988; Schubert 1987; Starosta 1988; Engel 1994; Heringer 1996; Bröker 1999; Groß 1999; Eroms 2000; Ágel et al. 2003; Hudson 1984; 1990, 2007, 2010). It has, however, been on the periphery of developments in syntactic theory over the past 60 years. Many readers may therefore be unfamiliar with its basic tenets. For this reason, some background information on the distinction between dependency and phrase structure is due.

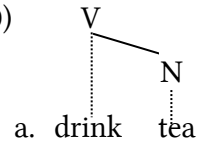
Various criteria have been used to characterize the difference between dependency and phrase structure, e.g. the ratio of words to nodes, the (non)necessity to acknowledge heads,

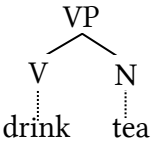
[4] The subject discussed in this article appears as a tangential issue and in much abbreviated form in three earlier journal articles (Osborne 2005: 254–8, 2006: 53–8, 2008: 1126–32), and it is presented more extensively in recent conference proceedings (Osborne 2015). The current article develops the subject much more rigorously than these previous works.

the (non)contiguity of related syntactic units.[5] My stance is that the first of these, i.e. the word-to-node ratio, is the most principled. Many grammarians take a strict one-to-one mapping of atomic units of syntax (e.g. words) to nodes as a trait of dependency syntax (e.g. Mel'čuk 1979: 96; Mel'čuk and Pertsov 1987: 48, 57–8; Schubert 1987: 78–86, 129; Engel 1994: 25, 28; Kahane 1996: 45; Bröker 2003: 297; Hudson 2003: 520, 2007: 183; Carnie 2010: 177). Phrase structure grammars, in contrast, have the number of nodes in the syntactic structure outnumbering the number of atomic units by at least one. The distinction is immediately visible in simple tree structures like (1a–b) above and (10–12) here:

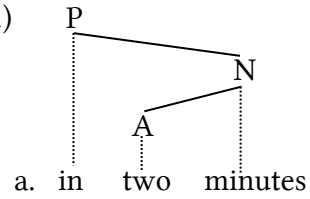
Dependency structure **Phrase structure**

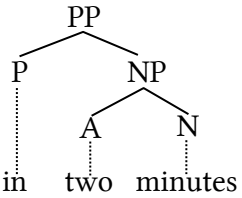
(10)



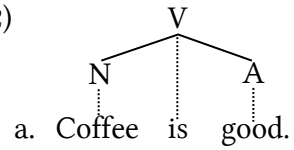


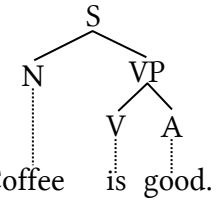
(11)





(12)





The dependency structures on the left adhere to strict one-to-one mapping; each word maps to one node in the structure and vice versa. In contrast, the phrase structures on the right have the number of nodes in the structure outnumbering the number of words by at least one. This is due to the presence of the purely phrasal nodes VP and PP, as well as of the S node.

Observe that both means of conceiving of syntactic structure view the words as organized hierarchically. The dependency structures acknowledge a hierarchy of words by linking words to each other directly, whereas the phrase structures posit the existence of purely phrasal nodes that mediate between the terminal nodes that correspond directly to words. In this respect, dependency is characterized as a strict *parent-child relation*, whereas phrase structure is taken to be a *part-whole relation*. Observe also that both approaches to syntactic structure, dependency and phrase structure, can acknowledge constituents. Given a dependency or phrase structure tree, a constituent is *any node/word plus all the nodes/words that that node/word dominates*. Numerous phrase structure grammarians have put forth this sort of definition of the constituent unit (see Table 4 below), and some dependency grammarians have also acknowledged that such a definition of the constituent unit is possible

[5] A node is understood here as an indicator in the syntactic structure that shows a distinct grouping of atomic units (e.g. words). If two or more vertices in a syntax tree mark the same grouping of words, then they together qualify as a single node. This technical point is intended to preempt objections that could be leveled at the current characterization of dependency in terms of one-to-one mapping.

in dependency syntax (e.g. Hudson 1984: 92; Starosta 1988: 105; Hellwig 2003: 603; Anderson 2011: 92).[6]

The parent-child relation of dependency and the part-whole relation of phrase structure are also visible when brackets are used to indicate the presence of syntactic groupings:[7]

	Dependency structure	**Phrase structure**
(13)	a. [drink [tea]]	b. [[drink] [tea]]
(14)	a. [in [[two] minutes]]	b. [[in] [[two] [minutes]]]
(15)	a. [[Coffee] is [good]].	b. [[Coffee] [[is] [good]]].

The brackets in these trees are used consistently: words appearing lower in the structure appear inside more sets of brackets. An advantage that dependency has over phrase structure is visible in these cases. The brackets showing dependency structure on the left identify heads and dependents: heads appear enclosed in fewer brackets than their dependents. The phrase structures on the right, in contrast, do not identify heads and dependents. For instance, in (13b) one cannot see whether *drink* or *tea* should be construed as the head of the phrase *drink tea* because both are enclosed in the same number of brackets. In order to identify heads, node labels are needed, e.g. *[$_{VP}$ [$_{V}$ drink] [$_{N}$ tea]]*.

Another convention used for showing hierarchical structure is arrows of the following sort:

	Dependency structure	**Phrase structure**
(16)	a. drink tea	b. drink tea
(17)	a. in two minutes	b. in two minutes
(18)	a. Coffee is good.	b. Coffee is good.

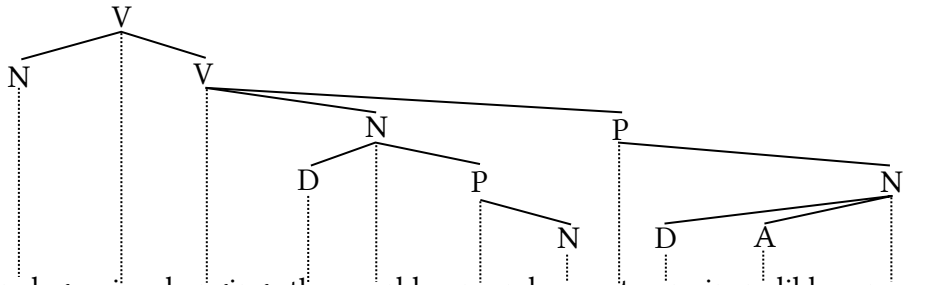
This convention is frequently used for showing dependency structure; the arrows point from heads to their dependents. The structures on the right demonstrate that the convention is also capable of indicating phrase structure, the arrows again pointing from heads to their dependents, whereby a dependent can be an individual word or a grouping of words.

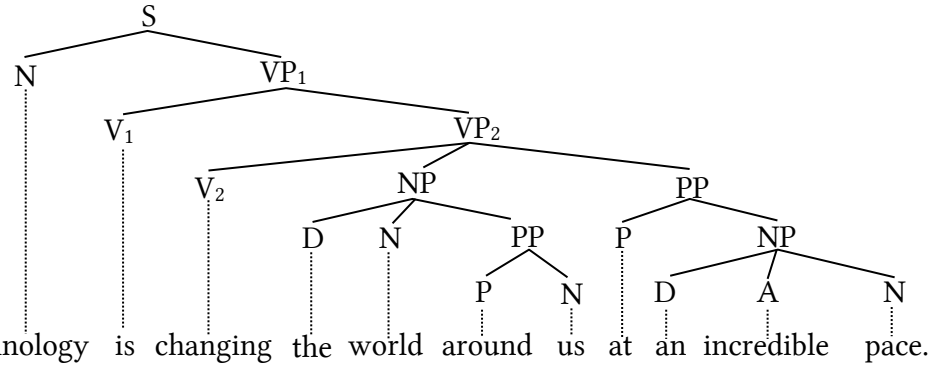
The examples produced so far illustrate some important differences between dependency structures and phrase structures. Above all, dependency structures are minimal compared to the phrase structure counterparts. This minimalism is a result of the strict one-to-one mapping of words to nodes that characterizes dependency. To emphasize this point, the dependency and phrase structures of a longer sentence are now given:

[6] Hays (1960: 261, 1964: 520) and Kunze (1975: 13) acknowledge complete subtrees in dependency syntax (called *vollständige Teilbäume* in German), whereby their understanding of the complete subtree matches the definition of the constituent just produced.

[7] The standard convention for using brackets to mark the constituents of phrase structure grammars omits the brackets around the individual words, e.g. *[in [two minutes]]*, since words are always constituents by default. This convention of abbreviations runs into difficulties when the desire is to clearly identify heads and dependents throughout the entire structure.

(19)





While one can debate the validity of these hierarchies, the minimalism of the dependency structure in (19a) is obvious compared to the phrase structure in (19b). Tree (19a) contains 11 nodes, one for each of the 11 words present. The phrase structure tree in (19b), in contrast, contains 18 nodes, 7 more than the number of words.

Proponents of phrase structure might object at this point. Minimalism of theoretical apparatus is of course of no benefit if this minimalism is incapable of shedding light on the phenomena under scrutiny, for complexity of theoretical apparatus may be necessary in order to address complex phenomena. The proponents of dependency syntax must concede this objection in general. In the specific area explored in this article, however, dependency syntax need concede nothing, since as suggested above with examples (1–9) and as established in much detail below, the minimal dependency structures are in fact more in line with what most tests for sentence structure actually reveal about the nature of syntactic structure in English. This point is the main message developed and presented in this article.

To conclude this discussion of the distinction between dependency and phrase structure, some clarification is necessary concerning the term *phrase structure grammar*. This term is being used here in a broad sense, to denote those grammars that are clearly not dependency grammars. In this respect, all of the following grammar frameworks are phrase structure grammars:

Phrase structure grammars
Transformational Grammar (TG),
Government and Binding Theory (GB),
Minimalist Program (MP),
Generalized Phrase Structure Grammar (GPSG),
Head-Driven Phrase Structure Grammar (HPSG),
Categorial Grammar (CG),
Lexical Functional Grammar (LFG).

Some prominent dependency grammars are:

Dependency grammars
Meaning-Text Theory (MTT),
Word Grammar (WG),
Lexicase,
Functional Generative Description (FGD).

Important in this area is that some linguists (e.g. Borsley 1991: 8–9) use the term *phrase structure grammar* more narrowly to denote the non-transformational grammars based on rewrite rules (mainly GPSG and HPSG). On this understanding, phrase structure grammars stand in contrast to transformational grammars (e.g. TG, GB, and MP). The debate about transformational (≈ derivational) vs. non-transformational (≈ nonderivational) syntax is not directly relevant to the message presented in this article and can hence be sidestepped.

