12

Infinitival Complements

12.1 Introduction

So far in this book, we have seen two examples of sentences expressing complex meanings, i.e. sentences in which one situation functions as a semantic argument of another.[1] The first was sentences with modifiers such as *today*, discussed in Chapter 8. The second was sentences involving extraposition, discussed in the last chapter. In this chapter, we will investigate additional constructions that involve semantic embedding. In particular, we will focus on infinitival complements in sentences such as (1):

(1) a. Pat continues to avoid conflict.
  b. Pat tries to avoid conflict.

We will see that, despite their superficial parallelism, examples (1a) and (1b) are quite different in their semantics and in certain associated syntactic properties. These two examples are representative of two basic ways in which propositions can be combined into complex meanings.

12.2 The Infinitival *To*

Before we delve into the subtle properties that distinguish (1a) from (1b), we need to provide an analysis for the word *to* that appears in both sentences. Like the lexemes we will consider in Chapter 13, the infinitival *to* functions as an auxiliary ([AUX +]) verb.[2] But it is a peculiar verb, one that has only a nonfinite form. In order to allow other verbs to select for VPs headed by *to*, we will need a way of distinguishing it (and the phrases it projects) from (the projections of) all other verbs. To this end, we introduce a new binary feature INF. The lexical entry for infinitival *to* will be specified as [INF +], whereas all other verbs will be [INF −]. We will in fact make [INF / −] a defeasible constraint on the type *verb-lxm*, one that is overridden only by *to*. Since *to* will also be

[1] As we noted, the semantic analysis we have given for a sentence like *That dogs bark annoys people* (or its extraposed counterpart) involves not the embedding of one feature structure within another, but rather the identification of the SIT value of one predication with the ARG value of another.

[2] Among the properties of *to* that lead us to call it an auxiliary verb is the fact that, like all auxiliary verbs, it may undergo VP-Ellipsis:

(i) Do you think they will go? They will __ .
(ii) Do you think they will go? They want to __ .

specified as [FORM base] in its lexical entry, it will not be able to undergo any lexical rule that specifies a different FORM value. Thus, only one kind of word will result from *to* – the kind that is the output of the Base Form Lexical Rule.

In addition, *to*, like the verb *be*, does not contribute to the semantics of the sentences in any substantive way. This is evident in those cases where it is optional. For example, there is no apparent difference in meaning between (2a) and (2b) or between (3a) and (3b):

(2) a. Pat helped Chris [to solve the problem].
    b. Pat helped [Chris solve the problem].

(3) a. They wouldn't dare [to attack us].
    b. They wouldn't dare [attack us].

Data like (2) and (3), by the way, provide independent motivation for treating infinitival *to* as [FORM base], as that analysis allows us to write lexical entries for *help* and *dare* that select for a VP[FORM base] complement, leaving the INF value unspecified.

The following lexical entry for *to* will allow our analysis to capture all these properties:

(4)
$$\left\langle \text{to}, \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{FORM} & \text{base} \\ \text{INF} & + \\ \text{AUX} & + \end{bmatrix} \end{bmatrix} \\ \text{ARG-ST} & \left\langle \boxed{1}, \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{INF} & - \\ \text{FORM} & \text{base}\end{bmatrix} \\ \text{VAL} & \begin{bmatrix}\text{SPR} & \langle \boxed{1} \rangle \\ \text{COMPS} & \langle\ \rangle\end{bmatrix} \\ \text{SEM} & \begin{bmatrix}\text{INDEX} & s\end{bmatrix}\end{bmatrix} \right\rangle \\ \text{SEM} & \begin{bmatrix}\text{INDEX} & s \\ \text{RESTR} & \langle\ \rangle\end{bmatrix}\end{bmatrix}\right\rangle$$

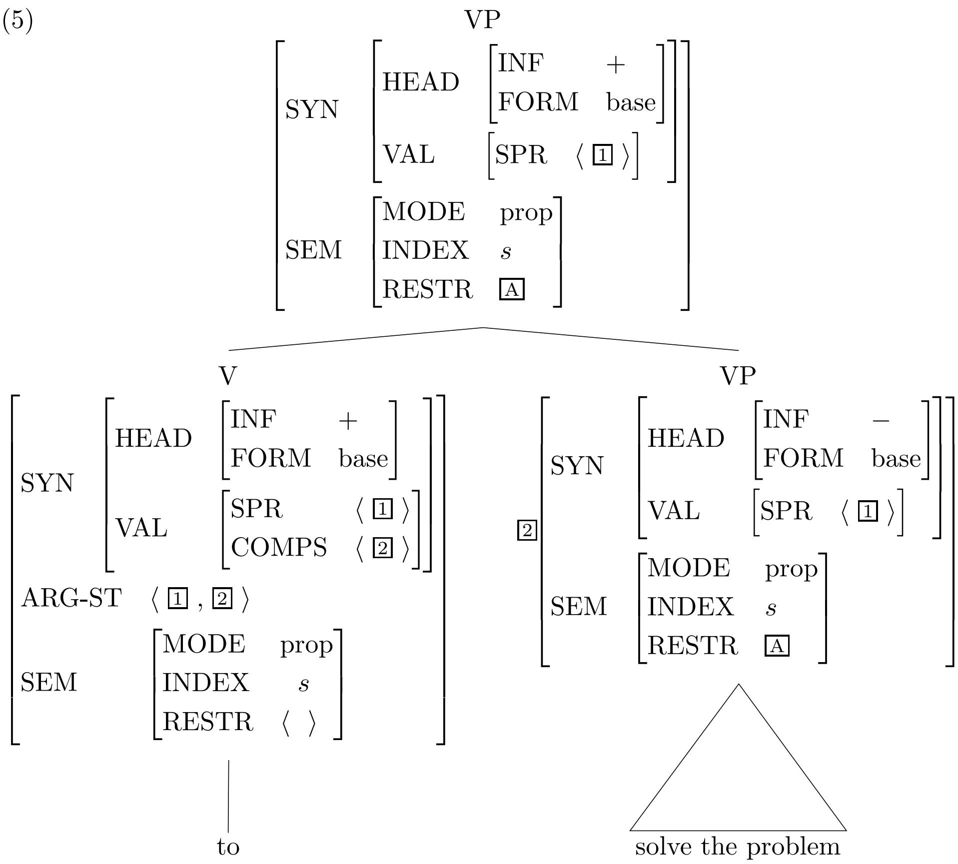
We haven't specified the type that this entry is an instance of, because it is a new type *auxiliary-verb-lexeme* (*auxv-lxm*), to be discussed in Chapter 13. We will find that *to* shares many of the above properties with other verbs, and we will be able to state these generalizations as constraints on that type. For the moment, it is sufficient to note that *auxv-lxm* is a subtype of the type *subject-raising-verb-lexeme* (*srv-lxm*; discussed in Section 12.3 below), and therefore *to* is a kind of *verb-lxm*. This means that *to* will also inherit all of the constraints associated with *verb-lxm*, *srv-lxm*, and *auxv-lxm* that are not overridden by constraints in its lexical entry.

The semantic emptiness of *to* is modeled in this lexical entry by the specification [RESTR ⟨ ⟩] and the fact that it shares the INDEX value of its VP complement. From these constraints, it follows that when *to* combines with its VP complement, only the latter contributes to the semantic restriction of the resulting VP. The rest of the constraints on the ARG-ST of *to* specify that it takes a VP complement that is both [INF −] and

[FORM base] (such as *bake a cake* or *be a hero*) as its second argument, and the SPR requirement of that VP as its first argument.

Once we include this somewhat unusual nonfinite verb in our lexicon, our grammar rules and principles interact to license structures like the following:

(5)



Structures like these will be the complement of verbs like *continue* and *try*, which are the topics of the next two sections.

Exercise 1: *To Fix This!

Given the analysis of infinitives just introduced, our grammar will now incorrectly generate imperative sentences like the following:

(i)*To get out of here!

(ii)*To stop that!

This overgeneration can be prevented by making a minor revision to our grammar. What is it?

12.3 The Verb *Continue*

Recall that the dummies *it* and *there*, as well as idiom chunks like *(close) tabs* or *(unfair) advantage*, have a restricted distribution – they occur only as subjects or objects of verbs that select them in those positions. What these NPs all have in common is that they are nonreferential – that is, they take 'none' as their value for MODE and INDEX. They are therefore inherently unsuited to play a role in any predication. Consequently, on semantic grounds, we have already explained the ungrammaticality of (6) and the fact that *it* must be referential in (7), as we noted in Chapter 11:

(6) a. $\text{*I hate} \left\{ \begin{array}{l} \text{advantage} \\ \text{tabs} \\ \text{there} \end{array} \right\}.$

b. $\text{*} \left\{ \begin{array}{l} \text{Advantage} \\ \text{tabs} \\ \text{there} \end{array} \right\} \text{really affected us.}$

(7) a. I hate it.

b. It really affected us.

It might seem surprising, then, that there are some other verbs that allow subject NPs that lack referential indices. *Continue* is one such example:

(8) a. Sandy continues to eat oysters.

b. There continued to be no easy answer to the dilemma.

c. It continues to bother me that Chris lied.

d. (Close) tabs continue to be kept on Bo by the FBI.

e. (Unfair) advantage continues to be taken of the refugees.

Let's consider this phenomenon more carefully. Suppose we have a finite VP like *eats oysters*. This VP, as we have seen, requires a referential subject, rather than a nonreferential one like *there*, (dummy) *it*, or *advantage*. The pattern that we find here is that whenever a verb phrase imposes such a constraint on its subject, then a larger VP made up of *continues to* or *continued to* plus the original VP (with the head verb in the base form) must obey the same constraint. There is a correlation: if the subject of *eats oysters* has to be referential, then so does the subject of *continues/continued to eat oysters*. Similarly, a finite VP like *is no compromise on this issue* must combine with a dummy *there* as its subject (even the dummy *it* is disallowed). Correlated with this is the fact that the larger VP *continued to be no compromise on this issue* also requires a dummy *there* as its subject. The same is true for VPs like *bothers me that Chris lied*, *were kept on Bo by the FBI*, and *was taken of the refugees*. These VPs require subjects that are dummy *it*, (*close*) *tabs*, and (*unfair*) *advantage*, respectively.[3] And for each of these

[3] In the last two cases, there are other subjects that can appear with superficially identical VPs. This is because the verbs *take* and *keep* participate in multiple different idioms in English, as illustrated in (i):

(i) Good care was taken of the refugees.

Under our current analysis of idioms, (i) would involve a different lexical entry for *take* which selects for an NP[FORM care]. The important point for the current discussion is that the range of possible subjects for *continues to be taken of the refugees* is exactly the same as the range of possible subjects for *was taken of the refugees*.

verbs, their '*continue-to-be*' counterpart exhibits exactly the same requirements. These theoretically critical contrasts are summarized in (9a-d):

(9) a.

$$\text{There continues to} \left\{ \begin{array}{l} \text{ be no easy answer to the dilemma} \\ \text{*eat oysters} \\ \text{*bother me that Chris lied} \\ \text{*be kept on Bo by the FBI} \\ \text{*be taken of the refugees} \end{array} \right\}.$$

b.

$$\text{It continues to} \left\{ \begin{array}{l} \text{ bother me that Chris lied} \\ \text{*eat oysters} \\ \text{*be no easy answer to the dilemma} \\ \text{*be kept on Bo by the FBI} \\ \text{*be taken of the refugees} \end{array} \right\}.$$

c.

$$\text{(Close) tabs continue to} \left\{ \begin{array}{l} \text{ be kept on Bo by the FBI} \\ \text{*eat oysters} \\ \text{*be no easy answer to the dilemma} \\ \text{*bother me that Chris lied} \\ \text{*be taken of the refugees} \end{array} \right\}.$$

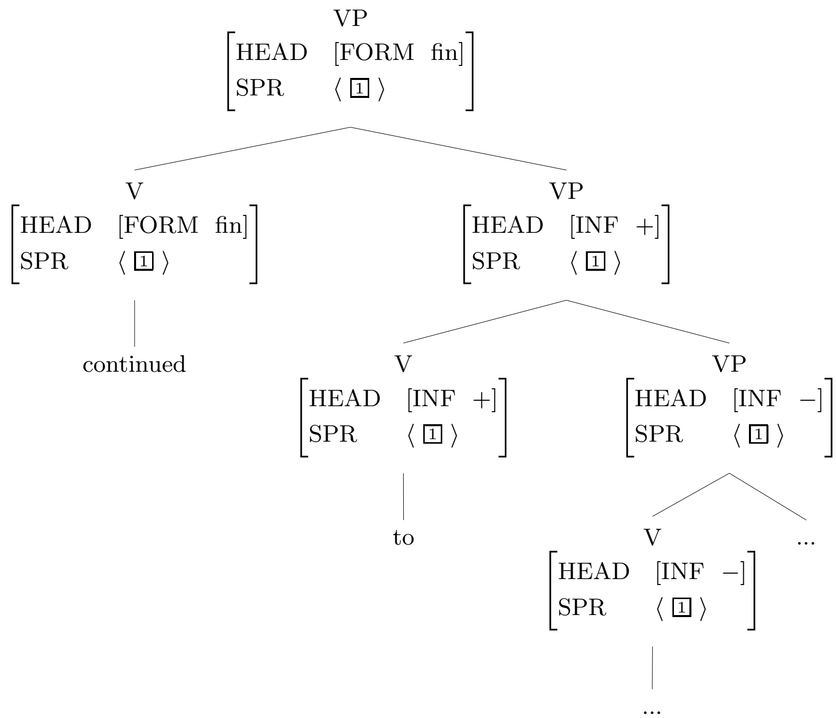
d.

$$\text{(Unfair) advantage continues to} \left\{ \begin{array}{l} \text{ be taken of the refugees} \\ \text{*eat oysters} \\ \text{*be no easy answer to the dilemma} \\ \text{*bother me that Chris lied} \\ \text{*be kept on Bo by the FBI} \end{array} \right\}.$$

The contrasts illustrated in (9) suggest that the verb *continue* is intuitively TRANSPARENT to the selectional demands that its VP complement imposes on its subject. That is, a verb like *continue* heads a VP that requires the same kind of subject that its VP complement requires.

