4

Complex Feature Values

4.1 Introduction

By reanalyzing grammatical categories feature structures, we were able to codify the relatedness of syntactic categories and to express the property of headedness via a general principle: the Head Feature Principle. The grammar of the preceding chapter not only provides a more compact way to represent syntactic information, it also systematically encodes the fact that phrases of different types exhibit parallel structures. In particular, the rules we gave in the previous chapter suggest that lexical head daughters in English uniformly occur at the left edge of their phrases.[1] Of course, VPs and PPs are consistently head-initial. In addition, assuming our analysis of NPs includes the intermediate-level category NOM, nouns are initial in the phrases they head, as well. The Chapter 3 grammar thus expresses a correct generalization about English phrases.

One motivation for revising our current analysis, however, is that our rules are still not maximally general. We have three distinct rules introducing lexical heads, one for each of the three COMPS values. This would not necessarily be a problem, except that, as noted in Chapter 2, these three valences are far from the only possible environments lexical heads may require. Consider the examples in (1):

(1) a. Pat relies on Kim.
 b.*Pat relies.
 c. The child put the toy on the table.
 d.*The child put the toy.
 e. The teacher became angry with the students.
 f.*The teacher became.
 g. The jury believed the witness lied.

Examples (1a,b) show that some verbs require a following PP; (1c,d) show that some verbs must be followed by both an NP and a PP; (1e,f) show a verb that can be followed by a kind of phrase we have not yet discussed, called an adjective phrase (AP); and (1g) shows a verb that can be followed by an S. We say only that *became* CAN be followed by an AP and that *believed* CAN be followed by an S, because they can also appear in sentences like *Pat became an astronaut* and *Pat believed the story*, in which they are

[1] This is not true in some other languages, e.g. in Japanese, the lexical head daughters are phrase-final, resulting in SOV (Subject-Object-Verb) ordering, as well as noun-final NPs.

followed by NPs. In fact, it is extremely common for verbs to be able to appear in multiple environments. Similarly, (2) shows that *ate*, like many other English verbs, can be used either transitively or intransitively:

(2) The guests ate (the cheese).

Facts like these show that the number of values of COMPS must be far greater than three. Hence, the Chapter 3 grammar would have to be augmented by many more grammar rules in order to accommodate the full range of verbal subcategories. In addition, given the way COMPS values are keyed to rules, a worrisome redundancy would arise: the lexical distinctions would all be encoded twice – once in the phrase structure rules and once in the (many) new values of COMPS that would be required.

Exercise 1: More Subcategories of Verb
There are other subcategories of verb, taking different combinations of complements than those illustrated so far. Think of examples of as many as you can. In particular, look for verbs followed by each of the following sequences: NP-S, NP-AP, PP-S, and PP-PP.

Intuitively, we would like to have one rule that simply says that a phrase (a VP, in the cases above) may consist of a lexical head (a V, in these cases) followed by whatever other phrases the lexical head requires. We could then relegate to the lexicon (and only to the lexicon) the task of specifying for each word what elements must appear together with that word. In this chapter, we develop a way to do just this. It involves enriching our conception of valence features (SPR and COMPS) in a way somewhat analogous to what we did with grammatical categories in the previous chapter. The new conception of the valence features not only allows for more general rules, but also leads to a reduction of unnecessary structure in our trees and to improvements in our analysis of agreement phenomena.

4.2 Complements

4.2.1 Syntactic and Semantic Aspects of Valence

Before we begin the discussion of this analysis, let us consider briefly the status of the kinds of co-occurrence restrictions we have been talking about. It has sometimes been argued that the number and type of complements a verb takes is fully determined by its meaning. For example, the verb *disappear* is used to describe events involving a single entity (expressed by its subject); *deny*'s semantics involves events with two participants, one typically human and the other a proposition; and an event described by *hand* must include three participants: the person who does the handing, the thing handed, and the recipient of the transaction. Correspondingly, *disappear* takes no complements, only a subject; *deny* takes a subject and a complement, which may be either an NP (as in *The defendant denied the charges*) or an S (as in *The defendant denied he was guilty*); and *hand* takes a subject and two NP complements (or one NP and one PP complement).