3. Texts surveyed and overview of tests

To get a sense of how widely employed tests for constituents actually are and thus how important they are for constructing theories of syntax, several dozen linguistics, syntax, and grammar books have been surveyed. These texts are listed here in chronological order of publication:

Texts surveyed

Keyser and Postal 1976: 29–41; Baker 1978: 261–68, 327–40, 413–25; Allerton 1979: 109–32; Brown and Miller 1980: 21–49; Matthews 1981, Radford 1981: 34–117, Aarts and Aarts 1982: 7–14, 56–8, 60–78, 88, 97–8, Atkinson et al. 1982: 170–4, Mel'čuk and Pertsov 1987, Radford 1988: 69–108, Baker 1989, Akmajian et al. 1990: 149–53, Borsley 1991: 23–31, Haegeman1991: 25–28, 79–82, 88–9, Cowper 1992: 19–47, Thomas 1993: 9–34, Napoli 1993: 148, 159–61, 164–9, 417–25, Ouhalla 1994: 14–21, Radford 1997: 102–17, Burton–Roberts 1997: 7–29, McCawley 1998: 55–84, Haegeman and Guéron 1999: 45–53, 68–72, Fromkin 2000: 146–62, Lasnik 2000: 9–11; Lobeck 2000: 47–77; Börjars and Burridge 2001: 21–44; Huddleston and Pullum 2002: 20–3, 1337–50; van Valin 2001: 110–43; Lockwood 2002: 1–5, 42–58; Poole 2002: 29–53; Adger 2003: 62–69, 122–36; Sag et al. 2003: 29–33; Radford 2004: 68–74; Kroeger 2005: 26–50; 81–2, 218–9; Tallerman 2005: 123–54; Downing and Locke 2006: 9–10; Haegeman 2006: 68–99; Moravcsik 2006: 122–4; Payne 2006: 158–80; Herbst and Schüler 2008: 4–15; Kim and Sells 2008: 19–32; Culicover 2009: 79–92; Carnie 2010: 8–24, 125; Hudson 2010: 145–52; Quirk et al. 2010: 38–52; 62–3, 75–83; Miller 2011: 53–7; Sobin 2011: 29–35; Carnie 2013: 98–107, 165–72; Denham and Lobeck 2013: 251–89; Sportiche et al. 2014: 43–85; Müller 2016: 6–17.

The main criterion used for determining whether a text was to be included in the survey concerned the notion of syntactic structure. If a surveyed text endeavors to introduce the concept of syntactic structure or to introduce a theory of syntax, then it was included in the list here. A wide range of syntax, linguistics, and grammar books and textbooks therefore appear in the list.

The pages listed for each text are generally those where the concept of syntactic structure is first introduced. In most cases, various tests for constituents are given and illustrated in

those pages. Some of the texts listed lack page numbers, though (Matthews 1981; Mel'čuk and Pertsov 1987; Baker 1989); in those cases, it was not possible to locate a clear introductory discussion or use of tests for sentence structure.[8] Furthermore, one should note that the large number of texts surveyed of course precluded the possibility of surveying each text in its entirety. The comments and points made below about the texts therefore pertain primarily just to the page ranges just listed (however, at times additional passages outside of the page ranges just listed are also cited, when they are particularly relevant).

Concerning the tests for constituents employed in the texts, Table 1 documents their use. These tests are listed in the order of frequency in which they are used, coordination being employed most frequently and of the 15 tests listed, *right node raising* (RNR) being employed the least:

Table 1. List of tests for constituents and sources that employ them, including the exact page numbers

Test	Texts that use the test
Coordination	Baker 1978: 269–76; Radford 1981: 59–60; Atkinson et al. 1982: 172–3; Radford 1988: 75–8; Akmajian et al. 1990: 152–3; Borsley 1991: 25–30; Cowper 1992: 34–7; Napoli 1993: 159–61; Ouhalla 1994: 17; Radford 1997: 104–7; Burton–Roberts 1997: 66–70; Haegeman and Guéron 1999: 27; Fromkin 2000: 160–2; Lasnik 2000: 11; Lobeck 2000: 61–3; Börjars and Burridge 2001: 27–31; Huddleston and Pullum 2002: 1348–9; van Valin 2001: 113–4; Poole 2002: 31–2; Adger 2003: 125–6; Sag et al. 2003: 30; Radford 2004: 70–1; Kroeger 2005: 91, 218–9; Tallerman 2005: 144–6; Haegeman 2006: 89–92; Payne 2006: 162; Kim and Sells 2008: 22; Carnie 2010: 115–6, 125; Quirk et al. 2010: 46–7; Sobin 2011: 31–2; Carnie 2013: 99–100; Sportiche et al. 2014: 62–8; Müller 2016: 10, 16–7
Proform substitution using a definite proform	Allerton 1979: 113–4; Radford 1981: 63–6; Atkinson et al 1982: 173–4; Radford 1988: 78–81, 98–9; Thomas 1993: 10–12; Napoli 1993: 168; Ouhalla 1994: 19; Radford 1997: 109; Haegeman and Guéron 1999: 46; Fromkin 2000: 155–8; Lasnik 2000: 9–10; Lobeck 2000: 53–7; Börjars and Burridge 2001: 24–5; van Valin 2001: 111–2; Poole 2002: 29–31; Adger 2003: 63; Radford 2004: 71; Tallerman 2005: 140–2; Haegeman 2006: 74–9; Moravcsik 2006: 123; Kim and Sells 2008: 21–2; Culicover 2009: 81; Carnie 2010: 19–20; Quirk et al. 2010: 75–7; Miller 2011: 54–5; Sobin 2011: 32; Carnie 2013: 98; Denham and Lobeck 2013: 262–5; Sportiche et al. 2014: 50; Müller 2016: 8
Topicalization	Allerton 1979: 114; Atkinson et al. 1982: 171–2; Radford 1988: 95; Borsley 1991: 24; Haegeman 1991: 27; Napoli 1993: 422; Ouhalla 1994: 20; Burton–Roberts 1997: 17–8; Haegeman and Guéron 1999: 46; Fromkin 2000: 151; Lasnik 2000: 10; Lobeck 2000: 47–9; Börjars and Burridge 2001: 26; van Valin 2001: 112; Poole 2002: 32; Adger 2003: 65; Sag et al. 2003: 33; Radford 2004: 72; Kroeger 2005: 31; Downing and Locke 2006: 10; Haegeman 2006: 79; Payne 2006: 160; Culicover 2009: 84; Quirk et al. 2010: 51; Miller 2011: 55; Sobin 2011: 31; Sportiche et al. 2014: 68; Müller 2016: 10
***Do–so* substitution**	Baker 1978: 261–8; Aarts and Aarts 1982: 56, Atkinson et al. 1982: 174; Borsley 1991: 63; Haegeman 1991: 79–82; Cowper 1992: 31; Napoli 1993: 423–5; Burton–Roberts 1997: 104–7; Haegeman and Guéron 1999: 74; Fromkin 2000: 156–7; van Valin 2001: 123, 127; Poole 2002: 41–3; Tallerman 2005: 130–1, 141; Haegeman 2006: 75–6; Payne 2006: 162; Culicover 2009: 81; Carnie 2010: 115–6; Quirk et al.

[8] Matthews (1981) and Mel'čuk and Pertsov (1987) are included in the list because they are important sources that introduce syntax in terms of dependencies and Baker (1989) is included because it is an introductory text that employs many of the tests sporadically throughout its account of English syntax.

	2010: 76, 82; Miller 2011: 54–5; Sobin 2011: 33; Carnie 2013: 169–70; Denham and Lobeck 2013: 265; Sportiche et al. 2014: 61
***One* substitution**	Baker 1978: 327–40, 413–25; Radford 1981: 92, 96–100; Aarts and Aarts 1982: 57; Haegeman 1991: 26, 88–9; Cowper 1992: 26; Napoli 1993: 423–5; Burton–Roberts 1997: 182–9; McCawley 1998: 183; Haegeman and Guéron 1999: 75–6; Fromkin 2000: 157–8; van Valin 2001: 122, 126, 128, Poole 2002: 37–9; Adger 2003: 63; Radford 2004: 37; Kroeger 2005: 97–8; Tallerman 2005: 150; Haegeman 2006: 109; Carnie 2010: 114–5; Quirk et al. 2010: 75; Carnie 2013: 166–7; Sportiche et al. 2014: 52, 57, 60
Answer fragments	Brown and Miller 1980: 25; Radford 1981: 72, 92; Radford 1988: 91; Burton–Roberts 1997: 15–8; Radford 1997: 107; Börjars and Burridge 2001: 25; Kroeger 2005: 31; Tallerman 2005: 125; Downing and Locke 2006: 10; Haegeman 2006: 82; Moravcsik 2006: 123; Herbst and Schüler 2008: 6–7; Kim and Sells 2008: 20; Carnie 2010: 18; Sobin 2011: 31; Carnie 2013: 98
Clefting	Brown and Miller 1980: 25; Radford 1981: 109–10; Aarts and Aarts 1982: 97–8; Akmajian et al. 1990: 150; Borsley 1991: 23; Napoli 1993: 148; McCawley 1998: 64; Haegeman and Guéron 1999: 49; Börjars and Burridge 2001: 27; Adger 2003: 67; Sag et al. 2003: 33; Tallerman 2005: 127; Downing and Locke 2006: 10; Haegeman 2006: 85; Kim and Sells 2008: 19; Carnie 2013: 98; Sportiche et al. 2014: 70
VP–ellipsis	Radford 1981: 67, 1988: 101; Napoli 1993: 424; Ouhalla 1994: 20; Radford 1997: 110; McCawley 1998: 67; Fromkin 2000: 158; Adger 2003: 65; Kroeger 2005: 82; Tallerman 2005: 141; Haegeman 2006: 84–5; Payne 2006: 163; Culicover 2009: 80; Denham and Lobeck 2013: 273–4; Sportiche et al. 2014: 58–60
Pseudoclefting	Brown and Miller 1980: 25; Aarts and Aarts 1982: 98; Borsley 1991: 24; Napoli 1993: 168; McCawley 1998: 64; Haegeman and Guéron 1999: 50; Kroeger 2005: 82; Downing and Locke 2006: 10; Haegeman 2006: 88; Payne 2006: 160; Culicover 2009: 89; Miller 2011: 56; Carnie 2013: 99; Sportiche et al. 2014: 71
Passivization	Brown and Miller 1980: 25; Borsley 1991: 24; Thomas 1993: 10; Lobeck 2000: 49–50; Downing and Locke 2006: 10; Carnie 2010: 21; Sobin 2011: 30; Carnie 2013: 99; Denham and Lobeck 2013: 277
Omission	Allerton 1979: 113–9; Aarts and Aarts 1982: 60–1, 65–7; Burton–Roberts 1997: 14–5; Börjars and Burridge 2001: 33–4; Payne 2006: 163–5; Carnie 2010: 19; Hudson 2010: 147; Quirk et al. 2010: 41, 51, 61; Miller 2011: 54; Sobin 2011: 33
Intrusion	Radford 1981: 60–2; 1988: 93; McCawley 1998: 68–70; Fromkin 2000: 147–51; Börjars and Burridge 2001: 34; Huddleston and Pullum 2002: 21; Moravcsik 2006: 123; Payne 2006: 162
Wh-fronting	Radford 1981: 108; Haegeman 1991: 28; Haegeman and Guéron 1999: 46–7; Lobeck 2000: 57–9; Payne 2006: 160; Culicover 2009: 90–1; Denham and Lobeck 2013: 279–81; Sportiche et al. 2014: 58–60; Müller 2016: 9
General substitution	Allerton 1979: 113; Brown and Miller 1980: 38; Aarts and Aarts 1982: 11; Radford 1988: 89–91; Moravcsik 2006: 123–4; Culicover 2009: 87; Quirk et al. 2010: 41; Müller 2016: 7–8
Right node raising (RNR)	Radford 1988: 77–8, 97; 1997: 106; McCawley 1998: 60–1; Haegeman and Guéron 1999: 52, 77; Sportiche et al. 2014: 67–8

Additional tests not listed in this table are also employed (e.g. shifting, stripping, extraposition, etc.), although these further tests are rarely encountered and will therefore not be considered in this article. Three of these 15 have already been illustrated above (see examples 2–9) and many more of them are illustrated below. Again, see the Appendix for an introduction and illustrations of all 15 of these tests.