We can capture this intuition by simply specifying that *continue* and its complement must have the same subject. We do this as we did earlier for the passive *be* and for the infinitival *to* above: the first element in *continue*'s ARG-ST list (the subject) will be identical to the SPR value of the second element in the ARG-ST list. Since the complement is a VP headed by *to*, the SPR value of the VP *continue to...* will be identical to the SPR value of the embedded VP. Hence the co-occurrence restrictions involving the nonreferential NPs will be transmitted from the verbs heading the infinitival VPs, through the infinitival *to*, up to the subject of the verb *continue*, as illustrated in (10):

(10)



Thus we have an account for the first striking property of the verb *continue*: it places no restrictions of its own on its subject, but rather takes as a subject whatever kind of subject its VP complement is looking for.

A second, related property of *continue* is that it doesn't do anything semantically with its subject. We can see that by comparing sentences with active and passive verbs in the VP complement of *continue*. One such pair of examples is given in (11):

(11) a. The FBI continued to visit Lee.
b. Lee continued to be visited by the FBI.

In (11a), the complement of *to* is a VP headed by the verb *visit*. In (11b), the complement of *to* is a VP headed by *be* which in turn takes as a complement headed by *visited*, the passive form of *visit*. In what follows, we will informally describe sentences like (11a) and (11b) simply as 'active-passive pairs' to have a simple way of referring to them since we will use them as a diagnostic. Pairs like this, i.e. pairs like NP_1 *continued to* V NP_2 and NP_2 *continued to be* V-ed by NP_1, have essentially the same meaning. That is, examples (11a) and (11b) are very close paraphrases of one another.[4]

In (11a) *the FBI* is a syntactic argument of *continue* and *Lee* isn't. In (11b) it is *Lee* that is a syntactic argument of *continue*, while *the FBI* isn't. The fact that these two sentences mean the same thing suggests that in neither case is the subject of *continue*

[4]We say 'very close' because there are subtle differences in emphasis between the two sentences. The crucial test, for our purposes, is that there are no conceivable conditions under which one of the sentences would be true and the other would be false. This is the operational test we will use throughout to determine whether sentences do or do not mean the same thing.

one of its semantic arguments. Rather, semantically, *continue* takes only one argument – the situation of its infinitival complement – and predicates of it that it continues to be the case. Thus, both sentences in (11) mean that it continues to be the case that the FBI visits Lee. Formally, we represent this as in (12):

(12)
$$\begin{bmatrix} \text{MODE} & \text{prop} \\ \text{INDEX} & s_1 \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{name} \\ \text{NAME} & \text{The FBI} \\ \text{NAMED} & i \end{bmatrix}, \begin{bmatrix} \text{RELN} & \textbf{continue} \\ \text{SIT} & s_1 \\ \text{ARG} & s_2 \end{bmatrix}, \right. \\ & \left. \begin{bmatrix} \text{RELN} & \textbf{visit} \\ \text{SIT} & s_2 \\ \text{VISITOR} & i \\ \text{VISITED} & j \end{bmatrix}, \begin{bmatrix} \text{RELN} & \textbf{name} \\ \text{NAME} & \text{Lee} \\ \text{NAMED} & j \end{bmatrix} \right\rangle \end{bmatrix}$$

Note that the **continue** predication has only one role slot (called ARG) and this is filled by the situational index of the **visit** predication (s_2). There is no role in the **continue** predication for either the index of *the FBI* or the index of *Lee*. This semantic fact is crucial not only to the active-passive paraphrase property of *continue*, but also to the first property we discussed: if *continue* were to assign a semantic role to its subject, it would be unable to accept nonreferential subjects like dummy *it* and *there* and idiom chunks ((*unfair*) *advantage*, (*close*) *tabs*, etc.).

Since *continue* is not an isolated example, but rather representative of a class of verbs (including *to*), we will posit a lexical type *subject-raising-verb-lexeme* (*srv-lxm*).[5] We thus postulate the following lexical type, which is a kind of (i.e. an immediate subtype of) *verb-lxm*:

(13) *subject-raising-verb-lxm* (*srv-lxm*):
$$\begin{bmatrix} \text{ARG-ST} & \left\langle \boxed{1}, \begin{bmatrix} \text{SPR} & \langle \boxed{1} \rangle \\ \text{COMPS} & \langle\ \rangle \\ \text{INDEX} & s_2 \end{bmatrix} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{RESTR} & \left\langle \begin{bmatrix} \text{ARG} & s_2 \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

With this type constraint in place, we can assign *continue* the following streamlined lexical entry:

[5] The perhaps nonmnemonic terms that permeate this discussion – 'raising' and 'control' verbs – reflect commonly used terminology in the field. They derive from the analysis of this distinction that was developed in transformational grammar (see Appendix B).

(14)
$$\left\langle \text{continue}\ ,\ \begin{bmatrix} \textit{srv-lxm} & \\ \text{ARG-ST} & \left\langle \text{X}\ ,\ \overset{\text{VP}}{\begin{bmatrix}\text{INF} & +\end{bmatrix}} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & s_1 \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{continue} \\ \text{SIT} & s_1 \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

In this analysis, the lexeme *continue* inherits information not only from the type *srv-lxm* but also from the supertype *verb-lxm*. The lexical sequences satisfying this lexical entry are schematized in (15), which also displays all of the inherited constraints:

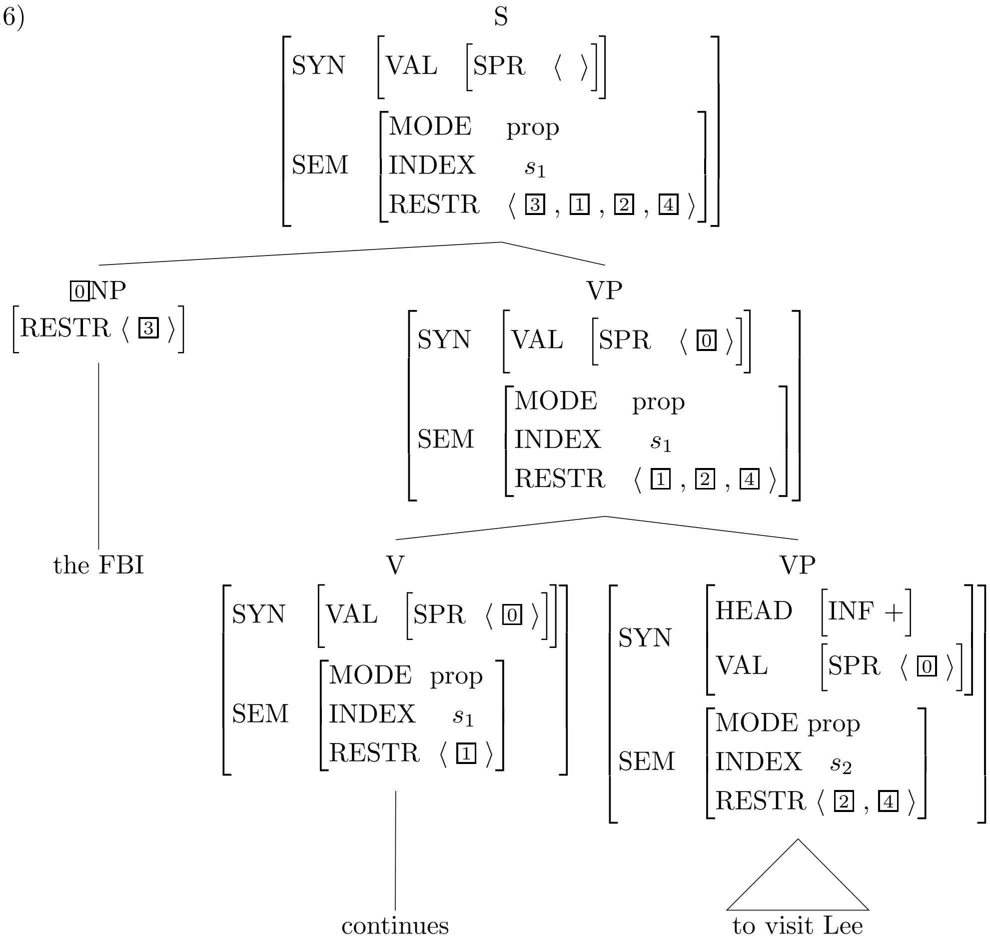
(15)
$$\left\langle \text{continue}\ ,\ \begin{bmatrix} \textit{srv-lxm} & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{PRED} & - \\ \text{INF} & - \\ \text{AGR} & \boxed{2} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\ [\text{AGR}\ \boxed{2}]\ \rangle \end{bmatrix} \end{bmatrix} \\ \text{ARG-ST} & \left\langle \boxed{1} \begin{bmatrix} \text{HEAD} & \textit{nominal} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\ \rangle \\ \text{COMPS} & \langle\ \rangle \end{bmatrix} \end{bmatrix}\ ,\ \overset{\text{VP}}{\begin{bmatrix} \text{INF} & + \\ \text{SPR} & \langle\ \boxed{1}\ \rangle \\ \text{INDEX} & s_2 \end{bmatrix}} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{MODE} & \text{prop} \\ \text{INDEX} & s_1 \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{continue} \\ \text{SIT} & s_1 \\ \text{ARG} & s_2 \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

Our analysis derives all of the following:

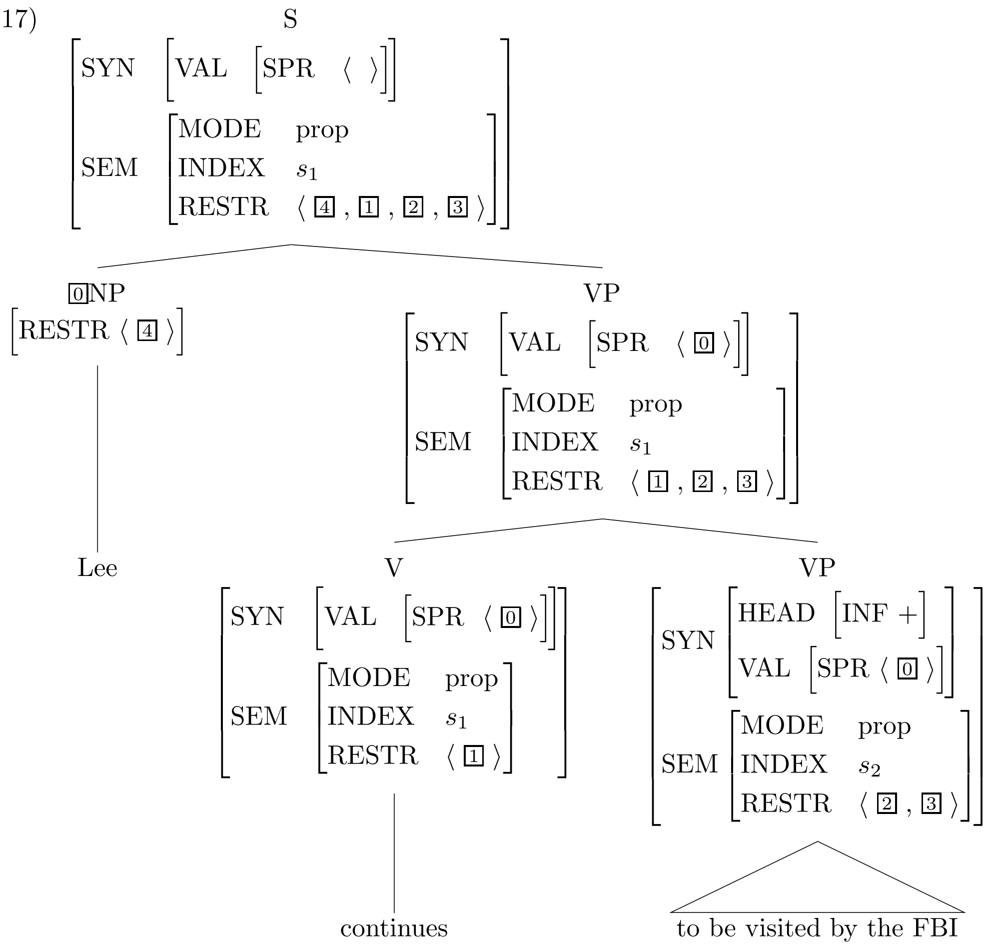
- the VP complement of *continue* is infinitival
- the VP complement of *continue* is its semantic argument (since (14) inherits the relevant constraint from the type *srv-lxm*),
- the subject of *continue* is the subject of the VP complement (since (14) inherits the relevant constraint from the type *srv-lxm*),
- the subject of *continue* plays no role in the **continue** predication, and
- as a result of the above points, the sentences in (11) are assigned equivalent semantic analyses.

These properties are illustrated in (16) and (17): (Note that the tags 1–4 refer to the same feature structure descriptions in (16)–(18).)