It is undeniable that the semantics of a verb is intimately related to its valence. There is, however, a certain amount of syntactic arbitrariness to it, as well. For example, the words *eat, dine*, and *devour* all denote activities necessarily involving both a consumer of food and the food itself. Hence, if a word's valence were fully determined by its meanings, one might expect that all three would be simple transitives, requiring a subject and an NP complement (that is, a direct object). But this expectation would be wrong – *dine* is intransitive, *devour* is obligatorily transitive, and (as noted above), *eat* can be used intransitively or transitively:

(3) a. The guests devoured the meal.
b.*The guests devoured.
c.*The guests dined the meal.
d. The guests dined.
e. The guests ate the meal.
f. The guests ate.

Thus, though we recognize that there is an important link between meaning and valence, we will continue to specify valence syntactically. We will say more about the connection between meaning and valence – and more generally about the syntax-semantics interface – in later chapters.

4.2.2 The COMPS Feature

In the Chapter 3 grammar, the lexical entry for a verb like *deny* would specify that it is [COMPS str]. This ensures that it can only appear in word structures whose mother node is specified as [COMPS str], and such word structures can be used to build larger structures only by using the rule of our grammar that introduces an immediately following NP. Hence, *deny* has to be followed by an NP.[2] As noted above, the co-occurrence effects of complement selection are dealt with by positing both a new COMPS value and a new grammar rule for each co-occurrence pattern.

How can we eliminate the redundancy of such a system? An alternative approach to complement selection is to use features directly in licensing complements – that is, to have a feature whose value specifies what the complements must be. We will now make this intuitive idea explicit. First, recall that in the last chapter we allowed some features (e.g. HEAD, AGR) to take values that are feature structures themselves. If we treat COMPS as such a feature, we can allow its value to state directly what the word's complement must be. The value of COMPS for *deny* can simply be an NP, as shown in (4):

(4) $$\begin{bmatrix} \text{COMPS} & \begin{bmatrix} \textit{phrase} & \\ \text{HEAD} & \textit{noun} \\ \text{SPR} & + \end{bmatrix} \end{bmatrix}$$

and in abbreviated form in (5):

(5) $$\begin{bmatrix} \text{COMPS} & \text{NP} \end{bmatrix}$$

Similarly, we can indicate that a verb takes another type of complement: *rely, become*, and *believe*, for example, can take COMPS values of PP, AP, and S, respectively. Optional

[2] Soon, we will consider the other possible environment for *deny*, namely the one where it is followed by a clause.

complements, such as the object of *eat* can be indicated using parentheses; that is, the lexical entry for *eat* can specify [COMPS (NP)]. Likewise, we can indicate alternative choices for complements using the vertical bar notation introduced in the discussion of regular expressions in Chapter 2. So the entry for *deny* or *believe* includes the specification: [COMPS NP | S].

Of course there is a problem with this proposal: it does not cover verbs like *hand* and *put* that require more than one complement. But it's not hard to invent a straightforward way of modifying this analysis to let it encompass multiple complements. Instead of treating the value of COMPS as a single feature structure, we will let it be a LIST of feature structures.[3] Intuitively, the list specifies a sequence of categories corresponding to the complements that the word combines with. So, for example, the COMPS values for *deny, become*, and *eat* will be lists of length one. For *hand*, the COMPS value will be a list of length two, namely ⟨ NP , NP ⟩. For verbs taking no complements, like *disappear*, the value of COMPS will be ⟨ ⟩ (a list of length zero). This will enable the rules we write to ensure that a tree containing a verb will be well-formed only if the sisters of the V-node can be identified with the categories specified on the list of the verb. For example, *rely* will only be allowed in trees where the VP dominates a V and a PP.

Now we can collapse all the different rules for expanding a phrase into a lexical head (**H**) and other material. We can just say:

(6) Head-Complement Rule

$$\begin{bmatrix} \textit{phrase} \\ \text{VAL} \quad \begin{bmatrix}\text{COMPS} \quad \langle\ \rangle\end{bmatrix} \end{bmatrix} \rightarrow \mathbf{H}\begin{bmatrix} \textit{word} \\ \text{VAL} \quad \begin{bmatrix}\text{COMPS} \quad \langle\, \boxed{1}\,, \ldots, \boxed{n}\,\rangle\end{bmatrix} \end{bmatrix} \quad \boxed{1} \ldots \boxed{n}$$

The tags in this rule enforce identity between the non-head daughters and the elements of the COMPS list of the head. The $\boxed{1} \ldots \boxed{n}$ notation allows this rule to account for phrases with a variable number of non-head daughters. *n* stands for any integer greater than or equal to 1. Thus, if a word is specified lexically as [COMPS ⟨ AP ⟩], it must co-occur with exactly one AP complement; if it is [COMPS ⟨ NP , NP ⟩], it must co-occur with exactly two NP complements, and so forth. Finally, the mother of any structure licensed by (6), which we will call a HEAD-COMPLEMENT PHRASE, must be specified as [COMPS ⟨ ⟩], because that mother must satisfy the description on the left-hand side of the rule.[4]