Concerning the nomenclature, it must be acknowledged that the terminology employed in the source texts varies, of course. Table 2 lists some of the alternative designations that one encounters:

Table 2. Designations used in this article for tests for constituents as well as alternative designations found in the literature

Designations used in this article	Alternative designations found in the literature
coordination	conjunction
proform substitution	replacement, substitution
topicalization	displacement, fronting, movement, preposing
do-so-substitution	proform replacement
one-substitution	proform replacement
answer fragment	fragments, stand-alone test, sentence fragment test
clefting	cleft sentence
VP-ellipsis	deletion, ellipsis, omissibility, reduction
pseudoclefting	pseudocleft sentence
passivization	movement
omission	deletion, optionality
intrusion	adverb insertion, interposition
wh-fronting	movement, wh-movement
general substitution	commutability, distribution, replacement, substitution
RNR	shared constituent test

The varying designations bear witness to a mixing and matching of the tests. Proform substitution is separated from general substitution here, although the two tests are closely related and are therefore often viewed as a single type of test. They are separated here because proform substitution (using a definite proform) can deliver much different results from substitution using a non-proform. Topicalization, passivization, and wh-fronting (and extraposition and shifting) are sometimes grouped together as a single type of test, called simply *movement*. Many of the texts separate these tests, though, so that the account here is justified in separating them as well.

Note further that *do-so*-substitution and *one*-substitution are particular manifestations of proform substitution and could thus be grouped together with proform substitution as a single test. The reason they are viewed as separate tests here concerns their special use. The texts that employ *do-so*-substitution and *one*-substitution usually do so as a means of arguing for the presence of intermediate constituents, i.e. bar-level constituents in the sense of X-bar Theory, inside verb phrases [VPs] (*do-so*-substitution) and noun phrases [NPs] (*one*-substitution). These two tests therefore perform a key role in motivating the rather layered, i.e. tall, phrase structures that one finds in many modern theories of syntax.

Table 1 lists 15 tests. Five of the 15 are, however, not included in the ten main tests that are employed in the following section for probing the syntactic status of strings. The reason they are not included is two-fold: firstly, employing all 15 tests each time would require too much space, and secondly, many of the tests are limited in their ability to cast light on the structure of random test strings. The five excluded tests are mentioned next.

***One*-substitution** is, as just stated, a very widely employed test for probing the structure of NPs. The value of the test is limited, though, since it is only helpful when the test string is part of an NP. This restriction on the use of *one*-substitution means that it is often not helpful

when probing the constituent status of random test strings. For this reason, *one*-substitution is not included in the ten central tests that are employed below. Section 7.2 does, however, examine *one*-substitution, demonstrating that it is not a reliable test for determining the structure of NPs.

The **VP-ellipsis** test is also a widely employed test for constituents; it identifies non-finite predicative phrases as constituents (e.g. *Tom is a good friend, and Fred is a good friend, too*). The test is, however, limited in its applicability since it is helpful only when testing for the status of predicative phrases. More importantly, the predicative phrases that the test identifies are rarely disputed. Phrase structure and dependency grammars alike can agree that such predicative phrases, e.g. non-finite verb phrases, are constituents. Hence since there is little dispute about the status of these phrases, VP-ellipsis is not included among the ten tests that are used time and again in this article.

Although widely employed, the **passivization** test is only helpful for identifying subject and object nouns, NPs, and clauses, e.g. *Stefan painted a picture of Maja* → *A picture of Maja was painted by Stefan* (Borsley 1991: 24). Since theories of syntax, whether based on dependency or phrase structure, do not disagree about the status of these strings, i.e. they are unanimously taken to be constituents, the passivization test is of little help when the goal is to decide between competing analyses of a given string. For this reason, passivization is not included among the ten central tests for constituents that are employed in the next section.

General substitution is a test that substitutes a single word or a phrase for the test string. When this test is used in a manner that replaces a string of words with a single word (e.g. *Students in evening courses work hard* → *Adults work hard*), it may be somewhat helpful. In such cases, however, it is closely similar to the proform substitution test (e.g. *Students in evening courses work hard* → *They work hard*). Furthermore, when this test is used in such a manner that a single non-proform word is replaced by another single non-proform word (e.g. *Students work hard* → *Adults work hard*), it reveals nothing about syntactic structure beyond the fact that individual words are taken (by phrase structure grammars) to be constituents by default. For these two reasons, general substitution is not included among the core ten tests.

Right node raising (RNR) is a test that probes the status of strings appearing at the end of a phrase or clause. Its usefulness is limited, precisely because it is applicable only in case the test string appears at the end of the phrase or clause at hand. Furthermore, the claim that the shared string to the right of RNR conjuncts is necessarily a constituent is incorrect, a fact that has been established by a number of linguists (Grosu 1976, Abbott 1976, Wilder 1997: 85–6, Chaves 2014: 866–7), e.g. *[Mary gave], and [Tom has now loaned], numerous books to the library recently*. The string *numerous books to the library recently* does not qualify as a constituent in most theories of syntax. For these two reasons, RNR is also not included in the core ten tests.

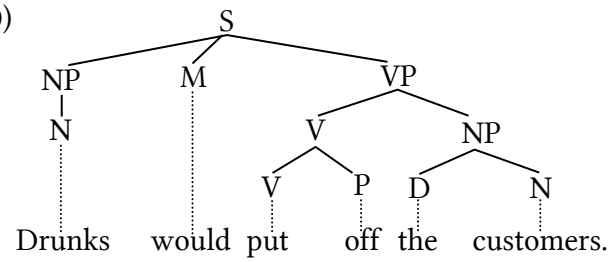
While the remaining ten tests are generally more widely applicable than the five tests just mentioned, some of them are limited, too. For instance, *do-so*-substitution is useful only when testing for the status of strings containing verbs, and the omission test can only identify optional strings as constituents (adjuncts and optional arguments); it is of no use when the test string is an obligatory argument or part of the main predicate. Despite these limitations, these

tests are relatively easy to use and are included in the main group of ten tests in the interest of arriving at a reasonably extensive inventory of tests for probing the structure of strings.

4. The main point

The difficulty facing phrase structure syntax, established above in the introduction disappears if one assumes dependency syntax instead. Given dependencies, subphrasal strings do not qualify as constituents; the only types of constituents that remain are phrasal ones. This point has already been illustrated with examples (1–9) above, and it is reinforced in what follows with a more extensive illustration and discussion of another example, one taken from Radford (1988: 91):

(20)

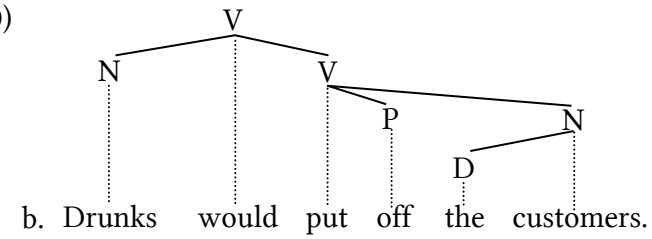


Since there are 11 nodes in this phrase structure tree, the analysis acknowledges 11 constituents, although due to the unary branching of NP—N, the tree effectively acknowledges just ten constituents. Radford motivates the analysis by way of eight tests: general substitution, movement, answer fragments, intrusion, coordination, RNR, proform substitution, and VP-ellipsis.

The tests Radford employs easily verify the structural analysis he gives insofar as they agree that the NP *drunks*, the NP *the customers*, and the VP *put off the customers* are constituents. The tests also easily verify the analysis concerning *off*, namely that it does not form a prepositional phrase [PP] constituent with the NP *the customers*. In the current context, the noteworthy aspect of Radford's analysis concerns the status of the individual words *would*, *put*, *off*, *the*, and *customers* as well as the status of the two-word phrasal verb *put off*. Radford's tree in (20a) shows these strings as constituents, so the tests he employs should identify them as such. Interestingly, however, Radford does not subject these units to the scrutiny of his tests, and the fact that he does not do so is understandable, because if he were to attempt this, the basic problem facing phrase structure syntax would become evident.

The dependency analysis of Radford's sentence is as follows:

(20)



Comparing this analysis with Radford's analysis in (20a), a couple of points are immediately clear. The two analyses agree that *drunks*, *the customers*, and *put off the customers* should be

identifiable as constituents by the tests because in both trees, they qualify as complete subtrees. Indeed, these strings are easily identified as constituents by the following tests:

(21) a. [**Drunks**] and [vagabonds] would put off the customers. – Coordination

b. **They** would put off the customers. (*they* = ***drunks***) – Proform substitution

c. …and **the customers**, drunks would put off. – Topicalization

d. What would drunks do? – **Put off the customers**. – Answer fragment

e. Drunks would **do so**. (*do so* = ***put off the customers***) – *Do-so*-substitution

f. It is **the customers** that drunks would put off. – Clefting

g. What drunks would do is **put off the customers**. – Pseudoclefting

h. (Inapplicable because the relevant strings appear obligatorily) – Omission

i. **Drunks** *probably* would put of the customers.
i'. Drunks would *probably* **put off the customers**. – Intrusion

j. **Who** would drunks put off? (*who* = ***the customers***) – Wh-fronting

The data demonstrate that *drunks*, *the customers*, and *put off the customers* are straightforwardly identified as constituents. Omission is inapplicable in these cases, since it can identify adjuncts and optional arguments only, as mentioned above

Observe that both analyses take *off* and *the* as constituents. Discerning these two words as constituents using tests is much more difficult to do due to the idiosyncratic traits of particles like *off* and determiners like *the*.[9] The ability to shift the particle *off* does support its status as a constituent, though (e.g. *Drunks would put them off*), and the ability to omit *the* supports its status as a constituent (*Drunks would put off customers*). More importantly, however, the two analyses agree that these two words are constituents, for they are complete subtrees in both (20a) and (20b). Their status in the hierarchy is therefore not directly relevant to the current debate (dependency vs. phrase structure).

What is of much greater interest in the current context is the status of *would*, *put*, *customers*, and *put off* in (20) , since the two trees disagree concerning these units. Radford's phrase structure analysis in (20a) views them as subphrasal constituents, whereas on the dependency analysis in (20b), they are not constituents to begin with. The majority of tests Radford employs suggest that these units are not constituents, and when one employs the wider array of tests, the conclusion is strengthened: these unts are not constituents. This point is illustrated first by focusing on *put off*:

[9] One might object here that the fact that most of the tests fail to identify *the* and *off* as constituents is an indication that both dependency and phrase structure get it wrong and that therefore, the value of both means of modeling sentence structure is debatable. In other words, the worth of tests for constituents comes into question in general. One should keep in mind in this area that tests for constituents are merely tools that deliver clues about the nature of sentence structure. Nowhere in the literature does one find claims to the effect that they are infallible. They are, rather, quite fallible. The relevant question is, rather, which of the two means of modeling sentence structure, dependency or phrase structure, gets one closer to what the tests reveal broadly.

(22) a. Drunks would [**put off**] and [offend] the customers. – Coordination

b. *Drunks would **do / do it** the customers.
(*do / do it* = ***put off***) – Proform
substitution

c. *…and **put off** drunks would the customers. – Topicalization

d. What would drunks do concerning the customers?
– ***Put off**. – Answer fragment

e. *Drunks would **do so** the customers. (*do so* = ***put off***) – *Do-so*-substitution

f. *It is **put off** that drunks would the customers. – Clefting

g. *What drunks would do to the customers is **put off**. – Pseudoclefting

h. *Drunks would the customers. – Omission

i. Drunks would *certainly* **put off** the customers.
i'. *Drunks would **put off** *certainly* the customers. – Intrusion

j. ***Do what** the drunks the customers? (*do what* = ***put off***) – Wh-fronting

Of the ten tests illustrated, only coordination supports *put off* as a constituent. The other nine tests suggest that *put off* should not be granted the status of a constituent.