(16)



(17)



Here the relevant predications are those given earlier and tagged appropriately in (18):

(18)
$$\begin{bmatrix} \text{MODE} & \text{prop} \\ \text{INDEX} & s_1 \\ \text{RESTR} & \left\langle \boxed{4}\begin{bmatrix} \text{RELN} & \textbf{name} \\ \text{NAME} & \text{Lee} \\ \text{NAMED} & j \end{bmatrix}, \boxed{1}\begin{bmatrix} \text{RELN} & \textbf{continue} \\ \text{SIT} & s_1 \\ \text{ARG} & s_2 \end{bmatrix}, \boxed{2}\begin{bmatrix} \text{RELN} & \textbf{visit} \\ \text{SIT} & s_2 \\ \text{VISITOR} & i \\ \text{VISITED} & j \end{bmatrix}, \boxed{3}\begin{bmatrix} \text{RELN} & \textbf{name} \\ \text{NAME} & \text{The FBI} \\ \text{NAMED} & i \end{bmatrix} \right\rangle \end{bmatrix}$$

As discussed in Chapter 5, the order of elements on the RESTR list has no semantic significance. Hence, since the semantic values assigned to these two sentences differ only in the order of elements on the RESTR list, active-passive pairs like these are correctly predicted to be semantically equivalent.

12.4 The Verb *Try*

The analysis of the verb *continue* that we just developed was motivated by two observations: (i) that *continue* is transparent to co-occurrence restrictions between its subject and its complement's verb; and (ii) that active-passive pairs like those discussed in the previous section are paraphrases.

Turning to the superficially similar verb *try*, we see that it differs from *continue* with respect to both (i) and (ii). Thus the analogs to (8b–e), with nonreferential subjects, are systematically ill formed (even though the verb embedded in *try*'s complement does indeed select for the relevant nonreferential subject):

(19) a. Sandy tried to eat oysters.
b.*There tried to be riots in Freedonia.
c.*It tried to bother me that Chris lied.
d.*(Close) tabs try to be kept on Bo by the FBI.
e.*(Unfair) advantage tries to be taken of the refugees.

Likewise, the following two sentences are not synonymous:

(20) a. The FBI tried to find Lee.
b. Lee tried to be found by the FBI.

(20a) could be true under circumstances where (20b) would be false; indeed, it is quite likely that most people whom the FBI is trying to find are not trying to be found by them (or by anybody else!). Since the analysis of *continue* was designed to account for points (i) and (ii) above, it is clear that we need to analyze *try* quite differently.

Let us begin with the semantics of *try*. Unlike **continue** predications, which take only one semantic role (ARG, whose value is a situation), predications of trying involve two things: an individual (the entity that is trying) and some situation or state of affairs that the trier is trying to bring about. This is why the examples in (20) differ in meaning: the two triers are not the same. Notice also what the trier is trying to bring about always involves the trier. That is, it is not possible to express a meaning in which, say, what Kim is trying is for Sandy to visit Bo.[6] These remarks are synthesized in the following semantic structure for *Sandy tries to visit Bo*:

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[6]Maybe you could force an interpretation on this, something like 'Kim tried to bring it about that Sandy visit Bo', but notice that in so doing you are coercing the interpretation of the complement to a meaning that DOES contain the trier. We will ignore such coercions here.

(21)

$$\begin{bmatrix} \text{MODE} & \text{prop} \\ \text{INDEX} & s_1 \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{name} \\ \text{NAME} & \text{Sandy} \\ \text{NAMED} & i \end{bmatrix}, \begin{bmatrix} \text{RELN} & \textbf{try} \\ \text{SIT} & s_1 \\ \text{TRIER} & i \\ \text{ARG} & s_2 \end{bmatrix}, \begin{bmatrix} \text{RELN} & \textbf{visit} \\ \text{SIT} & s_2 \\ \text{VISITOR} & i \\ \text{VISITED} & j \end{bmatrix}, \begin{bmatrix} \text{RELN} & \textbf{name} \\ \text{NAME} & \text{Bo} \\ \text{NAMED} & j \end{bmatrix} \right\rangle \end{bmatrix}$$

Semantic structures like this immediately rule out the use of nonreferential subjects (i.e. dummies and idiom chunks) with *try*. This is because the subject position of *try* always corresponds to a semantic argument, namely the TRIER. Since nonreferential NPs are specified as [INDEX none], it follows that there can be no semantics for examples like (19b–e). The index value of the TRIER role cannot be identified with the subject NP's index if the subject has no index.

Just as *continue* is representative of a class of verbs (RAISING verbs), *try* is representative of another class, called CONTROL verbs. In general, the control verbs assign a semantic role to their subject, while the raising verbs do not. From this critical difference, it follows that raising verbs can take nonreferential subjects while control verbs cannot, and that raising verbs allow active-passive pairs to be paraphrases, while control verbs do not.

As before, we will want to use lexical types to express constraints that apply generally to verbs of the control class. So we will want to introduce another subtype of *verb-lxm* like the one shown in (22):

(22) *subject-control-verb-lxm* (*scv-lxm*):

$$\begin{bmatrix} \text{ARG-ST} & \left\langle \text{NP}_i \, , \begin{bmatrix} \text{SPR} & \langle \text{ NP}_i \rangle \\ \text{COMPS} & \langle \ \rangle \\ \text{INDEX} & s_2 \end{bmatrix} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{RESTR} & \left\langle \begin{bmatrix} \text{ARG} & s_2 \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

The lexical entry for *try* can now be given in the streamlined form shown in (23):

(23)

$$\left\langle \text{try}\ ,\ \begin{bmatrix} \textit{scv-lxm} & \\ \text{ARG-ST} & \left\langle \text{NP}_i\ ,\ \overset{\text{VP}}{\begin{bmatrix}\text{INF}\ +\end{bmatrix}} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & s_1 \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{try} \\ \text{SIT} & s_1 \\ \text{TRIER} & i \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

Lexical sequences satisfying (23) thus inherit all the constraints shown in (24):

(24)

$$\left\langle \text{try}\ ,\ \begin{bmatrix} \textit{scv-lxm} & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{PRED} & - \\ \text{INF} & - \\ \text{AGR} & \boxed{1} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix}\text{SPR} & \langle\ [\text{AGR}\ \boxed{1}]\ \rangle\end{bmatrix} \end{bmatrix} \\ \text{ARG-ST} & \left\langle \text{NP}_i\ ,\ \overset{\text{VP}}{\begin{bmatrix} \text{INF} & + \\ \text{SPR} & \langle\ \text{NP}_i\ \rangle \\ \text{SEM} & \begin{bmatrix}\text{INDEX} & s_2\end{bmatrix} \end{bmatrix}} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & s_1 \\ \text{MODE} & \text{prop} \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{try} \\ \text{SIT} & s_1 \\ \text{TRIER} & i \\ \text{ARG} & s_2 \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

Note that the first argument of *try* and the subject of the VP are not identified; only their indices are. The subject-sharing analysis is necessary for raising verbs, because verbs like *continue* select for exactly the kind of subject that their complements select for. This includes information contained in the FORM value in the case of idiom chunks and dummy subjects, but also other HEAD information and the VAL values. At the same time, it is important that the index of the subject of *continue* be the same as the index of the subject of the embedded verb. This is because the subject can play a semantic role with respect to the embedded verb (when it is referential). Therefore, in order to get the semantics right, we need to ensure that the index of the subject is available to the embedded verb. The smallest feature structure containing all of the relevant values is the entire *expression*.

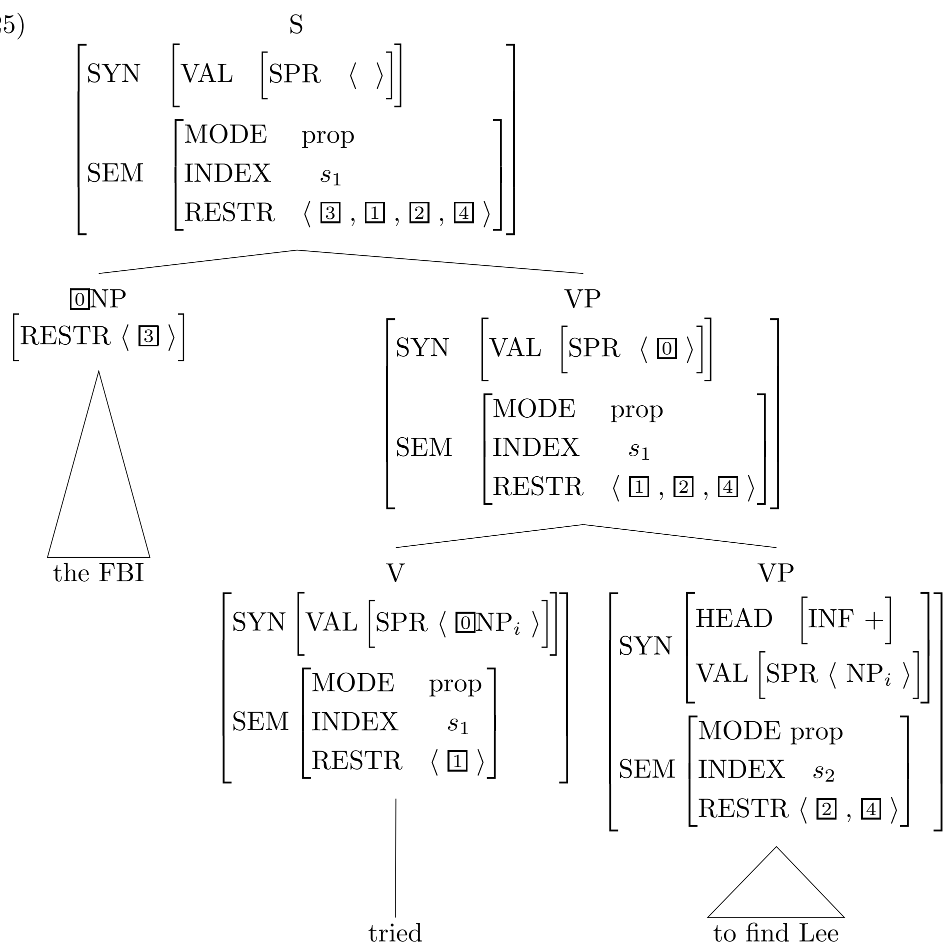
Judging only from the facts we've seen so far, we could also use the subject-sharing analysis for control verbs (like *try*). However, there is no data that requires sharing any information beyond the indices, so we take the more conservative step of sharing only what is needed. In fact, it turns out that data from other languages motivate this difference in the analyses of raising and control verbs. This point is developed in Problem 5.

Our analysis of control verbs like *try* guarantees that:

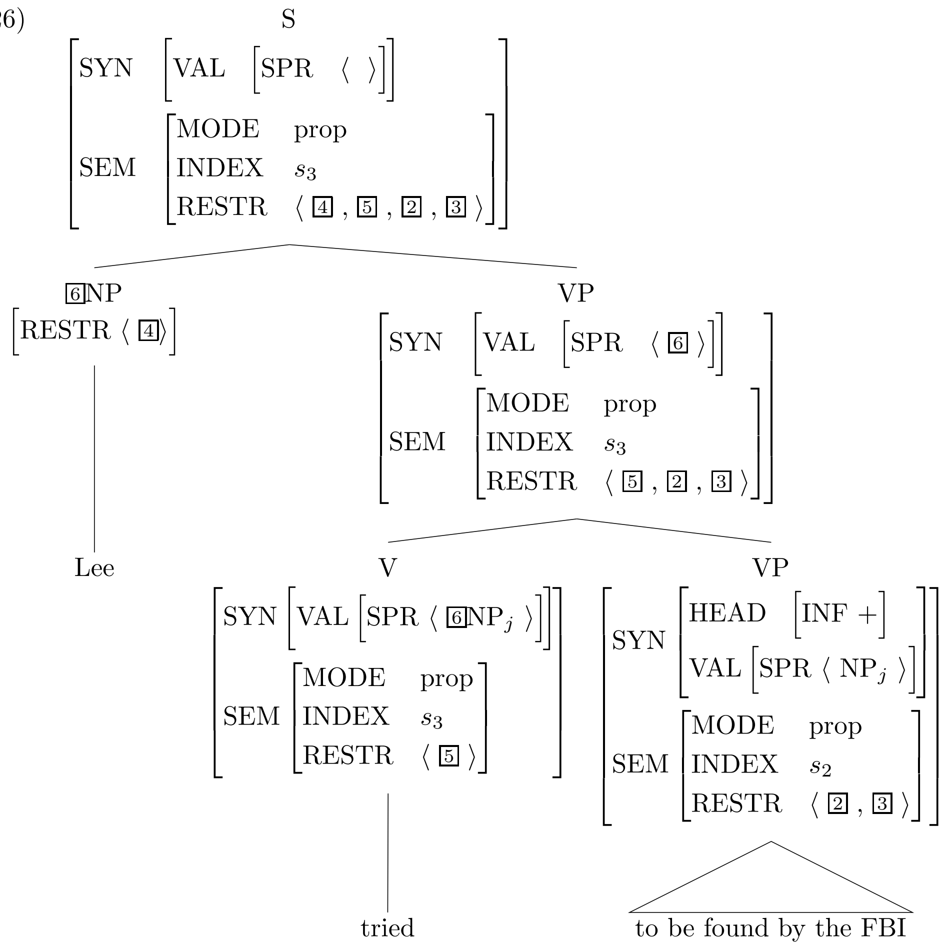
- The complement of *try* is an infinitival VP,
- the VP complement is a semantic argument of the **try** predication (since (23) inherits the relevant constraint from the type *scv-lxm*),
- the subject of *try* is assigned to the TRIER role; and hence
- nonreferential NPs can never be the subject of *try*,
- the infinitival complements of *try* can never be of a kind that requires a nonreferential subject (because they must have an index identified with the trier), and
- that (20a) and (20b) have different meanings (because in one case the FBI is the trier and in the other, Lee is).