In short, the COMPS list of a lexical entry specifies a word's co-occurrence requirements; and the COMPS list of a phrasal node is empty. So, in particular, a V must have sisters that match all the feature structures in its COMPS value, and the VP that it heads has the empty list as its COMPS value and hence cannot combine with complements. The Head-Complement Rule, as stated, requires all complements to be realized as sisters of the lexical head.[5]

---

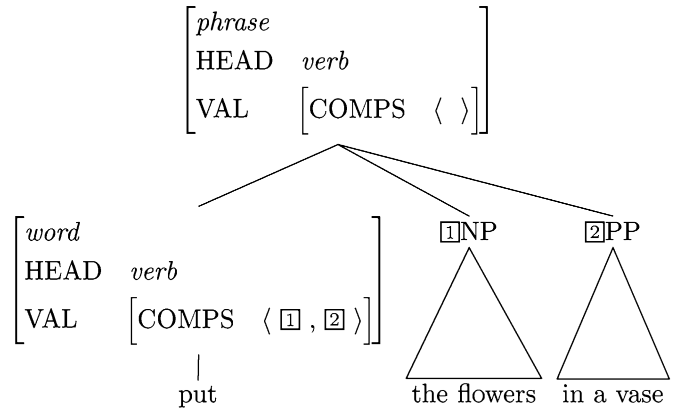
[3]Recall that we used this same technique to deal with multiple founders of organizations in our feature-structure model of universities presented at the beginning of Chapter 3.

[4]Note that by underspecifying the complements introduced by this rule – not even requiring them to be phrases, for example – we are implicitly leaving open the possibility that some complements will be nonphrasal. This will become important below and in the analysis of negation presented in Chapter 13.

[5]This flat structure appears well motivated for English, but our general theory would allow us to write a Head-Complement Rule for some other language that allows some of the complements to be introduced higher in the tree structure. For example, structures like the one in (i) would be allowed by a version of the Head-Complement Rule that required neither that the head daughter be of type *word*

If you think in terms of building the tree bottom-up, starting with the verb as head, then the verb has certain demands that have to be satisfied before a complete, or 'saturated', constituent is formed. On this conception, the complements can be thought of as being 'cancelled off' of the head daughter's COMPS list in the process of building a headed phrase. We illustrate this with the VP *put the flowers in a vase*: the verb *put* requires both a direct object NP and a PP complement, so its COMPS value is ⟨ NP , PP ⟩. The requisite NP and PP will both be sisters of the V, as in (7), as all three combine to form a VP, i.e. a verbal phrase whose complement requirements have been fulfilled:

(7)

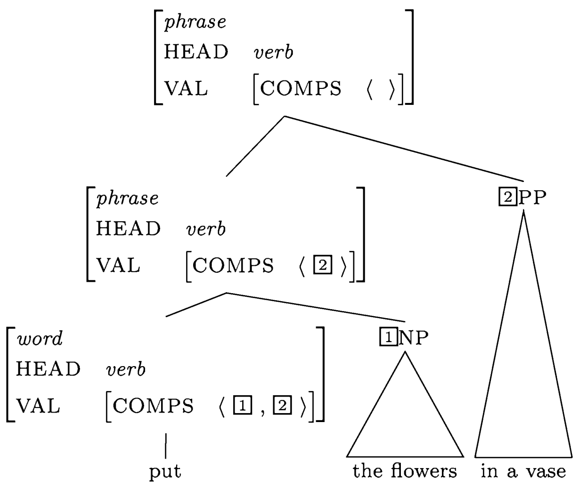


As is evident from this example, we assume that the elements in the value of COMPS occur in the same order as they appear in the sentence. We will continue to make this assumption, though ultimately a more sophisticated treatment of linear ordering of phrases in sentences may be necessary.

---

nor that the mother have an empty COMPS list:

(i) Tree Licensed by a Hypothetical Alternative Head-Complement Rule:



Such grammatical variations might be regarded as 'parameters' that are set differently in particular languages. That is, it may be that all languages manifest the Head-Complement Rule, but there are minor differences in the way languages incorporate the rule into their grammar. The order of the head and the complements is another possible parameter of variation.