Similar results are obtained when the tests are applied to *would*, *put*, and *customers*. A majority of the tests suggest that these units are not constituents. The following examples illustrate the point by focusing on *customers*:

(23) a. ?Drunks would put off the [**customers**] and
[neighbors]. – Coordination

b. *Drunks would put off the *them*. (*them* = ***customers***) – Proform
substitution

c. *…and **customers** drunks would put off the. – Topicalization

d. (Inapplicable) – *Do-so*-substitution

e. ?Drunks would put off the who? – ?**Customers**. – Answer fragment

f. *It was **customers** that drunks would put off the. – Clefting

g. *The ones who drunks would put off the are **customers**. – Pseudoclefting

h. *Drunks would put off the . – Omission

i. *Drunks would put off the *certainly* **customers**.[10] – Intrusion

[10] One might object here that inserting an adjective instead of an adverb results in an acceptable sentence, e.g. *Drunks would put off the **regular** customers*. As it is commonly employed, the intrusion test inserts an adverb, not an adjective or some other part of speech. Consider in this regard that if the intrusion test were not limited in this way, it would almost always be possible to verify every single string as a constituent, since there would always be some part of speech or another that could be inserted into each position in the sentence.

j. *__Who__ would the drunks put off the? (*who* = ***customers***) – Wh-fronting

In this case, even coordination has difficulty identifying *customers* as a constituent. Example (23a) is better if the determiner is repeated (*Drunks would put off [the customers] and [the neighbors]*). Example (23a) can actually be fully acceptable, but only on the unlikely reading where *customers* and *neighbors* are coextensive. Note as well that the question-answer pair in (23e) involves a rare type of echo question; acceptability in such cases is reduced.

The next data set focuses on *put*:

(24) a. *Drunks would [__put__] and [piss] off the customers. – Coordination

b. *Drunks would ***so / do it*** off the customers. (*so / do it* = ***put***) – Proform substitution

c. *…and __put__ drunks would off the customers. – Topicalization

d. *Drunks would __do so__ off the customers. (*do so* = ***put***) – *Do-so*-substitution

e. *Drunks would __do what__ off the customers? – *__Put__. – Answer fragment

f. *It was __put__ that drunks would off the customers. – Clefting

g. *What the drunks would do off to the customers is __put__. – Pseudoclefting

h. *Drunks would off the customers. – Omission

i. Drunks would *certainly* __put__ off the customers.
i'. *Drunks would __put__ *certainly* off the customers. – Intrusion

j. *__Do what__ would drunks off the customers? (*do what* = ***put***) – Wh-fronting

Even coordination fails in this case, surprisingly. Apparently, the idiosyncratic meaning associated with phrasal verbs blocks the sharing of the particle *off*.

The final point of disagreement between the phrase structure tree (20a) and the dependency tree (20b) concerns the finite verb *would*. The tests are again largely consistent, although there is one datum that bucks the pattern:

(25) a. Drunks [could] and [__would__] put of the customers. – Coordination

b. *Drunks __so / do it__ put off the customers. (*so / do it* = ***would***) – Proform substitution

c. *__Would__ drunks put off the customers. (Unacceptable as declarative statement) – Topicalization

d. *Drunks __do so__ put off the customers. (*do so* = ***would***) – *Do-so*-substitution

e. What about the drunks putting off customers? – *__Would__. – Answer fragment

f. *It is __would__ that drunks put off the customers. – Clefting

g. *What drunks put off the customers is **would**. – Pseudoclefting

h. Drunks put off the customers. – Omission
(Acceptable, but the meaning has changed significantly)

i. Drunks *certainly* **would** put off the customers.
i'. Drunks **would** *certainly* put off the customers. – Intrusion

j. ***Do what*** drunks put off the customers?
(*do what* = ***would***) – Wh-fronting

Two of the tests, coordination and intrusion, support granting *would* the status of a constituent, whereas the other eight advise against doing this. Note that topicalization changes the speech act (statement → polar question), so the star indicates that (25c) is unacceptable as a statement. Note also that omitting *would* in (25h) results in an acceptable sentence, but one that has a quite different meaning. Why intrusion contradicts the other eight tests in this case is an open question that is not explored here, although data such as (25i–i') probably have to do more with the idiosyncratic distribution of modal adverbs than with constituent structure.[11]

Taken as a whole, the results of the tests just illustrated strongly support the dependency analysis (20b) over the phrase structure analysis (20a). The reason dependency syntax does so much better is that given dependencies, the distinction between phrasal and subphrasal constituents disappears, with only phrasal constituents remaining. The one test that actually seems to consistently support phrase structure syntax is coordination. Coordination is scrutinized in Section 7.1.

5. The inconsistency

The point just established is that there is a significant inconsistency in how phrase structure grammars conceive of constituent structure. On the one hand, they acknowledge the existence of both phrasal and subphrasal constituents, yet on the other hand, the majority of tests they employ do not confirm the existence of subphrasal constituents. Phrase structures therefore lack the empirical support that one would otherwise expect tests for constituents to deliver. This section considers this inconsistency more closely, documenting its existence with the introductory statements that are made about the constituent unit.

[11] The eight texts surveyed that use intrusion as a test for constituents do so only rather briefly. They do not scrutinize its merits. One difficulty associated with intrusion concerns the fact that the results it delivers vary significantly based upon the type of adverbial that one employs. Modal adverbs, for instance, have a different distribution from frequency adverbs, e.g.

(i) a. Sam *certainly* has tried hard.
b. Sam has *certainly* tried hard.
(ii) a. ??Sam *repeatedly* has tried hard.
b. Sam has *repeatedly* tried hard.

Examples (ia–b) suggests that *Sam*, *has*, and *tried hard* are constituents, whereas (iia–b) suggest that *Sam has* and *tried hard* are constituents. The notion that *Sam has* is a constituent is contrary to (most) theories of syntax. These observations cast doubt on the validity of intrusion as a test for constituents. Indeed, six out of the eight texts that employ intrusion do so using modal adverbs. Intrusion used in this manner is thus more informative about the distribution of modal adverbs than it is about constituent structure more generally.

When linguistics and syntax texts first introduce the constituent unit, they often suggest an understanding of the constituent that is synonymous with the traditional phrase. This point is illustrated with the statements about constituents in Table 3. In each case, the passage cited is the key statement that is given when the constituent unit is first presented:

Table 3. Initial statements about the constituent unit, suggesting an understanding of the constituent that sets it equal to the traditional phrase

Source	How the constituent concept is introduced
Lasnik (2000: 9)	"Various tests have proved to be useful in determining what groups of words work together as units of structure, or constituents."
Börjars and Burridge (2001: 22–3)	"…These groups of words which 'go together' are called constituents.…A constituent is by definition a string of words which functions as a group at some level."
Poole (2002: 29)	"We all share the feeling that, for example, *at the station* [in the sentence *The student will meet her friend at the station*] forms some kind of unit, a PP in fact, whereas other strings of words don't form a unit. Let's call these units *constituents*."
Adger (2003: 63)	"A group of words that can be picked out in this way is called a constituent,… Essentially, a constituent is a group of words which has a certain internal cohesion."
Kroeger (2005: 26)	"…the words in a sentence are not organized as a simple list. Rather, words cluster together to form groups of various sizes; these groups are referred to as constituents."
Tallerman (2005: 124)	"A constituent is a set of words that forms a phrase in a sentence."
Kim and Sells (2008: 18)	"The grouping of words into larger phrasal units which we call constituents provides the first step…"
Carnie (2010: 18)	"Constituents are groups of words that function as units with respect to grammatical processes."
Sobin (2011: 30)	"…manipulating the form of sentences rarely involves words per se – it is phrases (also called constituents) that are the object of manipulation,"
Carnie (2013: 73)	"*Constituent*: A group of words that function together as a unit."
Sportiche et al. (2014: 47)	"A *constituent* is a string that speakers can manipulate as a single chunk."

These statements reveal a tendency to view the constituent unit as a group, set, or string of words, as opposed to as a single word. The texts do not, for instance, state that a constituent is *a word or a group of words*, but rather they adopt an intuitive understanding of the constituent unit that sets it as equal to the traditional phrase.

The situation is different when the constituent is discussed and defined over trees. Table 4 documents the manner in which constituents are seen as corresponding to nodes in trees:

Table 4. List of definitional statements that define the constituent over tree structures in terms of nodes

Source	How the constituent is defined over trees
Keyser and Postal (1976: 34)	"A certain sequence of words (or subparts of words) in a tree is a constituent of that tree if and only if that sequence makes up all and only the structure attached to some individual node."
Atkinson et al. (1982: 161)	"…a sequence of words is a constituent if the sequence can be traced back to a single *node* in the tree, with no other material under this node, or, correspondingly, if the sequence exhausts the contents of a pair of brackets."

Haegeman and Guéron (1999: 51)	"The material exhaustively dominated by one node is a constituent."
Fromkin (2000: 140)	"Tree diagrams…consist of a set of labeled nodes connected to one another by vertical or diagonal lines. Each node represents a *constituent*, or component part, of the phrase whose structure it represents."
van Valin (2001: 117)	"In terms of tree structure…, a group of words is a constituent if there is a single node in the tree which uniquely and completely dominates them."
Huddleston and Pullum (2002: 21)	Concerning the tree of the sentence *A bird hit the car*: "*A bird*, for example, is identified as a constituent because this word sequence can be traced via the branches to a single point in the tree; similarly, with *the car* and *hit the car*."
Poole (2002: 35)	"Any group of heads which are exhaustively dominated by a given node (i.e., there is a node which dominates every one of those heads and no others) is a constituent."
Kroeger (2005: 40)	"A constituent is a string of words which is exhaustively dominated by some node."
Tallerman (2005: 136)	"A set of elements forms a constituent in a tree diagram if and only if there is a single node that dominates just these elements, and no other items."
Carnie (2010: 37)	"*Constituent*: A set of nodes exhaustively dominated by a single node"
Sportiche et al. (2014: 47)	"If a string of words or morphemes is a constituent, we will represent this constituency by grouping all the words or morphemes as daughters of a single mother node in a tree representation"

These statements reveal that when trees are used to represent syntactic structure, each node in the tree corresponds to a constituent. For instance, if a tree contains five nodes, then there are five constituents in that tree, whereby the whole tree is the greatest constituent. Given a phrase structure approach to syntax, each individual word corresponds to a node, which means that each word is a constituent. This understanding of constituents is hence much more inclusive, since both phrases and individual words qualify as constituents.

The statements in the two tables point to a type of tension concerning how the constituent unit is understood. Table 3 documents an understanding of constituents from intuition, whereby the constituent unit is taken to be synonymous with the traditional phrase as defined in English language dictionaries. Table 4, in contrast, demonstrates that the understanding of the constituent shifts when a more rigorous account of constituents is pursued in terms of tree structures. Individual words now also count as constituents, not just phrases. The tension just established is noted by Carnie (2010: 17–8, n. 12) in his survey of theories of constituent structure. Carnie writes:

> It is worth clarifying a bit of terminology at this point. People frequently use the terms *constituent* and *phrase* interchangeably. The reason for this is quite simple: all phrases are constituents and most constituents are phrases. However, as we will see later in the chapter on X-bar theory, it is not the case that all constituents are phrases. The term *phrase* is limited to a particular kind of constituent: one where all the modifiers of the word heading the constituent (the most semantically prominent word) have been attached. As we will see in detail in Chapter 7, there is evidence for constituent structure smaller than that of phrases (that is, we will see that some phrases contain sub-constituents that are not themselves phrases). For this reason, I will use the term *constituent* to refer to all groups of words that function as units, including single word units, and reserve the name *phrases* for those constituents that are completed by their modifiers.

The type of evidence that Carnie produces (in his Chapter 7) to motivate the existence of subphrasal constituents is examined in Sections 7.1–7.3 below. The discussion there demonstrates that the standard evidence produced in this area (from coordination, *one*-substitution, and *do-so*-substitution) is not conclusive. The putative support for subphrasal constituents disappears upon scrutiny.