This analysis is illustrated in the following pair of semantically contrasting examples:

(25)



(26)



The first of these has the semantics shown in (27):

(27)
$$\begin{bmatrix} \text{MODE} & \text{prop} \\ \text{INDEX} & s_1 \\ \text{RESTR} & \left\langle \boxed{3}\begin{bmatrix} \text{RELN} & \textbf{name} \\ \text{NAME} & \text{The FBI} \\ \text{NAMED} & i \end{bmatrix}, \boxed{1}\begin{bmatrix} \text{RELN} & \textbf{try} \\ \text{SIT} & s_1 \\ \text{TRIER} & i \\ \text{ARG} & s_2 \end{bmatrix}, \boxed{2}\begin{bmatrix} \text{RELN} & \textbf{find} \\ \text{SIT} & s_2 \\ \text{FINDER} & i \\ \text{FOUND} & j \end{bmatrix}, \boxed{4}\begin{bmatrix} \text{RELN} & \textbf{name} \\ \text{NAME} & \text{Lee} \\ \text{NAMED} & j \end{bmatrix} \right\rangle \end{bmatrix}$$

In contrast, the sentence with the passive complement in (26) has the semantics given in (28), where the trier is j, the index of Lee, not the FBI.

(28)
$$\begin{bmatrix} \text{MODE} & \text{prop} \\ \text{INDEX} & s_3 \\ \text{RESTR} & \left\langle \boxed{4}\begin{bmatrix} \text{RELN} & \textbf{name} \\ \text{NAME} & \text{Lee} \\ \text{NAMED} & j \end{bmatrix}, \boxed{5}\begin{bmatrix} \text{RELN} & \textbf{try} \\ \text{SIT} & s_3 \\ \text{TRIER} & j \\ \text{ARG} & s_2 \end{bmatrix}, \boxed{2}\begin{bmatrix} \text{RELN} & \textbf{find} \\ \text{SIT} & s_2 \\ \text{FINDER} & i \\ \text{FOUND} & j \end{bmatrix}, \boxed{3}\begin{bmatrix} \text{RELN} & \textbf{name} \\ \text{NAME} & \text{The FBI} \\ \text{NAMED} & i \end{bmatrix} \right\rangle \end{bmatrix}$$

By positing a lexical distinction between raising and control verbs in the hierarchy of lexemes, we thus correctly account for their differing properties without adjusting our grammar rules or any other aspect of our theory.

12.5 Subject Raising and Subject Control

As noted above, the verbs *continue* and *try* are representative of the classes subject raising verb and subject control verb, respectively. To review the properties of these classes, subject raising verbs like *continue* express properties of situations, allow nonreferential subjects, and give rise to paraphrastic active-passive pairs like those examined above. Subject control verbs like *try*, on the other hand, express a relation between an individual and a situation, never take nonreferential subjects, and fail to give rise to analogous paraphrastic active-passive pairs.

In fact, it is not just verbs that can be divided into these two classes; there are also raising adjectives and control adjectives. They are exemplified in (29), with the diagnostic properties illustrated in (30)–(33).[7]

(29) a. Pat is likely to scream.
b. Pat is eager to scream.

(30) a. There is likely to be a letter in the mailbox.
b. It is likely to upset Pat that Chris left.
c. Tabs are likely to be kept on participants.
d. Advantage is likely to be taken of unwary customers.

(31) a.*There is eager to be a letter in the mailbox.
b.*It is eager to upset Pat that Chris left.
c.*Tabs are eager to be kept on participants.
d.*Advantage is eager to be taken of unwary customers.

(32) The doctor is likely to examine Pat. ≈ Pat is likely to be examined by the doctor.

(33) The doctor is eager to examine Pat. ≠ Pat is eager to be examined by the doctor.

This suggests that our system of lexical types should be somewhat more abstract (perhaps introducing a type like *subject-raising-lxm* as a supertype of *srv-lxm* and a similar type of

[7] Here we use the symbol '≈' to indicate sameness of truth conditions, and '≠' to indicate difference of truth conditions.

adjectival lexeme), in order to accommodate generalizations that cut across the various part of speech distinctions such as verb vs. adjective.[8]

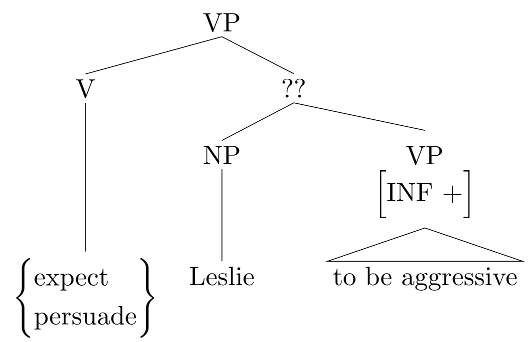
12.6 Object Raising and Object Control

Consider now two new verbs: *expect* and *persuade*. These two verbs are similar in that both can occur in examples like the following:

(34) a. I expected Leslie to be aggressive.
b. I persuaded Leslie to be aggressive.

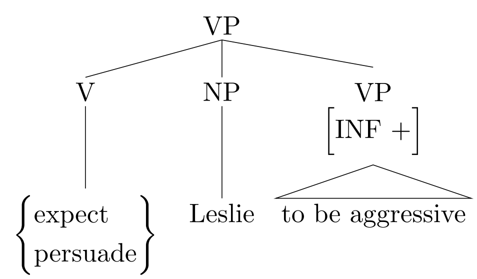
There are two possible analyses one could imagine for these verbs. There could be some kind of phrase that includes both the NP and the infinitival VP *to be aggressive*, as in:

(35)



Alternatively, it is possible that the NP is the direct object of the verb and the infinitival VP is also a complement of the verb:

(36)



But in fact, only the latter structure is consistent with the analyses of other phenomena presented in earlier chapters. We will return to why this is so at the end of this section. First, we briefly consider the analyses we will give to these verbs.

The difference between *expect* and *persuade* in structures like (36) is analogous to the distinction we just drew between *continue* and *try*. Just as the subject of *continue* plays no semantic role with respect to the **continue** predication, the object of *expect* plays no role with respect to the **expect** predication. Rather, in both cases, the semantic role of the NP in question is whatever the complement's verb assigns to its subject. Similarly, the object of *persuade* is like the subject of *try* in that it plays a semantic role with respect to the **persuade** predication while also playing the semantic role assigned to the subject of the complement's verb. *Expect* is an example of what is usually called

[8]This matter is taken up again in Chapter 16.

an ‘object raising’ verb and *persuade* is an ‘object control’ verb. Hence we will want to introduce the two types in (37) with the indicated constraints and then provide lexical entries for *expect* and *persuade* like the ones shown in (38):

(37) a. *object-raising-verb-lxm* (*orv-lxm*):

$$\begin{bmatrix} \text{ARG-ST} & \left\langle \text{NP}\ ,\ \boxed{1}\ ,\ \begin{bmatrix} \text{SPR} & \langle\ \boxed{1}\ \rangle \\ \text{COMPS} & \langle\ \rangle \\ \text{INDEX} & s_2 \end{bmatrix} \right\rangle \\ \\ \text{SEM} & \begin{bmatrix} \text{RESTR} & \left\langle \begin{bmatrix} \text{ARG} & s_2 \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

b. *object-control-verb-lxm* (*ocv-lxm*):

$$\begin{bmatrix} \text{ARG-ST} & \left\langle \text{NP}\ ,\ \text{NP}_i\ ,\ \begin{bmatrix} \text{SPR} & \langle\ \text{NP}_i\ \rangle \\ \text{COMPS} & \langle\ \rangle \\ \text{INDEX} & s_2 \end{bmatrix} \right\rangle \\ \\ \text{SEM} & \begin{bmatrix} \text{RESTR} & \left\langle \begin{bmatrix} \text{ARG} & s_2 \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

(38) a.

$$\left\langle \text{expect}\ ,\ \begin{bmatrix} \textit{orv-lxm} & \\ \text{ARG-ST} & \left\langle\ \text{NP}_j\ ,\ \text{X}\ ,\ \begin{matrix}\text{VP}\\ \begin{bmatrix}\text{INF} & +\end{bmatrix}\end{matrix} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & s \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{expect} \\ \text{SIT} & s \\ \text{EXPECTER} & j \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

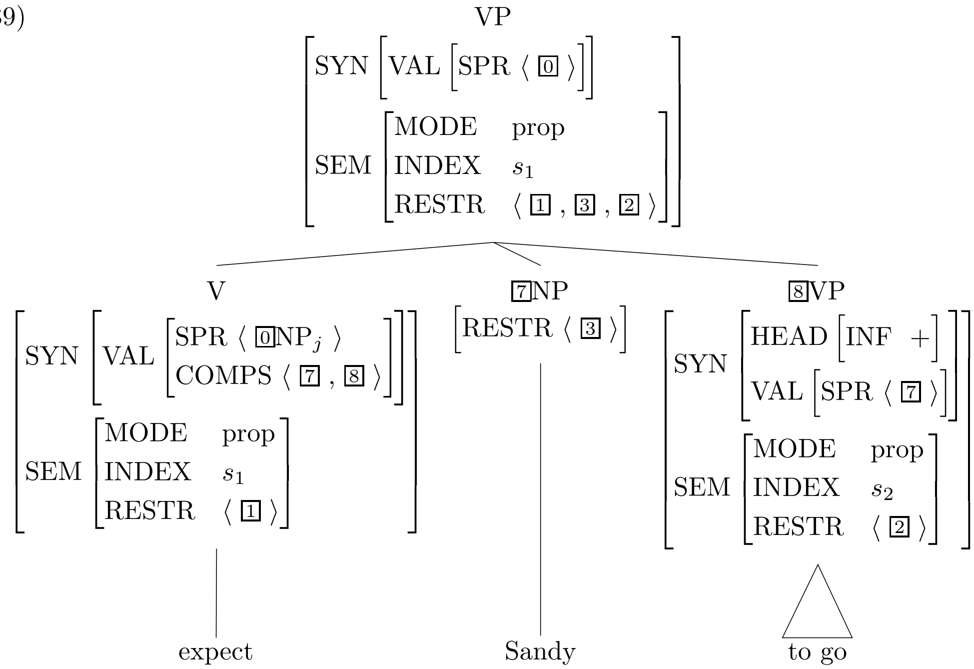
b.

$$\left\langle \text{persuade}\ ,\ \begin{bmatrix} \textit{ocv-lxm} & \\ \text{ARG-ST} & \left\langle\ \text{NP}_j\ ,\ \text{NP}_i\ ,\ \begin{matrix}\text{VP}\\ \begin{bmatrix}\text{INF} & +\end{bmatrix}\end{matrix} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & s \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{persuade} \\ \text{SIT} & s \\ \text{PERSUADER} & j \\ \text{PERSUADEE} & i \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

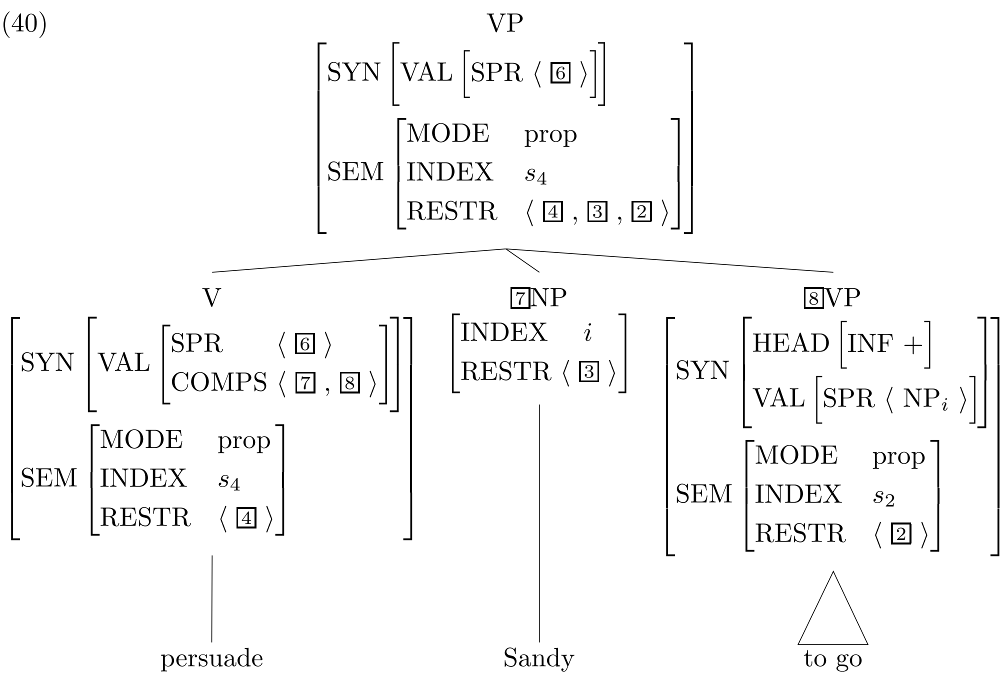
Notice that the contrast between the types *orv-lxm* and *ocv-lxm* is analogous to the contrast between *srv-lxm* and *scv-lxm*. The type *orv-lxm* specifies that the second argument is the same as the specifier of the third argument ($\boxed{1}$). In addition, the second argument isn’t assigned any role in the predication in the entry for the object raising verb *expect*. In contrast, the type *ocv-lxm* specifies that the index of the second argument is the same as the specifier of the third argument. Further, the second argument of *persuade* is assigned a role (PERSUADEE) in the **persuade** predication.