4.2.3 Complements vs. Modifiers

A common source of confusion is the fact that some kinds of constituents, notably PPs, can function either as complements or as modifiers. This often raises the question of how to analyze a particular PP: should it be treated as a complement, licensed by a PP on the COMPS list of a nearby word, or should it be analyzed as a modifier, introduced by a different grammar rule? Some cases are clear. For example, we know that a PP is a complement when the choice of preposition is idiosyncratically restricted by another word, such as the verb *rely*, which requires a PP headed by *on* or *upon*:

(8) a. We relied on/upon Leslie.
b.*We relied over/with/on top of/above Leslie.

In fact, PPs that are obligatorily selected by a head (e.g. the directional PP required by *put*) can safely be treated as complements, as we will assume that modifiers are always optional.

Conversely, there are certain kinds of PP that seem to be able to co-occur with almost any kind of verb, such as temporal or locative PPs, and these are almost always analyzed as modifiers. Another property of this kind of PP is that they can iterate: that is, where you can get one, you can get many:

(9) a. We celebrated in the streets.
b. We celebrated in the streets in the rain on Tuesday in the morning.

The underlying intuition here is that complements refer to the essential participants in the situation that the sentence describes, whereas modifiers serve to further refine the description of that situation. This is not a precisely defined distinction, and there are problems with trying to make it into a formal criterion. Consequently, there are difficult borderline cases that syntacticians disagree about. Nevertheless, there is considerable agreement that the distinction between complements and modifiers is a real one that should be reflected in a formal theory of grammar.

4.2.4 Complements of Non-verbal Heads

Returning to our analysis of complements, notice that although we have motivated our treatment of complements entirely in terms of verbs and verb phrases, we have formulated our analysis to be more general. In particular, our grammar of head-complement structures allows adjectives, nouns, and prepositions to take complements of various types. The following examples suggest that, like verbs, these kinds of words exhibit a range of valence possibilities:

(10) Adjectives
a. The children are happy.
b. The children are happy with the ice cream.
c. The children are happy that they have ice cream.
d.*The children are happy of ice cream.
e.*The children are fond.
f.*The children are fond with the ice cream.
g.*The children are fond that they have ice cream.
h. The children are fond of ice cream.

(11) Nouns

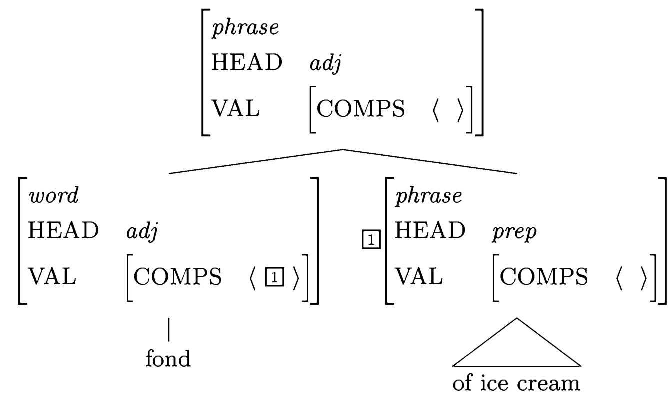
a. A magazine appeared on the newsstands.
b. A magazine about crime appeared on the newsstands.
c. *Newsweek* appeared on the newsstands.
d.**Newsweek* about crime appeared on the newsstands.
e. The report surprised many people.
f. The report that crime was declining surprised many people.
g. The book surprised many people.
h.*The book that crime was declining surprised many people.

(12) Prepositions

a. The storm arrived after the picnic.
b. The storm arrived after we ate lunch.
c. The storm arrived during the picnic.
d.*The storm arrived during we ate lunch.
e.*The storm arrived while the picnic.
f. The storm arrived while we ate lunch.

The Head-Complement Rule can license APs, PPs, and NPs in addition to VPs. As with the VPs, it will license only those complements that the head A, P or N is seeking. This is illustrated for adjectives in (13): the complement PP, tagged $\boxed{1}$, is precisely what the head adjective's COMPS list requires:

(13)



Exercise 2: COMPS Values of Non-Verbal Heads
Based on the examples above, write out the COMPS values for the lexical entries of *happy, magazine, Newsweek, report, book, after, during*, and *while*.