Given dependency syntax, the underlying source of the tension just documented with Tables 3 and 4 disappears. The intuitive understanding of the constituent unit (Table 3) is consistent with dependency syntax. At the same time, the more formal understanding of the constituent (Table 4) is also consistent with dependency syntax, since the units that one wants to acknowledge as constituents correspond directly to complete subtrees of dependency structures and thus correspond to single nodes in the dependency tree.

6. Reasons for the oversight

The problem facing phrase structure syntax just established resides with the distinction between phrasal and subphrasal constituents. This aspect of the tests has, interestingly, hardly been acknowledged by the linguists that use them. While some of the texts surveyed do acknowledge that certain tests are sensitive to phrasal constituents only, not one of them draws explicit attention to the inconsistency between the large number of constituents that phrase structures assume and the much smaller number of strings that most of the tests actually succeed at identifying as constituents. The oversight in this area is striking.

Some of the surveyed texts do in fact acknowledge that some of the tests are sensitive to phrasal constituents only. Table 5 documents some of these acknowledgements:

Table 5. List of statements acknowledging that many tests for constituents identify phrasal constituents only

Source	Statements to the effect that the tests identify phrasal constituents only
Concerning **omission**, Allerton (1979: 113) writes:	"What we can say, however, about both of these constructions [=phrases] is that they can only be omitted, if at all, as constructions; their individual parts may not be separately omitted."
Concerning **topicalization**, Radford (1988: 71) writes:	"Only phrasal constituents (whole phrases) can undergo preposing."
Concerning **answer fragments**, Radford (1988: 72) writes:	"Only phrasal constituents (i.e. whole phrases) can serve as sentence fragments (in an appropriate context)."
Concerning **VP-ellipsis**, Radford (1988: 83) writes:	"Only VPs (Verb Phrases) can undergo Ellipsis (under appropriate discourse conditions)."
Concerning **passivization**, Lobeck (2000: 50) writes:	"We further check our hypothesis by applying the Passive rule to other sentences, and we find that even very large noun phrases appear to move as syntactic units,… This supports the idea that this movement rule applies to phrases, and thus that the notion phrase is part of our unconscious knowledge of syntax."
Concerning **proform substitution**, Lobeck (2000: 53) writes:	"Pronominalization, the means by which syntactic material is replaced by a pronoun, or as we shall see, a proform, provides us with further evidence for phrases. This is because proforms replace phrases, rather than heads, and are thus words that 'stand for' phrases."

Concerning **topicalization** and **passivization**, van Valin (2001: 113) writes:	"In the remaining examples, a head noun alone or modifiers alone have permuted, with predictable ungrammatical results. Thus, in all the different permutations…, it is whole constituents that change function or position in every instance,…"
Concerning **topicalization**, Radford (2004: 72) writes:	"The smallest maximal projection is moved which contains the highlighted material."
Concerning **answer fragments**, Moravcsik (2006: 123) writes:	"The selection rule that specifies what can be an answer to a question is simpler if it can make reference to phrases rather than individual word types by stating that sets of words can make answers if they form a phrase."
Concerning **proform substitution**, Quirk et al. (2010: 76) write:	"…a pronoun tends to be a surrogate for a whole noun phrase rather than a noun: *Many students did better than many students expected* → *Many students did better than they expected.*"
Concerning **tests for constituents in general**, Sobin (2011: 30) writes:	"As we will see, manipulating the form of sentences rarely involves words per se – it is phrases (also called constituents) that are the object of manipulation,…"
Concerning **proform substitution**, Denham and Lobeck (2013: 264) write:	"If we assume that pronouns replace only NPs but not Ns, we explain why all of these NPs can be replaced by pronouns. We can also explain why the NPs in which we tried to replace only the head N are ungrammatical; pronouns do not replace nouns. Substitution, therefore, provides evidence for noun phrases as syntactic units."

Further statements that point in the same direction are present in a number of the other texts: concerning topicalization, see Napoli (1993: 422), Adger (2003: 66), and Downing and Locke (2006: 10); concerning answer fragments, see Herbst and Schüler (2008: 7); concerning clefting, see Radford (1981: 110); concerning wh-fronting, see Radford (1981: 108); and concerning intrusion, see Radford (1981: 61) and Börjars and Burridge (2001: 34).

The following question arises at this point: Why have the texts that use tests for constituents overlooked the fact that the tests as a whole do not support the richness of structure that phrase structure posits? There are at least three answers to this question:

1. Data from a couple of the tests, coordination being the most important of these, are unlike most of the other tests as they seem to support the existence of subphrasal constituents;
2. There is a lack of awareness of any sort of alternative analysis of the data; and
3. Those who one might expect to have drawn attention to the greater problem facing phrase structure syntax have not done so.

The first of these three answers is discussed at length below in Sections 7.1–7.3, where coordination, *one*-substitution, and *do-so*-substitution are scrutinized. The second and third of these three answers are addressed in the following paragraphs.

Perhaps the most important reason why the difficulty for phrase structure syntax has not been acknowledged and appropriately discussed by the texts that employ the tests is a lack of awareness of any sort of alternative. Most surveyed texts reflect no awareness of the alternative analysis of the data being developed here in terms of dependency grammar dependencies. Of the dozens of surveyed texts, only eight have anything to say about

dependency grammar, and of these eight, four mention dependency grammar only briefly: McCawley (1998: 11–2, 15, 50) acknowledges dependency grammar briefly three times; Sag et al. (2003: 535–6) grant just a page to dependency grammar; and Carnie (2010: 175–78) fills only three pages with information about dependency grammar. Given this lack of awareness of an alternative account, it is not surprising that the surveyed texts do not scrutinize their understanding of the tests.

The third reason is that even the texts that one might expect to draw attention to the problem have not done so. Six of the surveyed texts exhibit greater awareness of dependency grammar, but they also do not draw attention to the disconnect: Matthews (1981) examines dependency syntax in detail; Mel'čuk and Pertsov's (1987) Meaning-Text account of English syntax is of course a dependency grammar; van Valin (2001: 86–109) devotes a chapter to dependency grammar; Miller (2011) rejects verb phrases and assumes verb-centrality instead, which makes his approach to syntax a dependency grammar; Herbst and Schüler (2008) pursue a valency-based understanding of syntax, the concept of valency being closely associated with Tesnière's dependency grammar (1959/2015) and with dependency grammar in general; Hudson's Word Grammar (2010) is of course a dependency grammar framework; and Müller (2016) explores dependency syntax with a full chapter. Despite this awareness of dependencies, these texts have not seen the greater potential of dependency syntax to serve as a basis for predicting the constituents that tests for constituents do and do not identify.

Herbst and Schüler (2008) provide a good example of the oversight. They in fact seem close to acknowledging the problem that the tests pose to phrase structure syntax. When analyzing example (26), their sentence 6.7, they produce the following comments:

(26)I bought this hat at Heathrow this morning.

> What is remarkable, however, is that constituents such as *bought…*cannot be identified as constituents in this way since they cannot be elicited by a question. Questions of the type *What did you do with this hat at Heathrow?* and *What did you do at Heathrow this morning?* do not permit any response of the type **Buy.*" (Herbst and Schüler 2008: 7)

With these statements, Herbst and Schüler are close to recognizing the advantage that dependency syntax has concerning tests for syntactic structure. They do not, however, develop the insight any further. Their comments in the area remain brief, and they quickly move on to other aspects of their valency-based approach to the syntax of English.

Furthermore, prominent dependency grammars that have been in existence for decades also have not seen the advantage of dependency syntax with respect to the tests. Lucien Tesnière (1959/2015) was not concerned with tests for constituents. Richard Hudson in his works in the Word Grammar framework (e.g. Hudson 1984, 1990, 2007, 2010) also has not focused on tests for constituents. The same is true of Igor Mel'čuk's prolific works in the Meaning-Text framework (e.g. Mel'čuk and Pertsov 1987, Mel'čuk 1979, 1988, 2003, 2009). Thus, given that prominent dependency grammarians have not called attention to the advantage that dependency syntax has over phrase structure syntax with respect to tests for sentence structure, it is not surprising that phrase structure grammarians have not seen the need to scrutinize what the tests are actually revealing about the nature of sentence structure.

7. Putative evidence for subphrasal constituents

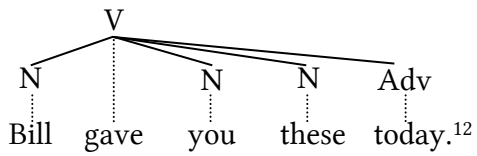
While the majority of tests for constituents support the existence of phrasal constituents only, a couple of the others do suggest that subphrasal strings can be constituents. In fact, there are three frequently employed tests in the surveyed texts that appear to support syntax in terms of phrase structure. Coordination is the most important of these, and the other two are *one*-substitution and *do-so*-substitution. The following three subsections scrutinize these tests.

7.1 Coordination

Coordination has played a central role in motivating syntactic analyses in terms of phrase structure. Chomsky (1957: 36) wrote in this regard that "…the possibility of conjunction offers one of the best criteria for the initial determination of phrase structure", and the discussion above has repeatedly drawn attention to the fact that coordination is the one main source of support produced in the surveyed texts for taking various subphrasal strings as constituents. The discussion above has also drawn attention to the fact that many of the texts that employ coordination as a test for constituents overlook the unique behavior of coordination in this regard. The texts have not appropriately addressed the fact that the data coordination delivers are quite unlike the data delivered by the other tests.

To illustrate this point, consider the example sentence in (27), for which the dependency tree is included:

(27)



[12]

This analysis acknowledges five constituents including the whole: *Bill*, *you*, *these*, *today*, and *Bill gave you these today*. The tests discussed above confirm the presence of these five constituents. A large majority of the tests do not, however, see the number of constituents exceeding five. In this regard, coordination is much more permissive. It allows one to acknowledge 15 constituents:

(27) a. [Bill] and [Fred] gave you these today.

b. Bill [found] and [gave] you these today.

c. Bill gave [you] and [me] these today.

d. Bill gave you [these] and [those] today.

[12] Given the equi-level appearance of subject and object in this tree, an anonymous reviewer poses a general question about how dependency syntax understands evidence suggesting the presence of a finite VP constituent, such as the numerous verb-plus-object idioms (e.g. *eat shit and die*, *kick the bucket*, *talk trash*, etc.) but almost complete absence of subject-plus-verb idioms. The answer to this question is that dependency syntax views this issue in a similar way to Chomskyan phrase structure syntax. The subject is licensed by the tense feature in the finite verb, whereas the object is licensed by the lexical content of the finite verb. The difference across the two approaches to syntax, though, is that these two licensers, tense and lexical content, are often unified in a single finite verb in dependency syntax. Dependency syntax cannot split them because of the strict one-to-one mapping of words to nodes.

e. Bill gave you these [today] and [yesterday].

f. ?[Bill gave] and [Fred loaned] you these today.

g. Bill [gave you] and [loaned me] these today.

h. Bill gave [you these] and [me those] today.

i. Bill gave you [these today] and [those yesterday].

j. ?[Bill gave you] and [Sue loaned me] these today.

k. Bill [gave you these] and [loaned me those] today.

l. Bill gave [you these today] and [me those yesterday].

m. ?[Bill gave you these] and [he loaned me those] today.

n. Bill [gave you these today] and [loaned me those yesterday].

o. [Bill gave you these today] and [he loaned me those yesterday].

Some of these examples are rather dubious given a neutral intonation contour; they improve, however, if read with rising-falling prosody. Coordination suggests that three times more constituents are present in this case than most of the other tests (15 vs. 5).