The active words derived from these lexemes will then give rise to structures like the following:

(39)



(40)



And the semantic analyses associated with these structures are as shown in (41) and (42):

(41)
$$\begin{bmatrix} \text{MODE} & \text{prop} \\ \text{INDEX} & s_1 \\ \text{RESTR} & \left\langle \boxed{1}\begin{bmatrix} \text{RELN} & \textbf{expect} \\ \text{SIT} & s_1 \\ \text{EXPECTER} & j \\ \text{ARG} & s_2 \end{bmatrix}, \boxed{3}\begin{bmatrix} \text{RELN} & \textbf{name} \\ \text{NAME} & \text{Sandy} \\ \text{NAMED} & i \end{bmatrix}, \boxed{2}\begin{bmatrix} \text{RELN} & \textbf{go} \\ \text{SIT} & s_2 \\ \text{GOER} & i \end{bmatrix} \right\rangle \end{bmatrix}$$

(42)
$$\begin{bmatrix} \text{MODE} & \text{prop} \\ \text{INDEX} & s_4 \\ \text{RESTR} & \left\langle \boxed{4}\begin{bmatrix} \text{RELN} & \textbf{persuade} \\ \text{SIT} & s_4 \\ \text{PERSUADER} & j \\ \text{PERSUADEE} & i \\ \text{ARG} & s_2 \end{bmatrix}, \boxed{3}\begin{bmatrix} \text{RELN} & \textbf{name} \\ \text{NAME} & \text{Sandy} \\ \text{NAMED} & i \end{bmatrix}, \boxed{2}\begin{bmatrix} \text{RELN} & \textbf{go} \\ \text{SIT} & s_2 \\ \text{GOER} & i \end{bmatrix} \right\rangle \end{bmatrix}$$

We are now in a position to discuss why the structure in (36) is compatible with our grammar so far and why the structure in (35) isn't. Consider the following passive sentences:

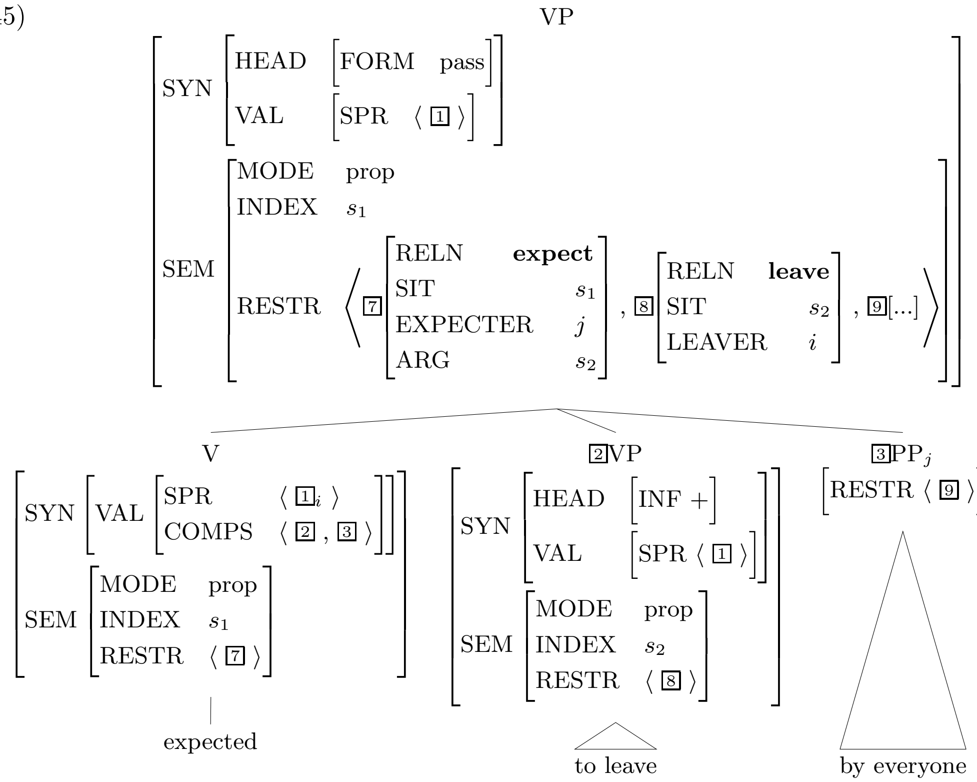
(43) a. Chris was expected to leave (by everyone).
b. Chris was persuaded to leave (by Ashley).

These examples are predicted to be grammatical by our analysis, assuming the type constraints in (37) and the lexical entries in (38). The lexical entry for *expect* in (38a) will give rise to the passive word sketched in (44):

(44)
$$\left\langle \text{expected}\ , \begin{bmatrix} \textit{word} & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{FORM} & \text{pass} \end{bmatrix} \end{bmatrix} \\ \text{ARG-ST} & \left\langle \boxed{1}\ , \overset{\text{VP}}{\begin{bmatrix} \text{INF} & + \\ \text{SPR} & \langle \boxed{1} \rangle \\ \text{INDEX} & s_2 \end{bmatrix}} \Big(, \text{PP[by]}_j\Big) \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & s_1 \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{expect} \\ \text{SIT} & s_1 \\ \text{EXPECTER} & j \\ \text{ARG} & s_2 \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

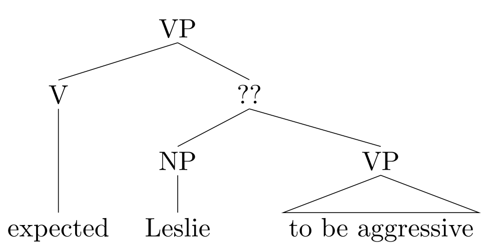
And this word will give rise to structures like (45) (analogous to (36)), which are precisely what we need to accommodate examples like (43a):

(45)



If, on the other hand, the structure in (35) (repeated here as (46)) were the correct structure for active sentences like (34), we would predict the passive examples in (43) to be ungrammatical.

(46)



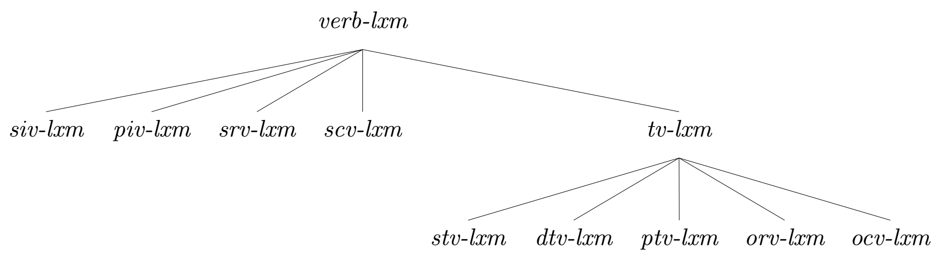
If structures like (46) were correct, then the lexical entries for these verbs would involve a doubleton ARG-ST list containing the subject NP and some kind of infinitival phrase that included the NP. But since passivization involves a rearrangement of the ARG-ST list, i.e. a lexical rule that 'promotes' an object NP to become the first argument of the passive verb form, such putative lexical entries would give us no way to analyze examples like (43). We would need to assume some passivization mechanism beyond those that are, as we saw in Chapter 10, independently motivated in our grammar. We conclude that the structure in (36) and the constraints we have posited on *orv-lxm* and *ocv-lxm* are correct.

12.7 Summary

This chapter explored further subtleties in the patterned distribution of nonreferential NPs. These patterns led us to posit a fundamental difference between two kinds of verbs: raising verbs, which select one ARG-ST member assigned no semantic role, and control verbs, which are superficially similar, but which assign a semantic role to each member of their ARG-ST list. We explored the various subclasses of raising and control verbs, including the defective infinitival verb *to* and concluded by examining the interaction of our proposed analysis with the passive analysis introduced in Chapter 10.

12.8 Changes to the Grammar

In this chapter, we revised the type hierarchy, introducing the new lexeme types: *subject-raising-verb-lxm* (*srv-lxm*), *subject-control-verb-lxm* (*scv-lxm*), *object-raising-verb-lxm* (*orv-lxm*), and *object-control-verb-lxm* (*ocv-lxm*). The hierarchy under *verb-lxm* now looks like this:



We also introduced the binary feature INF(INITIVE), appropriate for feature structures of type *verb*. The type *verb-lxm* was made subject to the following constraint:

$$\textit{verb-lxm}: \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{INF} \; / \; - \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

We then posited the following type constraints:

subject-raising-verb-lxm (*srv-lxm*):

$$\begin{bmatrix} \text{ARG-ST} & \left\langle \boxed{1} \, , \begin{bmatrix} \text{SPR} & \langle \boxed{1} \rangle \\ \text{COMPS} & \langle \; \rangle \\ \text{INDEX} & s \end{bmatrix} \right\rangle \\ \\ \text{SEM} & \begin{bmatrix} \text{RESTR} & \left\langle \begin{bmatrix} \text{ARG} & s \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

subject-control-verb-lxm (*scv-lxm*):

$$\begin{bmatrix} \text{ARG-ST} & \left\langle \text{NP}_i \, , \begin{bmatrix} \text{SPR} & \langle \text{NP}_i \rangle \\ \text{COMPS} & \langle \; \rangle \\ \text{INDEX} & s \end{bmatrix} \right\rangle \\ \\ \text{SEM} & \begin{bmatrix} \text{RESTR} & \left\langle \begin{bmatrix} \text{ARG} & s \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

object-raising-verb-lxm (*orv-lxm*):

$$\begin{bmatrix} \text{ARG-ST} & \left\langle \text{NP} , \boxed{1} , \begin{bmatrix}\text{SPR} & \langle \boxed{1} \rangle \\ \text{COMPS} & \langle\ \rangle \\ \text{INDEX} & s\end{bmatrix} \right\rangle \\ \text{SEM} & \begin{bmatrix}\text{RESTR} & \left\langle \begin{bmatrix}\text{ARG} & s\end{bmatrix}\right\rangle\end{bmatrix}\end{bmatrix}$$

object-control-verb-lxm (*ocv-lxm*):

$$\begin{bmatrix} \text{ARG-ST} & \left\langle \text{NP} , \text{NP}_i , \begin{bmatrix}\text{SPR} & \langle \text{NP}_i \rangle \\ \text{COMPS} & \langle\ \rangle \\ \text{INDEX} & s\end{bmatrix} \right\rangle \\ \text{SEM} & \begin{bmatrix}\text{RESTR} & \left\langle \begin{bmatrix}\text{ARG} & s\end{bmatrix}\right\rangle\end{bmatrix}\end{bmatrix}$$

We added the following entries to our lexicon:

$$\left\langle \text{to} , \begin{bmatrix} \textit{auxv-lxm}^{9} & \\ \text{SYN} & \begin{bmatrix}\text{HEAD} & \begin{bmatrix}\text{INF} & + \\ \text{AUX} & + \\ \text{FORM} & \text{base}\end{bmatrix}\end{bmatrix} \\ \text{ARG-ST} & \left\langle \boxed{1} , \begin{bmatrix} \text{HEAD} & \begin{bmatrix}\textit{verb} & \\ \text{INF} & - \\ \text{FORM} & \text{base}\end{bmatrix} \\ \text{VAL} & \begin{bmatrix}\text{SPR} & \langle \boxed{1} \rangle\end{bmatrix} \\ \text{SEM} & \begin{bmatrix}\text{INDEX} & s\end{bmatrix}\end{bmatrix}\right\rangle \\ \text{SEM} & \begin{bmatrix}\text{INDEX} & s \\ \text{RESTR} & \langle\ \rangle\end{bmatrix}\end{bmatrix}\right\rangle$$

$$\left\langle \text{continue} , \begin{bmatrix} \textit{srv-lxm} & \\ \text{ARG-ST} & \left\langle \text{X} , \begin{array}{c}\text{VP} \\ \begin{bmatrix}\text{INF} & +\end{bmatrix}\end{array} \right\rangle \\ \text{SEM} & \begin{bmatrix}\text{INDEX} & s \\ \text{RESTR} & \left\langle \begin{bmatrix}\text{RELN} & \textbf{continue} \\ \text{SIT} & s\end{bmatrix}\right\rangle\end{bmatrix}\end{bmatrix}\right\rangle$$

[9] The type *auxv-lxm* is discussed in the next chapter.

$$\left\langle \text{try}\ ,\ \begin{bmatrix} \textit{scv-lxm} & \\ \text{ARG-ST} & \left\langle \text{NP}_i\ ,\ \begin{matrix}\text{VP}\\ \begin{bmatrix}\text{INF} & +\end{bmatrix}\end{matrix} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & s \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{try} \\ \text{SIT} & s \\ \text{TRIER} & i \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

$$\left\langle \text{expect}\ ,\ \begin{bmatrix} \textit{orv-lxm} & \\ \text{ARG-ST} & \left\langle \text{NP}_j\ ,\ \text{X}\ ,\ \begin{matrix}\text{VP}\\ \begin{bmatrix}\text{INF} & +\end{bmatrix}\end{matrix} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & s \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{expect} \\ \text{SIT} & s \\ \text{EXPECTER} & j \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

$$\left\langle \text{persuade}\ ,\ \begin{bmatrix} \textit{ocv-lxm} & \\ \text{ARG-ST} & \left\langle \text{NP}_j\ ,\ \text{NP}_i\ ,\ \begin{matrix}\text{VP}\\ \begin{bmatrix}\text{INF} & +\end{bmatrix}\end{matrix} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & s \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{persuade} \\ \text{SIT} & s \\ \text{PERSUADER} & j \\ \text{PERSUADEE} & i \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

Finally, in Exercise 1 we modified the Imperative Rule so as to require that the daughter be [INF −], as well as [FORM base].