4.3 Specifiers

Co-occurrence restrictions are not limited to complements. As we have noted in earlier chapters, certain verb forms appear with only certain types of subjects. In particular, in the present tense, English subjects and verbs must agree in number. Likewise, as we saw in Problem 3 of Chapter 3, certain determiners co-occur only with nouns of a particular number:

(14) a. This dog barked.
b.*This dogs barked.
c.*These dog barked.
d. These dogs barked.

Moreover, some determiners co-occur only with 'mass' nouns (e.g. *furniture, footwear, information*), and others only with 'count' nouns (e.g. *chair, shoe, fact*), as illustrated in (15):

(15) a. Much furniture was broken.
b.*A furniture was broken.
c.*Much chair was broken.
d. A chair was broken.

We can handle such co-occurrence restrictions in much the same way that we dealt with the requirements that heads impose on their complements. To do so, we will reinterpret the feature SPR in the same way we reinterpreted the feature COMPS. Later in this chapter (see Sections 4.6.1 and 4.6.2), we'll see how we can use these features to handle facts like those in (14)–(15).

Recall that in Chapter 3, we used the term specifier to refer to both subjects and determiners. We will now propose to collapse our two earlier head-specifier rules into one grammar rule that will be used to build both Ss and NPs. In the Chapter 3 grammar, the feature SPR takes atomic values (+ or −) and records whether or not the phrase contains a specifier.[6] On analogy with the feature COMPS, the feature SPR will now take a list as its value. The lexical entry for a verb (such as *sleep*, *deny*, or *hand*) will include the following specification:

(16) $\begin{bmatrix}\text{SPR} & \langle \text{ NP } \rangle\end{bmatrix}$

Likewise, the lexical entry for a noun like *book*, *meal*, or *gift* will include the following specification:

(17) $\begin{bmatrix}\text{SPR} & \langle\ [\text{HEAD}\ \ \textit{det}]\ \rangle\end{bmatrix}$

The decision to treat the value of SPR as a list may strike some readers as odd, since sentences only have a single subject and NPs never have more than one determiner. But notice that it allows the feature SPR to continue to serve roughly the function it served in the Chapter 3 grammar, namely recording whether the specifier requirement of a phrase is satisfied. Indeed, making SPR list-valued provides a uniform way of formulating the

[6] More precisely, whether or not a given phrase has satisfied any needs it might have to combine with a specifier. Recall that proper nouns are also [SPR +] in the Chapter 3 grammar.

idea that a particular valence requirement is unfulfilled (the valence feature – COMPS or SPR – has a nonempty value) or else is fulfilled (the value of the valence feature is the empty list).

We can now redefine the category NOM in terms of the following feature structure descriptions:[7]

(18)
$$\text{NOM} = \begin{bmatrix} \text{HEAD} & \textit{noun} \\ \text{VAL} & \begin{bmatrix} \text{COMPS} & \langle\ \rangle \\ \text{SPR} & \langle \text{ X } \rangle \end{bmatrix} \end{bmatrix}$$

And once again there is a family resemblance between our interpretation of NOM and the description abbreviated by VP, which is now as shown in (19):

(19)
$$\text{VP} = \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{VAL} & \begin{bmatrix} \text{COMPS} & \langle\ \rangle \\ \text{SPR} & \langle \text{ X } \rangle \end{bmatrix} \end{bmatrix}$$

Both (18) and (19) have empty COMPS lists and a single element in their SPR lists. Both are intermediate between categories with nonempty COMPS lists and saturated expressions – that is, expressions whose COMPS and SPR lists are both empty.

Similarly, we can introduce a verbal category that is analogous in all relevant respects to the saturated category NP. This verbal category is the feature structure analog of the familiar category S:

(20)
$$\text{NP} = \begin{bmatrix} \text{HEAD} & \textit{noun} \\ \text{VAL} & \begin{bmatrix} \text{COMPS} & \langle\ \rangle \\ \text{SPR} & \langle\ \rangle \end{bmatrix} \end{bmatrix} \qquad \text{S} = \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{VAL} & \begin{bmatrix} \text{COMPS} & \langle\ \rangle \\ \text{SPR} & \langle\ \rangle \end{bmatrix} \end{bmatrix}$$

Note crucially that our abbreviations for NOM, VP, NP and S no longer mention the type *phrase*. Since these are the constructs we will use to formulate rules and lexical entries in this chapter (and the rest of the book), we are in effect shifting to a perspective where phrasality has a much smaller role to play in syntax. The binary distinction between words and phrases is largely replaced by a more nuanced notion of 'degree of saturation' of an expression – that is the degree to which the elements specified in the head's valence features are present in the expression. As we will see in a moment, there is a payoff from this perspective in terms of simpler phrase structure trees.