The full extent of the problem facing coordination as a test for constituents becomes apparent when one considers what is and is not possible. On a phrase structure approach that takes all branching to be binary, the most overt constituents an analysis of the sentence *Bill gave you these today* can acknowledge is 9 (=5×2-1).[13] Yet sentences (27a–o) illustrate that each of the 15 distinct strings present can be coordinated.[14] Thus, the number of constituents that coordination suggests are present in this case exceeds the number of possible constituents by 6. Note further in this area that examples (27a–o) arguably do not involve the gapping/stripping mechanism. If gapping/stripping cases are also acknowledged, the discrepancy in the numbers grows further because one must also acknowledge cases such as *[Bill gave you these today], and [me those].*

A few of the surveyed texts that employ coordination as a test for syntactic structure acknowledge there are problems with it, as documented in Table 6:

Table 6. Statements hedging the validity of coordination as a test for constituents

Source	Hedges concerning the value of coordination as a test for constituents
Baker (1989: 425)	"In addition to joining words or phrases with conjunctions, we may also join sequences of phrases. (18) a. *Martha went [to Austin] [on Thursday] and [to Dallas] [on Friday]…* For sentences of this sort, it is very difficult to suggest appropriate tree structures."

[13] If covert constituents are also acknowledged, the number of constituents that strictly binary branching structures posit can increase dramatically beyond 9. This is particularly true of the VP shells associated with Larson's (1988) analysis of ditransitive structures.

[14] Note that data of the sort given here as (27a–o) have been (part of) the impetus to pursue very different accounts of constituent structure. For instance, Combinatory Categorial Grammar (Steedman 2000) takes such data as evidence in favor of flexible constituent structure, and Phillips (1996, 2003) develops a dynamic processing approach to constituent structure based on such data.

McCawley (1998: 63)	"An important qualification to the use of coordination as a test for constituent structure is raised by sentences as in (18), in which each conjunct consists of two constituents of the V′ that do not comprise a single constituent as far as we can tell from other tests of constituency: (18) a. *John donated $50 to the Anti-Vivisection Society and $75 to the Red Cross.*"
Adger (2003: 125)	"Coordination, however, sometimes gives results which aren't immediately consistent with other constituency tests, and so it's a test to be used carefully."
Payne (2006: 162)	"… coordination can be a way of confirming what phrasal category a clump belongs to, or whether it is a clump at all. However, it can't be the major way of determining constituent structure."
Kim and Sells (2008: 22)	When discussing coordination: "Even though such syntactic constituent tests are limited in certain cases, they are often adopted in determining the constituent of given expressions."
Carnie (2010: 21)	"Perhaps the most difficult class of constituency tests to apply are those involving coordination…this test is prone to false positives. For example, it would appear as if the subjects and the verbs form constituents as distinct from the object in the following right-node-raising sentence: *[Bruce loved] and [Dory hated] tuna salad sandwiches.*"
Carnie (2013: 100)	"Unfortunately, sometimes it is the case that constituency tests give false results (which is one of the reasons why we haven't spent much time on them in this text). Consider the case of the subject of a sentence and its verb. These do not form a constituent. However, under certain circumstances you can conjoin a subject and verb to the exclusion of the object: (i) *Bruce loved and Kelly hated phonology class.* Sentence (i) seems to indicate that the verb and subject form a constituent, which they don't."
Sportiche et al. (2014: 66)	"Anyone using coordination and ellipsis as constituency tests is likely to run into such puzzling constructions as right node raising and gapping. Since these constructions pose particular problems for the claims we have made so far, it is useful to be familiar with them. The analysis of these constructions is an advanced topic, but the basic problem they raise for the interpretation of the constituent tests so far is easy to describe."
Müller (2016: 16–7)	Coordinate structures like the one in (33) are also problematic: (33) *Deshalb kaufte [der Mann einen Esel] und [die Frau ein Pferd]* 'For that reason bought the man a donkey and the woman a horse.' At first blush, it would seem that *der Mann einen Esel* and *die Frau ein Pferd* are now each a constituent. But as other tests for constituents show, the notion that these strings are constituents is not supported…" (Translated from German)

These statements demonstrate that some of the linguists who employ coordination as a test for constituents are aware of the problems associated with it. They also illustrate that the contradictory data delivered by coordination are addressed by augmenting the theory of coordination in terms of gapping and RNR.

The extent to which the acknowledgment of additional mechanisms associated with coordination can rectify coordination as a test for constituents depends on the understanding of these mechanisms (gapping, stripping, right node raising [RNR], and non-constituent conjuncts [NCC]). The literature is massive in this area and the accounts vary in major ways. It should be apparent, however, that the validity of coordination as a test for constituents is directly reliant on the merits of these accounts. In the absence of convincing theories of gapping, stripping, RNR, and NCC, the value of coordination as a test for constituents is seriously reduced.

7.2 One-substitution

The substitution of the pronominal count noun *one* into an NP is another test that seems to support the existence of subphrasal constituents (in NPs). *One*-substitution is, however, much more restricted in its applicability than coordination, since it is helpful only when investigating the structure of NPs. Nevertheless, *one*-substitution is widely employed (21 texts, see Table 1). The majority of authors that use *one*-substitution do so only briefly, though, on just a page or two. Their intent is not to consider the merits of the test or to explore the problems with it, but rather they introduce the test as a means of motivating one or another layered analysis of NPs. The following discussion demonstrates that scrutiny of *one*-substitution as a test for constituents is warranted, since when one takes a closer look, the test is in fact not a reliable test for identifying constituents. Note that the sort of evidence produced here against the value of *one*-substitution as a test for constituents is not new (cf. Culicover and Jackendoff 2005, Payne et al. 2013; Goldberg and Michaelis 2017).

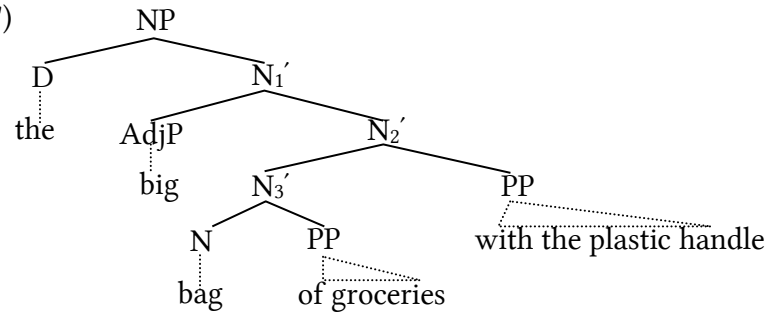
One-substitution is typically employed to motivate the existence of intermediate phrases inside NPs (referred to as N′s). Carnie (2010: 114–5, 125–6) provides a good example of the reasoning. Based on sentences such as (28), Carnie sees motivation for positing layered structures for NPs in the spirit of the X-bar schema:

(28)a. I bought the big bag of groceries with the plastic handle, not the small **one**.

b. I bought the big bag of groceries with the plastic handle, not the small **one** with the ugly logo.

Each of these sentences has a reading where pronominal *one* takes the underlined string as its antecedent. Such data therefore seem to motivate a syntactic structure along the following lines (adapted slightly from Carnie 2010: 114):

(28')



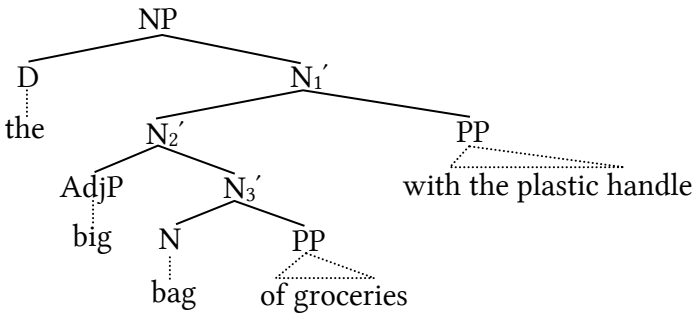
This analysis accommodates (28a–b) insofar as the underlined string each time is a constituent: the underlined string in (28a) is N_2' and the underlined string in (28b) is N_3'. The reasoning Carnie produces in this area is present in many of the 21 texts surveyed that use *one*-substitution. By and large the assumption is that in order to accommodate the data delivered by *one*-substitution, one has to posit layered structures for NPs, structures containing intermediate N′ constituents.

There is a problem facing the reasoning concerning intermediate N' constituents, though, a problem that is overlooked by most of the 21 texts listed in Table 1 that employ the *one*-test. This problem becomes evident with the following additional datum:

(28) c. I bought the <u>big bag of groceries</u> with the plastic handle, not the **one** with the ugly logo.

This sentence suggests that *big bag of groceries* should also form a constituent. Carnie's analysis in (28′) does not, however, grant this string the status of a constituent. Based on example (28c), the following analysis would seem appropriate:

(28″)



This tree now views *big bag of groceries* as a constituent in line with (28c). Crucially, however, it no longer views *bag of groceries with a plastic handle* as a constituent, so it does not accommodate example (28a). To state the problem more clearly, there is no plausible single analysis that can simultaneously view all three of the relevant strings (*bag of groceries with a plastic handle*, *bag of groceries*, and *big bag of groceries*) as constituents. The data thus reveal a type of bracketing paradox.

This problem is not acknowledged by most of the 21 texts surveyed that employ the *one*-test. Four of the texts do acknowledge the problem, however: Cowper (1992: 30), Napoli (1993: 425), Burton-Roberts (1997: 187), and Carnie (2013: 190–2). While Napoli recommends caution concerning conclusions based on *one*-substitution (and *do-so*-substitution), the solution to the problem that Cowper, Burton-Roberts, and Carnie suggest is to assume that NPs can have two (or more) distinct structures. Carnie's (2013) account in this area is particularly noteworthy, since he acknowledges a nuanced meaning difference across the competing structural analyses.

But even if one is willing to allow the structure of NPs to be flexible, there are further cases that simply cannot be accommodated by allowing flexible constituent structure. Based on examples such as the following ones, Culicover and Jackendoff (2005) reject the use of *one* as a test for constituents:

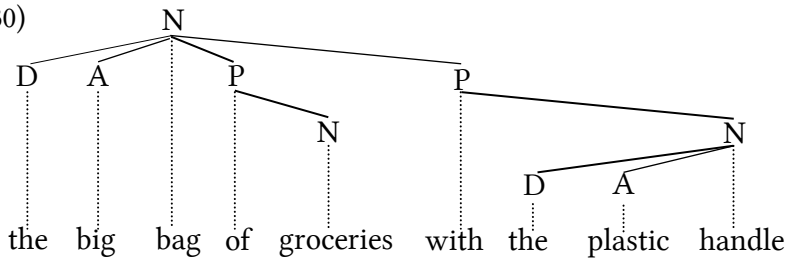
(29) a. that silly <u>picture of Robin</u> from Mary <u>that is on the table</u>, and this artful **one** from Susan (Culicover and Jackendoff 2005: 137)

b. that <u>silly picture of Robin</u> from Mary <u>that is on the table</u>, and this **one** from Susan (Culicover and Jackendoff 2005: 137)

The pronominal count noun *one* takes *picture of Robin…that is on the table* as its antecedent in (29a) and *silly picture of Robin…that is on the table* as its antecedent in (29b). Barring an approach that allows discontinuous constituents, there is no structural analysis of (29a–b) that could assign these word combinations the status of constituents. Thus, Culicover and Jackendoff altogether reject the notion that pronominal *one* identifies constituents.