12.9 Further Reading

The raising/control distinction was first introduced into the generative literature (but with different terminology) by Chomsky (1965) and Rosenbaum (1967). Other discussions of these phenomena include Jackendoff 1972, Postal 1974, Bach 1979, Bresnan 1982a, Postal and Pullum 1988, and Sag and Pollard 1991. Some of the terms that you might find in this literature include ‘equi’ for ‘control’, ‘subject-subject raising’ for ‘subject raising’ and ‘object-subject raising’ for ‘object raising’.

12.10 Problems

⚠ **Problem 1: Classifying Verbs**

Classify the following verbs as raising or control:

- tend
- decide
- manage
- fail
- happen

Justify your classification by applying each of the following four tests to each verb. Show your work by providing relevant examples and indicating their grammaticality.

(i) Can the verb take a dummy *there* subject if and only if its complement selects for a dummy *there* subject?

(ii) Can the verb take a dummy *it* subject if and only if its complement selects for a dummy *it* subject?

(iii) Can the verb take an idiom chunk subject if and only if the rest of the idiom is in its complement?

(iv) Do pairs of sentences containing active and passive complements to the verb end up being paraphrases of each other?

Make sure to restrict your attention to cases of the form: NP V *to* VP. That is, ignore cases like *Kim manages a store*, *Alex failed physics*, and any other valence that doesn't resemble the *continue* vs. *try* pattern.

⚠ **Problem 2: Classifying Adjectives**

Classify the following adjectives as raising or control:

- anxious
- bound
- certain
- lucky

Justify your classification by providing each of the four types of data discussed in Problem 1 for each adjective.

Make sure to restrict your attention to cases of the form: NP *be* Adj *to* VP. That is, ignore cases like *Kim is anxious about the exam*, *Carrie is certain of the answer*, and any other valence that doesn't resemble the *likely* vs. *eager* pattern.

Problem 3: Lexical Entries for Adjectives

To accommodate raising and control adjectives in our grammar, we need types *subject-raising-adjective-lexeme* (*sra-lxm*) and *subject-control-adjective-lexeme* (*sca-lxm*).

A. What is the immediate supertype of these two types? How else (if at all) do they differ from *srv-lxm* and *scv-lxm*?

B. Provide lexical entries for *likely* and *eager*, making use of these new types.

[*Hint: Keep in mind as you do this problem that in sentences like (i),* be *is a raising verb that mediates the relationship between* likely *and its subject.*]

(i) Kim is likely to leave.

Problem 4: ***Expect*** **vs.** ***Persuade***

In Section 12.6, we sketched an analysis of the verbs *expect* and *persuade* without providing justification for the fundamental distinction between the two types of lexeme we have posited. The purpose of this problem is to have you construct the arguments that underlie the proposed distinction between *orv-lxm* and *ocv-lxm*.

Construct examples of each of the following four types which show a contrast between *expect* and *persuade*. Explain how the contrasts are accounted for by the differences in the types *orv-lxm* and *ocv-lxm* and/or the lexical entries for *expect* and *persuade*.[10]

(i) Examples with dummy *there*.

(ii) Examples with dummy *it*.

(iii) Examples with idiom chunks.

(iv) Examples of relevant pairs of sentences containing active and passive complements. Indicate whether they are or are not paraphrases of each other.

Problem 5: Raising/Control in Icelandic

In Section 12.4 we discussed a formal difference in our treatment of raising and control. In raising, the whole *synsem* of the first argument of the embedded verb is identified with some argument of the higher verb. In control, the two arguments are only coindexed. This problem investigates some data from Icelandic that help motivate this formal distinction.

As noted in Problem 7 of Chapter 4, Icelandic has verbs that assign idiosyncratic cases to their subjects. Thus we get contrasts like the following (where other case markings on the subjects are unacceptable):

(i) Hun er vinsael.
She.NOM is popular

(ii) Hana vantar peninga.
Her.ACC lacks money

(iii) Henni batanaði veikin.
Her.DAT recovered-from the-disease

[10] Again, make sure you ignore all irrelevant uses of these verbs, including cases of CP complements, e.g. *persuade NP that ...* or *expect that ...* and anything else not directly relevant (*I expect to go*, *I am expecting Kim*, *She is expecting*, and so forth).

In infinitival constructions, two patterns are observed (again, other case markings on the subjects are unacceptable):

(iv) Eg vonast til að vanta ekki peninga.
I.NOM hope for to lack not money

(v) Eg vonast til að batnað veikin
I.NOM hope for to recover-from the-disease

(vi) Hana virðist vanta peninga.
Her.ACC seems to-lack money

(vii) Henni virðist hafa batnað veikin.
Her.DAT seems to-have recovered-from the-disease

A. The verbs *vonast* and *virðist* differ in the case they require on their subjects. Describe the pattern for each verb.
B. Assume that our analysis of raising and control for English is broadly applicable to Icelandic. Which class do the data in (i)–(vii) suggest that *vonast* and *virðist* each belong to? Why?
C. One alternative analysis of control verbs would identify the whole *synsem* of the first argument of a control verb with the subject of the infinitival complement. Use the data in (i)–(vii) to construct an argument against this alternative analysis.

Problem 6: A Type for Existential ***Be***

The *be* that takes *there* (see (11) on page 336) as its subject wasn't given a true lexical type in Chapter 11, because no suitable type had been introduced. One of the types in this chapter will do, if we make some of its constraints defeasible.

A. Which of the types introduced in this chapter comes closest to being consistent with the constraints on *there*-taking *be*?
B. Rewrite that type indicating which constraints must be made defeasible.
C. Give a stream-lined lexical entry for the *there*-taking *be* which stipulates only those constraints which are truly idiosyncratic to the lexeme.

Problem 7: There, There...

Problem 1 of Chapter 11 asked you to investigate verb agreement in sentences with *there* as the subject. There is actually considerable variation on this point, but the normative or prescriptively correct pattern is that finite forms of *be* that take *there* as their subject agree in number with the NP following *be*:

(i) There was/*were a riot in the park.
(ii) There were/*was many people at the party.

One way to formalize this is to have the lexical entry for the existential *be* lexeme stipulate that the NUM value on *there* is the same as the NUM value on the second element of the ARG-ST list. This entry would then undergo the normal inflectional lexical rules. Note that this analysis requires *there* to have an underspecified value for the feature NUM.

A. Give a lexical entry for the lexeme *be* that is consistent with the analysis described above.

B. Explain how your lexical entry interacts with the rest of the grammar to account for the contrast between (i) and (ii). Be sure to make reference to the role of lexical rules, grammar rules, and principles, as appropriate.

C. Does this analysis correctly predict the grammaticality of (iii) and the ungrammaticality of (iv)? Why or why not?

(iii) There continues to be a bug in my program.
(iv)*There continue to be a bug in my program.

Problem 8: Reflexives in Infinitival Complements

In Problem 4 above, you justified our analysis of *expect* and *persuade*.

A. Does that analysis (and in particular the ARG-ST values) interact with the Binding Theory of Chapter 7 to make the right predictions about the data in (i)–(viii)? Explain why or why not. Be sure to address all of the data given.

(i) We expect the doctor to examine us.
(ii)*We expect the doctor to examine ourselves.
(iii) We expect them to examine themselves.
(iv)*We expect them$_i$ to examine them$_i$.
(v) We persuaded the doctor to examine us.
(vi)*We persuaded the doctor to examine ourselves.
(vii) We persuaded them to examine themselves.
(viii)*We persuaded them$_i$ to examine them$_i$.

Now consider two more verbs: *appear* and *appeal*. *Appear* is a raising verb, and *appeal* is a control verb. They also differ as to which of their arguments is identified (or coindexed) with the subject of the lower clause.

B. Use the binding data in (ix)–(x) to decide which argument of *appear* is identified with the subject of *support*. Justify your answer.

(ix) They appeared to us to support themselves.
(x)*They$_i$ appeared to us to support them$_i$.

C. Use the binding data in (xi)–(xii) to decide which argument of *appeal* is coindexed with the subject of *support*. Justify your answer.

(xi)*They appealed to us to support themselves.
(xii) They$_i$ appealed to us to support them$_i$.

Problem 9: Extraposition and Raising

Our grammar as it currently stands gives three parses for sentences like (i), because the Extraposition Lexical Rule can apply to three different words in the sentence. This ambiguity is spurious, that is, it is not clear that there are really three different meanings for the sentence corresponding to the three parses.

(i) It seems to annoy Kim that dogs bark.

A. Which words could undergo the Extraposition Lexical Rule?
B. Draw the three structures (trees) that the grammar licenses for (i). You may use abbreviations like NP and S on all of the nodes.
C. Extra credit: Modify the Extraposition Lexical Rule to rule out the extra parses, or provide a reason that this can't easily be achieved.

Problem 10: Control and PP Complements
In Section 11.2 of Chapter 11, we noted that predicational prepositions must have ARG-ST lists with two elements in order to account for sentences like (i), where *be* is a raising verb:

(i) The fence is around the house.

If predicational prepositions like *around* have two arguments, we have to be careful what we say about sentences like (ii) and (iii):

(ii) The house$_j$ had a fence around it$_j$.
(iii)*The house$_j$ had a fence around itself$_j$.

In particular, if we don't say anything about the first argument of *around* in (iii) it could just happen to have the same index as the house (j), predicting that (iii) should be grammatical. Intuitively, however, the first argument of *around* should be the fence, and not the house.

A. Assuming the meaning of *around* involves a two-argument predication whose RELN is **around** and whose roles are ENCLOSED and COVER, write a lexical entry for *around* as it is used in (i).
B. Give the RESTR value that the grammar (including your lexical entry for *around*) should assign to the sentence in (i). (Recall that *the* is treated as a generalized quantifier, similar to *a*.)
C. Write a lexical entry for *have* as it is used in (ii) and (iii) which requires coindexing between the NP *a fence* and the first argument of *around*. [*Hints: This will be similar to lexical entries for object control verbs. However, since the ARG-ST of this have doesn't match the constraints on the type ocv-lxm, it can't be an instance of that type. Assume instead that it's an instance of ptv-lxm. Further assume that it selects for a predicational PP complement by specifying [MODE prop] on that argument. Finally, assume that the meaning of (ii) is 'the house has a fence, and the fence is around the house.' This makes it relatively easy to write the lexical entry for have, because you don't have to worry about how the predication introduced by the PP fits in: the Semantic Compositionality Principle will take care of that. What you need to attend to is the coindexing of elements in the lexical entry of have.*]
D. Explain how your lexical entry in part (C) interacts with the Binding Theory to correctly predict the judgments in (ii) and (iii).

14

Long-Distance Dependencies

14.1 Introduction

One of the principal tasks of a theory of grammar is to provide mechanisms that allow economical formulations of the sorts of co-occurrence restrictions that exist in natural languages. In earlier chapters, we developed techniques for analyzing such aspects of syntax as differences in the valence of particular verbs, agreement between subject and verb, agreement between determiner and head noun, and restrictions on the distribution of dummy NPs. All of these co-occurrence restrictions are quite local, in the sense that they involve limitations on what can occur together as elements of a single clause. We extended this locality slightly with our analysis of raising, which in effect permits the co-occurrence restrictions of one verb to be transmitted to a higher verb.

The present chapter introduces a new type of construction in which the locality of co-occurrence restrictions appears to be violated in a more radical way. In these cases, two elements (say, an NP and a verb) appear far from one another in a sentence, despite the existence of a syntactic dependency (such as case marking or agreement) between them. Handling these 'long distance dependencies' (or LDDs, as we will call them) will require several changes to our theory:

- two new features,
- reformulation of the constraints on the types *word*, *lexeme* and *l-rule*, and on the initial symbol (in reference to the new features),
- a minor reformulation of some of our grammar rules,
- a new principle,
- a new grammar rule, and
- a new lexical rule.

14.2 Some Data

Our current grammar correctly rules out examples like the following:

(1) a.*They handed to the baby.
  b.*They handed the toy.
  c.*You have talked to.
  d.*The children discover.

Because the lexical entry for *hand* specifies that its COMPS list has both an object NP and a PP, (1a–b) are ruled out through the interaction of the lexicon, the headed grammar rules, the Argument Realization Principle, and the Valence Principle. Similarly, (1c–d) are ruled out because both the preposition *to* and the verb *discover* require an object NP, which is absent from these examples.

So it's interesting to find that there are grammatical sentences that contain exactly the ungrammatical strings of words in (1). For example, there are questions containing *wh*-words ('*wh*-questions') such as following:

(2) a. What did they hand to the baby?
b. To whom did they hand the toy?
c. Who(m) should you have talked to?
d. What will the children discover?

There are also NPs modified by RELATIVE CLAUSES which contain the same ungrammatical strings:

(3) a. The toy which they handed to the baby...
b. The baby to whom they handed the toy ...
c. The people who(m) you have talked to...
d. The presents that the children discover...