Because NP and S now have a parallel formulation in terms of feature structures and parallel constituent structures, we may collapse our old rules for expanding these categories (given in (21)) into a single rule, shown in (22):

[7] The specification [SPR ⟨ X ⟩] represents a SPR list with exactly one element on it. The 'X' is used to represent a completely underspecified feature structure. In the case of a NOM, this element will always be [HEAD *det*], but it would be redundant to state this in the definition of the abbreviation.

(21) Head-Specifier Rules from the Chapter Three Grammar:

a.
$$\begin{bmatrix} \textit{phrase} & \\ \text{VAL} & \begin{bmatrix}\text{COMPS} & \text{itr}\\ \text{SPR} & +\end{bmatrix}\end{bmatrix} \rightarrow \overset{\text{NP}}{\begin{bmatrix}\text{HEAD} & \begin{bmatrix}\text{AGR} & \boxed{1}\end{bmatrix}\end{bmatrix}} \ \mathbf{H}\begin{bmatrix}\textit{phrase} & \\ \text{HEAD} & \begin{bmatrix}\textit{verb} & \\ \text{AGR} & \boxed{1}\end{bmatrix}\\ \text{VAL} & \begin{bmatrix}\text{SPR} & -\end{bmatrix}\end{bmatrix}$$

b.
$$\begin{bmatrix} \textit{phrase} & \\ \text{VAL} & \begin{bmatrix}\text{COMPS} & \text{itr}\\ \text{SPR} & +\end{bmatrix}\end{bmatrix} \rightarrow \text{D} \ \ \mathbf{H}\begin{bmatrix}\textit{phrase} & \\ \text{HEAD} & \textit{noun}\\ \text{VAL} & \begin{bmatrix}\text{SPR} & -\end{bmatrix}\end{bmatrix}$$

(22) Head-Specifier Rule (Version I)

$$\begin{bmatrix} \textit{phrase} & \\ \text{VAL} & \begin{bmatrix}\text{COMPS} & \langle\ \rangle\\ \text{SPR} & \langle\ \rangle\end{bmatrix}\end{bmatrix} \rightarrow \ \boxed{2} \ \ \mathbf{H}\begin{bmatrix}\text{VAL} & \begin{bmatrix}\text{COMPS} & \langle\ \rangle\\ \text{SPR} & \langle \boxed{2} \rangle\end{bmatrix}\end{bmatrix}$$

The tag $\boxed{2}$ in this rule identifies the SPR requirement of the head daughter with the non-head daughter. If the head daughter is 'seeking' an NP specifier (i.e. is specified as [SPR ⟨ NP ⟩]), then the non-head daughter will be an NP. If the head daughter is 'seeking' a determiner specifier, then the non-head daughter will be [HEAD det]. Phrases licensed by (22) will be known as HEAD-SPECIFIER PHRASES.

We said earlier that the lexical entries for nouns and verbs indicate what kind of specifier they require. However, the head-daughter of a head-specifier phrase need not be a word. For example, in the sentence *Kim likes books*, the head daughter of the head-specifier phrase will be the phrase *likes books*. Recall that the head-complement rules in the Chapter 3 grammar all required that mother and the head daughter be specified as [SPR −]. In our current grammar, however, we need to ensure that the particular kind of specifier selected by the head daughter in a head-complement phrase is also selected by the head-complement phrase itself (so that a VP combines only with an NP and a NOM combines only with a determiner). We must somehow guarantee that the SPR value of a head-complement phrase is the same as the SPR value of its head daughter.[8] We might thus add a stipulation to this effect, as shown in (23):[9]

(23) Head-Complement Rule (Temporary Revision)

$$\begin{bmatrix} \textit{phrase} & \\ \text{VAL} & \begin{bmatrix}\text{SPR} & \boxed{A}\\ \text{COMPS} & \langle\ \rangle\end{bmatrix}\end{bmatrix} \rightarrow \mathbf{H}\begin{bmatrix}\textit{word} & \\ \text{VAL} & \begin{bmatrix}\text{SPR} & \boxed{A}\\ \text{COMPS} & \langle \boxed{1}, \ldots, \boxed{n} \rangle\end{bmatrix}\end{bmatrix} \ \boxed{1} \ldots \boxed{n}$$

[8] At first glance, one might be tempted to accomplish this by making SPR a head feature, but in that case the statement of the HFP would have to be complicated, to allow rule (22) to introduce a discrepancy between the HEAD value of a mother and its head daughter.