Based in part on the behavior of *one*, Culicover and Jackendoff assume a relatively flat analysis of NPs in place of the more widely assumed layered analyses like (28′) and (28″) discussed by Carnie and assumed by many others. Dependency-based syntax agrees with Culicover and Jackendoff's flat analysis of NP structure. The dependency-based analysis of the relevant NP from examples (28a–c) is as follows:

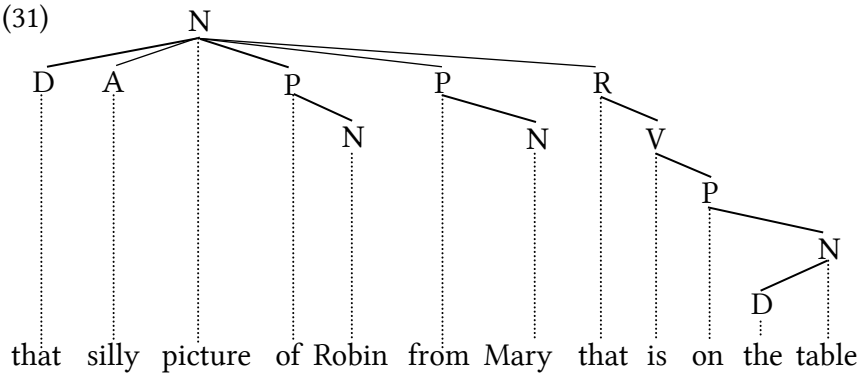
(30)



While the strings that pronominal *one* takes as its antecedent in (28a–c) (*bag of groceries with a plastic handle*, *bag of groceries*, and *big bag of groceries*) certainly do not qualify as constituents on this flat analysis, they do qualify as *catenae* (Osborne et al. 2012). A catena is *a word or a combination of words that are linked together by dependencies*, that is, a catena is any *subtree* (complete or incomplete). Since the catena unit is a well-defined unit of structure, a flat analysis like this one is in a strong position to accommodate the distribution of pronominal *one*.

The dependency-based approach that acknowledges catenae is also capable of accommodating Culicover and Jackendoff's examples:

(31)



The discontinuous word combinations that *one* takes as its antecedent in (29a–b) are catenae on this analysis. The word combination *picture of Robin…that is on the table* in (29a) is a catena in (31) because *picture* immediately dominates *of Robin* and *that is on the table*. Similarly, the word combination *silly picture of Robin…that is on the table* of (29b) is also a catena in (31) because *picture* immediately dominates *silly*, *of Robin*, and *that is on the table*.

To summarize, the numerous texts that employ the pronominal count noun *one* as a test for the structure of NPs largely overlook the data that contradict the layered analyses they assume. The distribution of pronominal *one* cannot be construed as identifying constituents. The distribution of *one* is in fact consistent with the relatively flat NPs assumed by a dependency grammar that acknowledges the catena unit.

7.3 Do-so-substitution

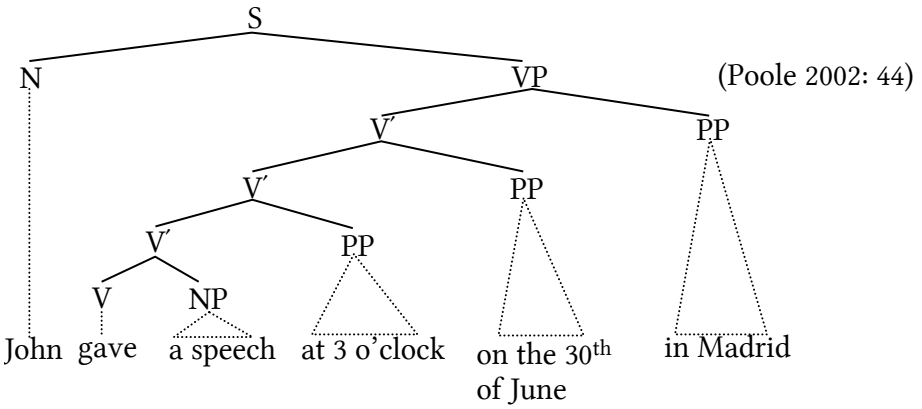
Do-so-substitution is a third widely-employed test that appears to support the existence of subphrasal constituents. Like *one*-substitution, *do-so*-substitution is seen as delivering evidence for layered analyses of sentence structure. *Do-so*-substitution is also like *one*-substitution insofar as it is much more limited than coordination in its applicability; since *do* is a verb, *do-so*-substitution delivers clues about the structure of strings containing one or more verbs only. The discussion below demonstrates that *do-so*-substitution does in fact *not* support the existence of subphrasal constituents, but rather it is consistent with dependency syntax in the same way as *one*-substitution (Osborne and Groß 2016). The problems that *do-so*-substitution faces are of the same nature as those facing the *one*-substitution (the *one*-test is not focused on in Osborne and Groß 2016).

Poole (2002: 41–4) provides good representative examples and a discussion of how *do-so*-substitution is employed to motivate layered VPs. The following examples and tree structure illustrate the same sort of reasoning for *do so* that was just described above for pronominal *one*:

(32) a. John gave a speech at 3 o'clock on the 30th of June in Madrid, and Mary **did so** at 5 o'clock on the 27th of September in Valencia

b. John gave a speech at 3 o'clock on the 30th of June in Madrid, and Mary **did so** on the 27th of September in Valencia

c. John gave a speech at 3 o'clock on the 30th of June in Madrid, and Mary **did so** in Valencia.



(Poole 2002: 44)

In each of (32a–c), *do so* takes the underlined string as its antecedent. Poole accommodates these data with the tree, which shows each of the underlined strings as a V′ (*V-bar*) constituent.

The striking aspect of Poole's analysis concerning (32a–c) is that the data set is not extended to similar cases. The following examples are not included:

(32) d. John gave a speech at 3 o'clock on the 30th of June in Madrid, and Mary **did so** at 5 o'clock.

e. John gave a speech at 3 o'clock on the 30th of June in Madrid, and Mary **did so** at 5 o'clock in Valencia.

f. John gave a speech at 3 o'clock on the 30th of June in Madrid, and Mary **did so** on the 27th of September.

The underlined strings now do not qualify as constituents in the tree. Like pronominal *one*, *do so* can take a discontinuous word combination as its antecedent. Of the 23 sources listed in Table 1 that use *do-so*-substitution, only one, Napoli (1993: 425), acknowledges a problem; for her, the validity of the test is in question. Culicover and Jackendoff (2005: 125) also call attention to cases like (32d–f); the example they give is similar: *Robin slept for twelve hours in the bunkbed, and Leslie* ***did so*** *for eight hours*. They therefore reject the test and assume flat VPs accordingly.

Poole's reasoning might attempt to save *do-so-substitution* by conceding that *do so* can take a non-constituent word combination as its antecedent, but at the same time by stipulating that the words that *do so* actually replaces can in fact be construed as a constituent due to the flexible word order associated with adjuncts. For instance, example (32d) without *did so* would actually have the following word order:

(32) d′. John gave a speech at 3 o'clock on the 30th of June in Madrid, and Mary **gave a speech on the 30th of June in Madrid** at 5 o'clock.

On this analysis, when *did so* appears it actually does replace a string of words, although this fact is obscured. While such a stipulation might work for examples (32d–f), it does not work in other cases, e.g.

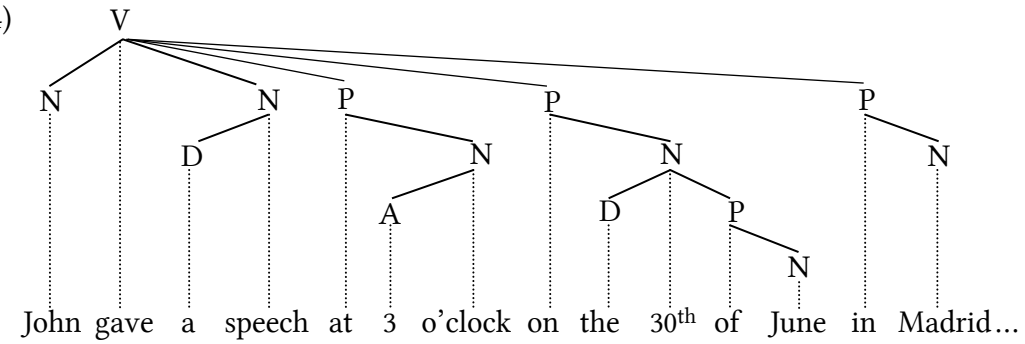
(33) a. Bill spends time in the mall so that he can meet lots of girls, and Fred **does so** in the movie theater.

b. *Bill spends time in the mall so that he can meet lots of girls, and Fred **spends time so that he can meet lots of girls** in the movie theater.

The alternative word order given in (33b) is not acceptable; the relatively heavy finite clause *so that he can meet lots of girls* cannot precede the much lighter PP *in the movie theater*.

The dependency-based analysis in terms of catenae is not confronted with these difficulties:

(34)



On this analysis, each of the word combinations underlined in examples (32a–f) is a catena, and this is so even in (32d–f), where the underlined words do not qualify as strings. The nature of *do-so*-substitution is hence that *do so* replaces a catena that must minimally contain

the verb. Flexibility of interpretation is possible concerning the adjunct dependents of the verb, that is, which of them should be interpreted as also being replaced by *one*.

To summarize this section and the last, the widespread use of *one*-substitution and *do-so*-substitution to motivate the existence of subphrasal constituents inside NPs and VPs, i.e. bar-level constituents, overlooks important data. In fact, there seems to be willingness to overlook the contradictory cases of the sort discussed here. Relatively flat, dependency analyses of NPs and VPs that acknowledge the catena unit are capable of accommodating the data delivered by *one*- and *do-so*-substitutions. These dependency-based structures have two advantages over the more layered phrase structures: they accommodate a wider range of data, such as examples (32d–f) and (33), at the same time that they are consistent with the other tests for constituents discussed above, these other tests not verifying the existence of subphrasal constituents.

8. Other languages

The discussion so far has focused on data from English. In this respect, one can object that the account of the tests for constituents above is not so relevant from a cross-linguistic point of view, since the extent to which the tests are relevant for other languages is not apparent. Some of the tests explored here may not be directly applicable to the syntax of other languages, especially languages with freer word order than that of English. The account here concedes this point, but the importance of this concession should not be overestimated. There are a couple of considerations that elevate the importance of the data from English, and one should also not ignore the fact that some of the tests employed above are likely valid for many other languages beyond English.

The texts surveyed above focus mainly on the syntax of English, and a majority of the authors of these texts are native speakers of English. The tests have thus been developed primarily with the syntax of English in mind. Consider in this regard that phrase structure syntax has generally been viewed as appropriate for the syntax of languages like English, whereas syntax in terms of dependencies is deemed more capable of accommodating languages with freer word order. The discussion above has demonstrated that this perception of the two basic possibilities for modeling the syntax of natural languages is not accurate. Dependency syntax is in fact more capable than phrase structure syntax of modeling the constituent structure of English, which is, again, a language with relatively strict word order.

The syntax of English has exercised and continues to exercise tremendous influence on the study of syntax as a discipline internationally. Many prominent syntacticians on the international stage are/were native speakers of English (e.g. Bloomfield, Chomsky, Sag, Lasnik, Harris, Bresnan, Langacker, Goldberg, Jackendoff, Culicover, Larson, among many others). These linguists have written a lot about the syntax of English, and so when their works are read, the exposure gained is mainly exposure to the syntax of English. In these respects, it is difficult to underestimate the importance of texts written in English primarily about English for the development of syntactic theory in general.

Many of the textbooks surveyed are used in English departments at colleges and universities around the world. These texts are thus influencing young linguists when they first gain exposure to the formal study of syntax. The importance of the tests should also not be underestimated in this regard. First exposure leaves an impression, and if this impression

does not match the linguistic facts, then correcting the faulty impression can be difficult, requiring much more exposure to the facts at a later stage.

These points about the importance of English on the development of syntactic theory established, some of the tests discussed above should also be valid for many other languages. This is particularly true of proform substitution and answer fragments. Most if not all languages have proforms that can be used to probe syntactic structure, and most if not all languages employ question-answer pairs to illicit information in communicative situations.[15] And further, most languages have various means to focus constituents, these means perhaps being similar to the clefting and pseudoclefting constructions of English.