Another sort of example is a kind of sentence that is used for a certain sort of emphasis that is usually called a 'topicalized' sentence. In such sentences, a topicalized element can be followed by one of those same ungrammatical word sequences in (1):[1]

(4) a. That toy, they handed to the baby.
b. To the baby, they handed a toy.
c. That kind of person, you have talked to (many times).
d. Presents that come from grandma, the children (always) discover.

And finally, there are certain adjectives like *easy* and *hard* whose infinitival complements may contain a verb or preposition lacking a normally obligatory object:

(5) a. That toy would be easy to hand to the baby.
b. You are easy to talk to.
c. The presents from grandma were hard for the children to discover.

In each of the examples in (2)–(5), there is a dependency between a phrase or 'filler' at the beginning of a clause and a 'gap' somewhere within the clause. In questions, relative

[1]When examples like (4) are first presented, some students claim that they find them unacceptable, but examination of actual usage indicates that topicalization is quite common, e.g. in examples like the following:

(i) Me, you bring an empty food dish; him, you bring a leash. (from a cartoon)
(ii) The film clips you're going to see tonight, no one's ever seen before. (Carol Burnett radio ad, November 26, 2001)

The name 'topicalization' is actually rather misleading. To be sure, the fronted element refers to an entity whose role in the discourse is distinguished in some way, but that entity need not correspond to the 'topic of discussion' in any straightforward way, as (i) indicates.

clauses, and topicalized sentences, the filler appears to be an extra phrase in that position; in examples like (5), the subject of the clause also serves as the filler.

In short, we see that elements whose presence is usually required in a clause are allowed to be absent if there is an appropriate filler in the right place. Likewise, if there is a filler, then there must be a gap somewhere within the sentence that follows the filler:

(6) a.*What did Kim hand the toys to the baby?
b.*The dolls that Kim handed the toys to the baby....
c.*The dolls, Kim handed the toys to the baby.
d.*The dolls are easy to hand the toys to the baby.

In such constructions, the filler can be separated from the gap by extra clauses, as indicated in (7)–(10). To help readers identify the location of the gaps, we have marked them with an underlined space.

(7) a. What did you say they handed __ to the baby?
b. Who(m) did he claim that they handed the toy to __ ?
c. Who(m) do you think you have talked to __ ?
d. What will he predict that the children discover __ ?

(8) a. The toy which we believe they handed __ to the baby...
b. The baby that I think they handed the toy to __ ...
c. The person who(m) everyone thinks you have talked to __ ...
d. The presents that it annoys me that the children discover __ ...

(9) a. That toy, I think they handed __ to the baby.
b. This baby, I know that they handed a toy to __ .
c. That kind of person, you know you have talked to __ .
d. Presents that come from grandma, I know that the children (always) discover __ .

(10) a. This toy isn't easy to try to hand __ to the baby.
b. The baby is easy to ask someone to hand a toy to __ .
c. That kind of person is hard to find anyone to talk to __ .
d. Presents from grandma are easy to help the children to discover __ .

In fact, there can be multiple extra clauses intervening:

(11) What did you think Pat claimed I said they handed __ to the baby?

14.3 Formulating the Problem

We want to be able to build clauses with elements missing within them. But somehow we have to keep track of the fact that something is missing. Furthermore, as the following contrasts show, we need to keep track of just what is missing:

(12) a. This, you can rely on.
b.*This, you can rely.
c.*On this, you can rely on.
d. On this, you can rely.
e.*On this, you can trust.

(13) a. Him, you can rely on.
b.*He, you can rely on.

(14) a. The twins, I can't tell the difference between.
b.*That couple, I can't tell the difference between.

Exercise 1: Long-Distance Selectional Dependencies
What exactly is wrong with the starred examples in (12)–(14)? Which element is selecting for the missing (or 'gapped') element, and which requirement of the selecting head does the filler not fulfill?

We can think of this as an information problem. We have to make sure that the phrases within the sentence keep track of what's missing from them as they are built. This has to be done just right, so that sentences missing a phrase of category *X* (no matter how deeply embedded that gap may be) combine with a filler of category *X*, and that fillers are allowed only when there is a gap for them to fill (cf. (6)).

14.4 Formulating a Solution

Our solution to this information problem will involve breaking it down into three parts: the bottom, the middle and the top. The bottom of an LDD is where the gap is 'introduced' – i.e. the smallest subtree where something is missing. Many theories handle the bottom by positing an empty element in the tree. We will avoid using empty elements in this way and instead handle the bottom by means of a feature (GAP) and a revision to the ARP that allows ARG-ST elements to show up on GAP instead of on the COMPS list. This is the topic of Section 14.4.1. The middle of an LDD is the 'transmission' of the information about what is missing from bottom to top (alternatively, the 'transmission' of what is available as a filler from top to bottom). We will handle this by means of a principle that relates the GAP values of phrases to the GAP values of their daughters. This is the topic of Section 14.4.2. The top of an LDD is where the filler is introduced, and the GAP requirement cancelled off. How exactly this happens depends on the particular kind of LDD. In Section 14.4.3, we will consider two kinds: 'topicalized' sentences, which we analyze in terms of a new phrase structure rule, and LDDs with *easy*-class adjectives, where the lexical entry for the adjective handles the top of the LDD.

14.4.1 The Feature GAP

. We introduce the feature GAP (on *syn-cat*) to encode the fact that a phrase is missing a certain kind of element. There are examples of clauses where more than one phrase is missing,[2] a phenomenon we will return to in Problem 5 below:

(15) a. Problems this involved, my friends on the East Coast are hard to talk to __ about __ .
b. Violins this well crafted, these sonatas are easy to play __ on __ .

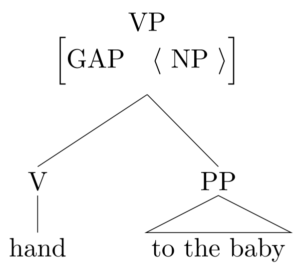
[2]Or, as linguists sometimes say (though it is somewhat of an oxymoron): 'where more than one gap appears'.

Note that the two gaps in each of these sentences have distinct fillers. In (15a), for example, the filler for the first gap is *my friends on the East Coast*, and the filler for the second one is *problems this involved*. Such examples are rare in English and sound a bit awkward, but there are other languages (for example several Slavic and Scandinavian languages) that allow multiple gaps more freely.

Given the existence of sentences with multiple gaps, we need a mechanism that can keep track of multiple missing elements. This suggests that the value of GAP is a list of feature structures, like the values of COMPS, SPR, MOD, and ARG-ST.

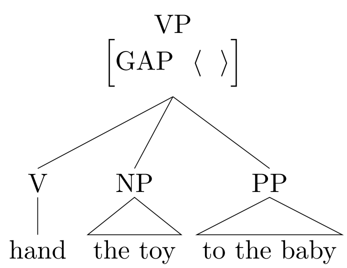
The intuitive significance of a phrase specified as, say, [GAP ⟨ NP ⟩] is that it is missing exactly one NP. The trick will be to make GAP have the right values in the right places. What we want is to allow a transitive verb or preposition to build a VP or PP without ever combining with an object NP. Furthermore, we want to ensure that it is only when an NP is absent that the relevant phrase is specified as [GAP ⟨ NP ⟩], as illustrated in (16):

(16)



When nothing is missing, we want the relevant phrase to be [GAP ⟨ ⟩], as in (17):

(17)



We will deal with this kind of 'missing element' as an instance of something that is present in argument structure but absent from the valence features. We could accomplish this by means of a lexical rule, but a more general solution is to modify the Argument Realization Principle. Our current version of the principle says that a word's SPR and COMPS lists add up to be its argument structure (ARG-ST) list. We now want to allow for the possibility that some element or elements of ARG-ST are on neither the SPR list nor the COMPS list, but on the GAP list instead.

To make this modification precise, we will introduce a kind of subtraction operation on lists, which we will mark with the symbol $\ominus$. Intuitively, if A and B are lists, then A $\ominus$ B is a list that results from removing the elements of B from A. A couple of caveats are in order here. First, we want A $\ominus$ B to be defined only when the elements of B all occur in A, and in the same order. So there are many pairs of lists for which this kind of list subtraction is undefined. This is unlike our form of list addition ($\oplus$), which is defined for any pair of lists. Second, when $A \ominus B$ is defined, it need not be unique. For example, if $A = \langle NP, PP, NP \rangle$ and $B = \langle NP \rangle$, then there are two possible values for $A \ominus B$, namely $\langle NP, PP \rangle$ and $\langle PP, NP \rangle$. We will interpret an equation like $A \ominus B = C$ to mean that there is some value for $A \ominus B$ that is identical to C.

With this new tool in hand, we can restate the Argument Realization Principle as follows:

(18) Argument Realization Principle:

$$
\textit{word}: \left[\begin{array}{ll}
\text{SYN} & \left[\begin{array}{ll}
\text{VAL} & \left[\begin{array}{ll}
\text{SPR} & \boxed{\text{A}} \\
\text{COMPS} & \boxed{\text{B}} \ominus \boxed{\text{C}}
\end{array}\right] \\
\text{GAP} & \boxed{\text{C}}
\end{array}\right] \\
\text{ARG-ST} & \boxed{\text{A}} \oplus \boxed{\text{B}}
\end{array}\right]
$$

The revised ARP guarantees that any argument that could appear on a word's COMPS list can appear on its GAP list instead. (We will deal with gaps that correspond to subjects, rather than complements, in Section 14.5) Further, (18) guarantees that whenever an argument is missing, any co-occurrence restrictions the word imposes on that argument will be registered on the element that appears on the GAP list.

Because the result of list subtraction ($\ominus$), as we have defined it, is not always unique, when we specify the ARG-ST in a verb's lexical entry without also specifying its SPR, COMPS, and GAP values, we are actually providing an underspecified lexical entry that will give rise to a family of words that differ with respect to how the ARP is satisfied. Consider, for example, the lexical entry for the lexeme *hand*, as specified in (19):

(19)

$$
\left\langle \text{hand}, \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{ptv-lxm}} \\
\text{ARG-ST} & \left\langle \text{X}_i, \text{Y}_k, \left[\begin{array}{ll}
\text{FORM} & \text{to} \\
\text{INDEX} & j
\end{array}\right] \right\rangle \\
\text{SEM} & \left[\begin{array}{ll}
\text{INDEX} & \text{s} \\
\text{RESTR} & \left\langle \left[\begin{array}{ll}
\text{RELN} & \textbf{hand} \\
\text{SIT} & s \\
\text{HANDER} & i \\
\text{HANDED-TO} & j \\
\text{HANDED-ITEM} & k
\end{array}\right] \right\rangle
\end{array}\right]
\end{array}\right] \right\rangle
$$

This can undergo the Non-3rd-Singular Verb Lexical Rule presented in Chapter 8, which gives rise to lexical sequences which satisfy the following description:

(20)

$$
\left\langle \text{hand}, \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{word}} \\
\text{SYN} & \left[\text{HEAD} \left[\text{FORM} \;\; \text{fin}\right]\right] \\
\text{ARG-ST} & \left\langle \left[\begin{array}{ll}
\text{CASE} & \text{nom} \\
\text{AGR} & \textit{non-3sing}
\end{array}\right], \begin{array}{c}\text{NP} \\ \left[\text{CASE acc}\right]\end{array}, \left[\text{FORM} \;\; \text{to}\right] \right\rangle
\end{array}\right] \right\rangle
$$

Since the second member of these lexical sequences is of type *word*, it is subject to the ARP. But now there are multiple ways to satisfy the ARP. In particular, the family of lexical sequences described in (20) includes lexical sequences meeting each of the following (more detailed) descriptions:

(21)

$$\left\langle \text{hand} \;,\; \begin{bmatrix} \textit{word} & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{FORM} & \text{fin} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle \boxed{1} \rangle \\ \text{COMPS} & \langle \boxed{2}\text{NP[acc]} \;,\; \boxed{3}\text{PP[to]} \rangle \end{bmatrix} \\ \text{GAP} & \langle \; \rangle \end{bmatrix} \\ \text{ARG-ST} & \left\langle \begin{matrix} \boxed{1}\text{NP} \\ \begin{bmatrix} \text{CASE} & \text{nom} \\ \text{AGR} & \textit{non-3sing} \end{bmatrix} \end{matrix} , \boxed{2} , \boxed{3} \right\rangle \end{bmatrix} \right\rangle$$

(22)

$$\left\langle \text{hand} \;,\; \begin{bmatrix} \textit{word} & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{FORM} & \text{fin} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle \boxed{1} \rangle \\ \text{COMPS} & \langle \boxed{3}\text{PP[to]} \rangle \end{bmatrix} \\ \text{GAP} & \langle \boxed{2}\text{NP[acc]} \rangle \end{bmatrix} \\ \text{ARG-ST} & \left\langle \begin{matrix} \boxed{1}\text{NP} \\ \begin{bmatrix} \text{CASE} & \text{nom} \\ \text{AGR} & \textit{non-3sing} \end{bmatrix} \end{matrix} , \boxed{2} , \boxed{3} \right\rangle \end{bmatrix} \right\rangle$$

(23)

$$\left\langle \text{hand} \;,\; \begin{bmatrix} \textit{word} & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{FORM} & \text{fin} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle \boxed{1} \rangle \\ \text{COMPS} & \langle \boxed{2}\text{NP[acc]} \rangle \end{bmatrix} \\ \text{GAP} & \langle \boxed{3}\text{PP[to]} \rangle \end{bmatrix} \\ \text{ARG-ST} & \left\langle \begin{matrix} \boxed{1}\text{NP} \\ \begin{bmatrix} \text{CASE} & \text{nom} \\ \text{AGR} & \textit{non-3sing} \end{bmatrix} \end{matrix} , \boxed{2} , \boxed{3} \right\rangle \end{bmatrix} \right\rangle$$

All of these are legitimate lexical sequences: (21) shows *hand*'s feature structure in sentences like (24a); (22) is the way *hand* appears in the tree our grammar assigns to sentences like (24b); and (23) shows *hand* as it appears in the tree we assign to sentences like (24c):[3]

(24) a. You handed the toy to the baby.
b. What did you hand to the baby?
c. To whom did you hand the toy?