[9] This version of the Head-Complement Rule should be considered a temporary revision, as we will soon find a more general way to incorporate this constraint into the grammar.

(Note that here we are using the tag $\boxed{A}$ to designate neither an atomic value nor a feature structure, but rather a list of feature structures.[10])

4.4 Applying the Rules

Now that we have working versions of both the Head-Specifier and Head-Complement Rules, let's use them to construct a tree for a simple example. These rules build the tree in (26) for the sentence in (24) from the lexical entries in (25):[11]

(24) Alex likes the opera.

(25) a.

$$\left\langle \text{likes}\,,\ \begin{bmatrix} \textit{word} & \\ \text{HEAD} & \textit{verb} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\ \text{NP}\ \rangle \\ \text{COMPS} & \langle\ \text{NP}\ \rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

b.

$$\left\langle \text{Alex}\,,\ \begin{bmatrix} \textit{word} & \\ \text{HEAD} & \textit{noun} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\ \rangle \\ \text{COMPS} & \langle\ \rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

c.

$$\left\langle \text{the}\,,\ \begin{bmatrix} \textit{word} & \\ \text{HEAD} & \textit{det} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\ \rangle \\ \text{COMPS} & \langle\ \rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

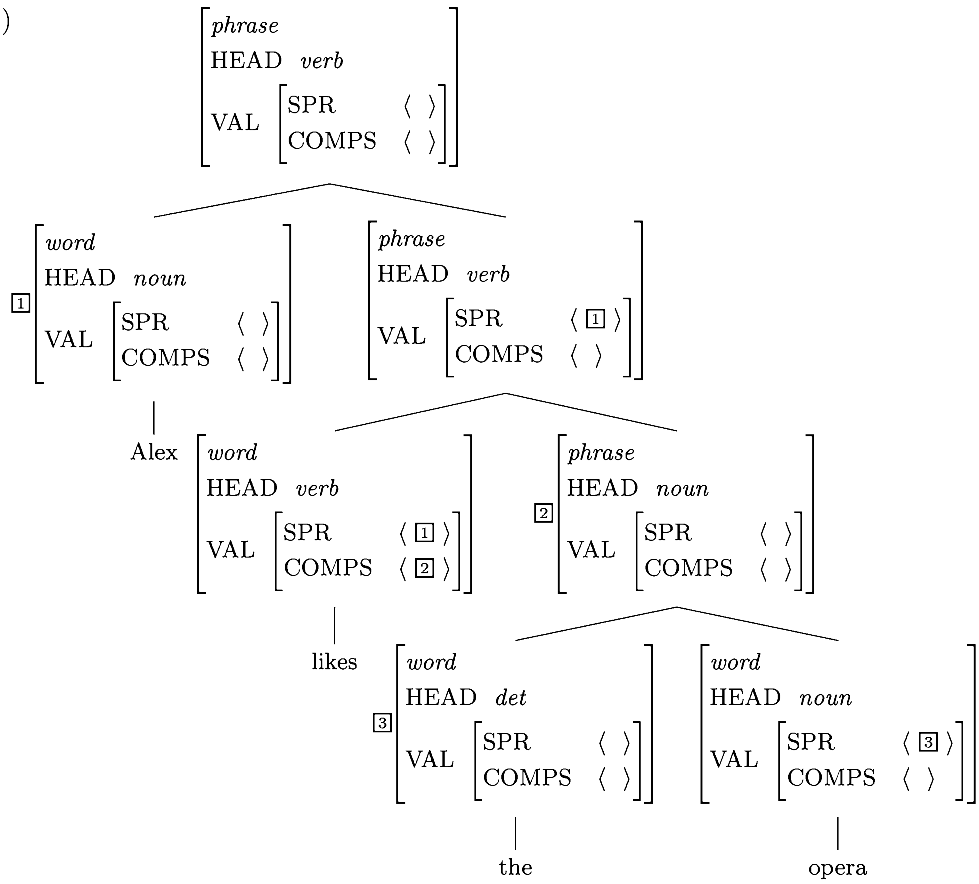
d.

$$\left\langle \text{opera}\,,\ \begin{bmatrix} \textit{word} & \\ \text{HEAD} & \textit{noun} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\ \text{D}\ \rangle \\ \text{COMPS} & \langle\ \rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

[10] We will henceforth adopt the convention of using numbers to tag feature structures or atomic values and letters to tag lists of feature structures.