9. Concluding statement

This article has scrutinized the tests for constituents that are widely employed in syntax, linguistics, and grammar books and textbooks. This scrutiny has revealed that the results of most of the tests are more consistent with dependency syntax than with phrase structure syntax. Syntax in terms of phrase structure posits more structure than most of the tests can motivate. The issue is understood best in terms of phrasal and subphrasal constituents. Most tests for constituents identify phrasal constituents only; they do not support the existence of subphrasal constituents. This situation is consistent with dependency syntax, because most subphrasal constituents are not constituents in dependency syntax to begin with.

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[15] An anonymous reviewer points to a potential difficulty for the reasoning employed in this article when using the answer fragment test in other languages. Many languages produce answers to polar questions consisting of an auxiliary verb alone, as illustrated with the next example from Mandarin:

(i) *Wǒ néng dāi zài kā fēi diàn ma? – Néng.*
I may stay in café shop INT may
'May I stay in the café?' – You may.

The answer *Néng* consists of the auxiliary verb alone, which would seem to contradict the dependency grammar assumption that the auxiliary is the root of sentence (which means that it alone is not a dependency grammar constituent). This is an open issue that must be conceded at this point. One avenue of accounting for such data, though, is to assume ellipsis of the subject in terms of null anaphora combined with VP ellipsis of the nonfinite verb phrase. Support for this sort of approach is evident in the acceptability of the answer that includes the subject: *Wǒ néng dāi zài kā fēi diàn ma? – Nǐ néng.* 'Can I stay in the café? – You may.' Note that VP-ellipsis occurs frequently in Mandarin, as does null complement anaphora.

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Appendix: Fifteen tests for constituents

The 15 tests for constituents that are mentioned, discussed, and employed in this article are introduced here in one spot, so as to increase the accessibility of the article's content. The tests are illustrated using the test sentence *Frank has been working on the first problem at night*.

The coordination test checks to see if the target string can be coordinated with a similar string using *and*, *or*, or *but* to form a coordinate structure, e.g.

(A) a. [**Frank**] and [Sam] have been working on the first problem.

b. Frank has been working on [**the first problem at night**] and [the second one during the day].

c. [**Frank has**], but [Sam hasn't], been working on the first problem.

The square brackets mark the conjuncts of the coordinate structure each time, i.e. the coordinated strings. The acceptability of the coordinate structures in these sentences suggests that the strings *Frank*, *the first problem at night*, and *Frank has* are constituents in the test sentence.

Proform substitution replaces the target string in the test sentence with a proform (pronoun, pro-verb, pro-adjective, etc.), e.g.:

(B) a. **He** has been working on **it then**. (*He = Frank, it = the first problem, then = at night*)

b. He has been **doing it**. (*doing it = working on the first problem at night*)

The presence of the pronouns *He* and *it* and the pro-adverb *then* in the acceptable sentence (Ba) suggests that the strings *Frank*, *the first problem* and *at night* are constituents in the test sentence. The same is true of the pro-verb *doing it* in sentence (Bb), which indicates that *working on the first problem at night* is a constituent in the test sentence.

The topicalization test moves the target string to the front of the sentence. Such frontings can be of questionable acceptability when taken out of context, so the examples here suggest context by including *…and*. In addition, an adverb can be added, e.g. *certainly*:

(C) a. …and **at night** Frank has been working on the first problem.

b. …and **the first problem**, Frank has been working on at night.

c. …and **working on the first problem at night**, Frank (certainly) has been.

These examples suggest that the strings *at night*, *the first problem*, and *working on the first problem at night* are constituents in the test sentence.

The *do-so*-substitution test replaces the target string with *do so*. Since the *do* of *do so* is a verb, this test is only useful when probing the structure of strings containing verbs, e.g.

(D) a. Frank has been **doing so**. (*doing so = working on the first problem at night*)

b. Frank has been **doing so** at night. (*doing so = working on the first problem*)

c. Frank **does so**. (*does so ≠ has been working on the first problem at night*)

Sentences (Da) and (Db) suggest that *working on the first problem at night* and *working on the first problem* are constituents in the target sentence. Note, however, that sentence (Dc) does not allow one to construe *has been working on the first problem at night* as a constituent, since there is a mismatch in aspect across the test sentence and (Dc) (present perfect progressive vs. simple present).

The *one*-substitution test is similar to the *do-so*-substitution test in its limited applicability. Since *one* has the status of a count noun, the test can probe the structure of noun phrases containing a count noun only, e.g.

(E) a. the first problem about ellipsis and the second **one** about anaphora

b. the first problem about ellipsis and the **one** about anaphora

c. the *first* problem about ellipsis and the second **one**, too

The pronoun *one* can be interpreted as standing in for the underlined string each time, hence such data suggest that the strings *problem*, *first problem*, and *problem about ellipsis* should have the status of constituents in the noun phrase *the first problem about ellipsis*.

The answer fragment test checks to see if the target string can stand alone as the answer to a question that contains a single question word (*what*, *who*, *when*, *where*, *how*, etc.), e.g.

(F) a. **Who** has been working on the first problem? – **Frank**.

b. **What** has Frank been working on? – **The first problem**.

c. **When** has Frank been working on the first problem? – **At night**.

The acceptability of these answer fragments suggests that the strings *Frank*, *the first problem*, and *at night* are constituents in the test sentence. An important caveat associated with this test is the requirement that the structure and content of the question correspond as closely as possible to the structure and content of the test sentence.

The clefting test positions the target string as the pivot of a cleft sentence. Cleft sentences in English begin with *it* followed by a form of the copula (*is*, *are*, *was*, *were*), and the pivot immediately follows the copula. A relative clause then fills out the rest of the sentence, e.g.

(G) a. It is **Frank** who has been working on the first problem at night.

b. It is **the first problem** that Frank has been working on at night.

c. It is **on the first problem** that Frank has been working at night.

The acceptability of these sentences suggests that the strings *Frank*, *the first problem*, and *on the first problem* are constituents in the test sentence. The structure and content of the relative clause should correspond as directly as possible to the structure and content of the test sentence.

The VP-ellipsis test omits the target string. This test is only suited for probing the constituent structure of strings that include predicative elements, verbs being the most prominent type of predicative element, e.g.

(H) Sam has been working on the first problem at night, and

a. Frank has been working on the first problem at night also.

b. Frank has been working on the first problem at night also.

c. Frank has been working on the first problem during the day.

d. Frank has been working on the first problem during the day.

The light font shade indicates ellipsis, i.e. the omission of the target string. The acceptability of these examples suggests that the strings marked with a light font shade are constituents in the test sentence.

The pseudoclefting test focuses the target string by positioning it immediately before or after the copula in a sentence including a free relative clause beginning with *what*, e.g.

(I) a. What Frank has been working on at night is **the first problem**.
a′. **The first problem** is what Frank has been working on at night.

b. What Frank has been doing is **working on the first problem at night**.

c. What Frank has been doing at night is **working on the first problem**.

There are two variants of pseudocleft sentences, as indicated with (Ia) and (Ia′). The acceptability of these sentences suggests that the strings *the first problem*, *working on the first problem at night*, and *working on the first problem* are constituents in the test sentence. Note that the necessity to employ a free relative clause introduced by *what* is a limitation on this test. A related test employs a normal relative clause. In this manner, one can test for the constituent status of animate noun phrases, e.g. *The one who has been working on the first problem at night is* ***Frank***.

The passivization test switches between the active and passive variants of a sentence. The phrases that change functional status in the process are deemed constituents, e.g.

(J) a. **Frank** has been working on **the first problem** at night. – Active

b. **The first problem** has been worked on at night by **Frank**. – Passive

Based on these data, one can conclude that the strings *Frank* and *the first problem* are constituents in the test sentence. The passivization test is limited in its applicability, since it only identifies subjects and objects (including oblique objects) as constituents.

The omission test is easy to use; one need merely omit the target string from the test sentence. If the resulting sentence is acceptable and there is no major shift in meaning, then the target string is likely a constituent, e.g.

(K) a. Frank has been working on the **first** problem **at night**.

b. Frank has been working on the problem.

Based on the acceptability of sentence (Kb), one can conclude that the strings *first* and *at night* are constituents in sentence (Ka) (note that one would not conclude that *first* and *at night* form a single constituent together, for they are discontinuous and must hence be interpreted as distinct constituents). Like the passivization test, the omission test is quite limited in its applicability, since it is incapable of identifying constituents that appear obligatorily. In other words, it succeeds at identifying only those constituents that appear optionally.

The intrusion test inserts an adverb into the test sentence to see if the target string can be separated from the rest of the sentence, e.g.

(L) a. Frank **certainly** has been working on the first problem at night.

b. Frank has **certainly** been working on the first problem at night.

Sentence (La) suggests that the string *Frank*, which appears to the left of the adverb *certainly*, and the string *has been working on the first problem at night*, which appears to the right of *certainly*, are constituents. Further, sentence (Lb) suggests that *Frank has* and *working on the first problem at night* are constituents. Finally, the combination of (La) and (Lb) suggest that *has* is also a constituent. Note that neither sentence (La) nor sentence (Lb) alone suggests that *has* is a constituent, but rather only the combination of the two allows one to reach such a conclusion.

The wh-fronting test consists of just the first part of the answer fragment test, namely of just the question. If the target string can be fronted as a wh-expression, then it is likely a constituent, e.g.

(M) a. **Who** has been working on the first problem at night? (*who* ↔ *Frank*)

b. **What** has Frank been working on at night? (*what* ↔ *the first problem*)

c. **On what** has Frank been working at night? (*on what* ↔ *on the first problem*)

d. **When** has Frank been working on the first problem? (*when* ↔ *at night*)

e. **What** has Frank been doing? (*what…doing* ↔ *working on the first problem at night*)

The acceptability of these questions suggests that the strings *Frank*, *the first problem*, *on the first problem*, *at night*, and *working on the first problem at night* are constituents in the test sentence.

The general substitution test replaces the test string with a single word, e.g.

(N) a. **Sam** has been working on the **second question** at night. (*Sam* ↔ *Frank*, *second* ↔ *first*, *question* ↔ *problem*)

b. Sam has been **sleeping**. (*sleeping* ↔ *working on the second problem at night)*

Based on the acceptability of these sentences, one might conclude that the strings *Frank*, *first*, *problem*, and *working on your second problem at night* are constituents in the test sentence. This test is similar to the proform substitution test, the only difference being that general substitution employs non-proforms.

The right node raising (RNR) test checks to see if the target string can appear to the right of a coordinate structure and be shared by the conjuncts of a coordinate structure.

(O) a. [Frank has been working on the first problem] and [Sam has been working on the second problem] **at night**.

b. ?[Frank has been working on], and [Sam has been altering carefully] **the first problem at night**.

The acceptability of sentence (Oa) suggests that *at night* is a constituent in the test sentence, and the marginality of example (Ob) suggests that *the first problem at night* could perhaps be a constituent. The RNR diagnostic is limited in the strings that it can test, since the target string must appear at the end of the sentence.

About the author

Timothy Osborne did his BA in German at Colorado State University and his Ph.D. in German (with a specialization in linguistics) at Pennsylvania State University, where he then worked for a number of years as an adjunct professor. During his studies, he spent several years in Germany in Regensburg, Flensburg, and Kiel. He is currently an associate professor of linguistics at Zhejiang University in Hangzhou, China. His research efforts are in theoretical syntax, focusing on various phenomena, such as coordination, comparatives, ellipsis, scope, predicate-argument structures, etc. He (in collaboration with Sylvain Kahane) translated Lucien Tesnière's monumental work *Éléments de syntaxe structurale* (1959) to English, the translated volume appearing in 2015. He has been a consistent advocate for dependency grammar (DG) throughout his academic career.