[11] For the purposes of this example, we are ignoring the problem of subject-verb agreement. It will be taken up below in Section 4.6.1.

(26)



There are several things to notice about this tree:

First, compared to the trees generated by the Chapter 3 grammar, it has a simpler constituent structure. In particular, it has no non-branching nodes (except those immediately dominating the actual words). The Head-Specifier Rule requires that its head daughter be [COMPS ⟨ ⟩], but there are two ways that this could come about. The head daughter could be a word that is [COMPS ⟨ ⟩] to start with, like *opera*; or it could be a phrase licensed by the Head-Complement Rule, like *likes the opera*. This phrase is [COMPS ⟨ ⟩] according to the definition of the Head-Complement Rule. In brief, the head daughter of the Head-Specifier Rule can be either a *word* or a *phrase*, as long as it is [COMPS ⟨ ⟩].

Similarly, the verb *likes* requires an NP complement and an NP specifier. Of course, the symbol NP (and similarly D) is just an abbreviation for a feature structure description, namely that shown in (20). Once again, we see that the type (*word* or *phrase*) of the expression isn't specified, only the HEAD, SPR and COMPS values. Thus any nominal expression that is saturated (i.e. has no unfulfilled valence features) can serve as the specifier or complement of *likes*, regardless of whether it's saturated because it started out that way (like *Alex*) or because it 'has already found' the specifier it selected lexically (as in *the opera*).

This is an advantage of the Chapter 4 grammar over the Chapter 3 grammar: the non-branching nodes in the trees licensed by the Chapter 3 grammar constitute unmotivated extra structure. As noted above, this structural simplification is a direct consequence of our decision to continue specifying things in terms of NP, NOM, S and VP, while changing the interpretation of these symbols. However, we will continue to use the symbols N and V as abbreviations for the following feature structure descriptions:

(27)
$$\mathrm{N} \;=\; \begin{bmatrix} \textit{word} & \\ \mathrm{HEAD} & \textit{noun} \end{bmatrix} \qquad \mathrm{V} \;=\; \begin{bmatrix} \textit{word} & \\ \mathrm{HEAD} & \textit{verb} \end{bmatrix}$$

This means that in some cases, two abbreviations may apply to the same node. For instance, the node above *Alex* in (26) may be abbreviated as either NP or N. Similarly, the node above *opera* may be abbreviated as either NOM or N. This ambiguity is not problematic, as the abbreviations have no theoretical status in our grammar: they are merely there for expository convenience.

Another important thing to notice is that the rules are written so that head-complement phrases are embedded within head-specifier phrases, and not vice versa. The key constraint here is the specification on the Head-Complement Rule that the head daughter must be of type *word*. Since the mother of the Head-Specifier Rule is of type *phrase*, a head-specifier phrase can never serve as the head daughter of a head-complement phrase.

A final thing to notice about the tree is that in any given phrase, one item is the head and it selects for its sisters. That is, *Alex* is the specifier of *likes the opera* (and also of *likes*), and *likes* is not the specifier or complement of anything.

Exercise 3: Which Rules Where?
Which subtrees of (26) are licensed by the Head-Complement Rule and which are licensed by the Head-Specifier Rule?

4.5 The Valence Principle

Recall that in order to get the SPR selection information from a lexical head like *likes* or *story* to the (phrasal) VP or NOM that it heads, we had to add a stipulation to the Head-Complement Rule. More stipulations are needed if we consider additional rules. In particular, recall the rule for introducing PP modifiers, discussed in the previous chapter. Because no complements or specifiers are introduced by this rule, we do not want any cancellation from either of the head daughter's valence features to take place. Hence, we would need to complicate the rule so as to transmit values for both valence features up from the head daughter to the mother, as shown in (28):

(28) Head-Modifier Rule (Version I)
$$\begin{bmatrix} \textit{phrase} & \\ \mathrm{VAL} & \begin{bmatrix} \mathrm{SPR} & \boxed{\mathrm{A}} \\ \mathrm{COMPS} & \boxed{\mathrm{B}} \end{bmatrix} \end{bmatrix} \rightarrow \mathbf{H}\begin{bmatrix} \mathrm{VAL} & \begin{bmatrix} \mathrm{SPR} & \boxed{\mathrm{A}} \\ \mathrm{COMPS} & \boxed{\mathrm{B}}\langle\ \rangle \end{bmatrix} \end{bmatrix} \quad \mathrm{PP}$$