The prepositional lexeme in (25) will now give rise to the word structures sketched in (26) and (27) (omitting what is not directly relevant):

(25)

$$\left\langle \text{to}\ ,\ \begin{bmatrix} \textit{argmkp-lxm} & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{prep} & \\ \text{FORM} & \text{to} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\ \rangle \end{bmatrix} \end{bmatrix} \\ \text{ARG-ST} & \left\langle \boxed{1}\text{NP[acc]} \right\rangle \end{bmatrix} \right\rangle$$

(26)

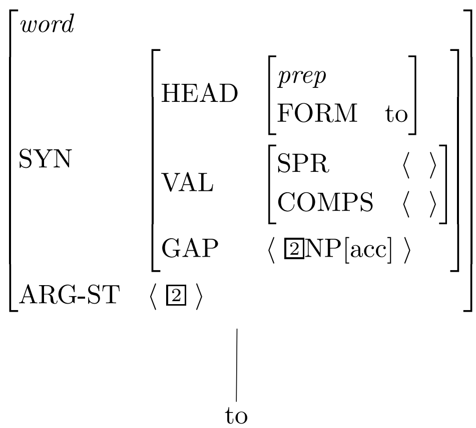
$$\begin{bmatrix} \textit{word} & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{prep} & \\ \text{FORM} & \text{to} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\ \rangle \\ \text{COMPS} & \langle \boxed{2}\text{NP[acc]} \rangle \end{bmatrix} \\ \text{GAP} & \langle\ \rangle \end{bmatrix} \\ \text{ARG-ST} & \langle \boxed{2} \rangle \end{bmatrix}$$

$$|$$

to

[3]The ARP also allows for a family of lexical sequences in which both the NP and PP complements are in the GAP list, rather than the COMPS list. We will return to multiple-gap sentences in Problem 5 below.

(27)



This last lexical tree is the one that allows for sentences like (28):

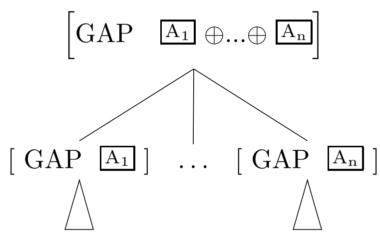
(28) Which baby did you hand the toy to?

14.4.2 The GAP Principle

The GAP feature tells us which of a word's arguments is missing. The Argument Realization Principle, as we have reformulated it, permits us to instantiate gaps freely (other than elements that must be on the SPR list). Now we need some way of passing the information in the GAP value up[4] from words like those just illustrated so that the phrases that they head will register the fact that something is missing, and from those phrases to larger phrases. To do so, we adopt the principle shown in (29):

(29) The GAP Principle (Preliminary Version)

A local subtree Φ satisfies the GAP Principle with respect to a headed rule ρ if and only if Φ satisfies:



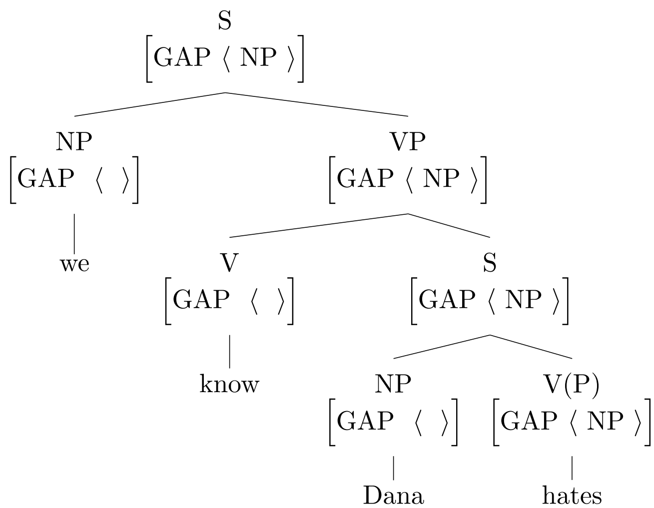
In other words, in a headed structure, the GAP values of all the daughters must add up to be the GAP value of the mother. That is, a phrase whose daughter is missing something is missing the exact same thing. There is one exception to this generalization, and that is the case where the larger phrase also contains the filler. We'll return to these cases directly.

The notion of lists 'adding up to' something is the same one we have employed before, namely the operation that we denote with the symbol '$\oplus$'. In most cases, most of the

[4]The metaphor of passing information between nodes should again not be taken literally. What the principle in (29) does is similar to what the Head Feature Principle and Valence Principle do, namely, enforce a particular relationship between certain feature values in mothers and daughters in phrase structure trees. That is, it is simply part of our definition of phrase-structure well-formedness.

GAP lists that are added up in this way are in fact empty, because most constituents don't contain gaps, so the addition is quite trivial. The effect of (29), then, given our lexical entries (and the word structures they sanction in virtue of our revision of the ARP), is illustrated in (30):

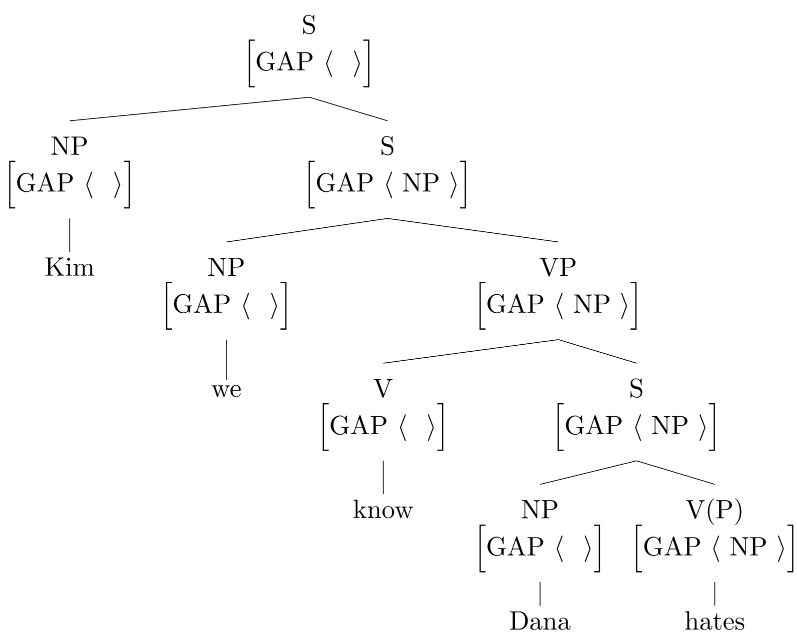
(30)



Note that each local tree in (30) satisfies the GAP Principle. That is, in each tree, the GAP values of the daughters add up to the mother's GAP value: $(\langle\ \rangle \oplus \langle \text{NP} \rangle) = \langle \text{NP} \rangle$

We now return to the exception (mentioned above) to the GAP Principle, as stated in the preliminary version: At the top of the LDD, where the gap is filled, we want the mother node to be [GAP ⟨ ⟩]. This is illustrated in (31):

(31)



We have not yet seen the phrase structure rule which licenses the topmost subtree of (31). It will be introduced in the next subsection. Here, we are concerned with the GAP values in that subtree. We want the mother to be [GAP ⟨ ⟩] as shown, because, intuitively, the NP *Kim* is 'filling' the gap. That is, the tree structure shown in (31) is no longer 'missing something', and this should be reflected in the GAP value of the root node in (31).

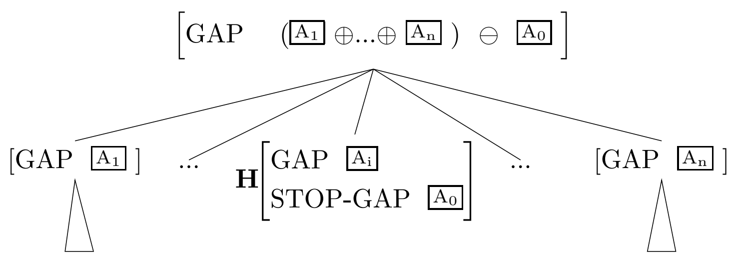
Adjectives like *hard* and *easy*, which we discussed earlier, also perform a gap-filling function, even though they also serve as the head daughter of a head-complement phrase. The VP in (32a) is 'gappy' – it is missing an NP and hence should be specified as [GAP ⟨ NP ⟩], while the AP in (32b) is not gappy and should be specified as [GAP ⟨ ⟩], like all other APs that we have encountered.

(32) a. [to talk to __]
b. [easy to talk to __]

We will provide a unified account of gap filling by introducing a new list-valued feature called STOP-GAP. Like GAP, STOP-GAP is a feature of *syn-cat*s. This feature signals what gap is to be filled in the local subtree where it appears. Most nodes will be [STOP-GAP ⟨ ⟩], but where a gap is associated with its filler, the feature has a non-empty list as its value. In particular, the lexical entries for gap stoppers like *easy* and *hard* will specify a non-empty value for this feature, as will the grammar rule we introduce for the topicalization construction. Making use of this new feature, we can reformulate the GAP Principle so that it passes up GAP values only if they are not filled. This is shown in (33):

(33) The GAP Principle (Final Version)

A local subtree Φ satisfies the GAP Principle with respect to a headed rule ρ if and only if Φ satisfies:



What this revision says is that the GAP value of the mother node in a headed structure is determined by adding up the GAP values of all the daughters and then subtracting any gaps that are being filled, as indicated by the head daughter's STOP-GAP value.

14.4.3 The Head-Filler Rule and *Easy*-Adjectives

We have dealt with the bottom of LDDs, where non-empty values for GAP are introduced, and the middle of LDDs where those GAP values are propagated through the tree (until they meet their fillers). Now we turn to the top of LDDs: the filling of the gap. As noted above, we will consider two types of gap-filling here: topicalized sentences and *easy*-adjectives.

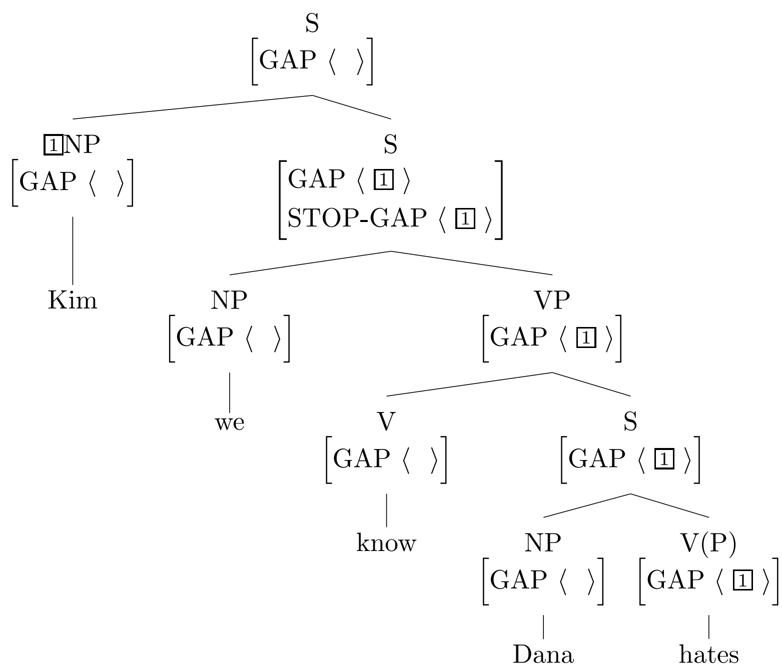
To deal with topicalized sentences, we now introduce a new grammar rule, formulated as follows:

(34) Head-Filler Rule

$$[\textit{phrase}] \rightarrow \boxed{1}\left[\text{GAP} \quad \langle\ \rangle\right] \quad \mathbf{H}\begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{FORM} & \text{fin}\end{bmatrix} \\ \text{VAL} & \begin{bmatrix}\text{SPR} & \langle\ \rangle \\ \text{COMPS} & \langle\ \rangle\end{bmatrix} \\ \text{STOP-GAP} & \langle \boxed{1} \rangle \\ \text{GAP} & \langle \boxed{1}\rangle \end{bmatrix}$$

This rule says that a phrase can consist of a head with a gap preceded by an expression that meets whatever requirements the head places on that gap.[5] The Head-Filler Rule licenses the topmost subtree in (35), and it enforces the identity between the NP *Kim* and the element on the GAP list of the gappy S *we know Dana hates* ($\boxed{1}$). Because that GAP element is identified with the GAP element of the V *hates* (and therefore also with an element of its ARG-ST list), any requirements that *hates* places on its complement (that it be a [CASE acc] NP, that its INDEX be identified with the HATED value in the **hate** predication) must be satisfied by the filler *Kim*.

(35)



The topmost node of (35) is [GAP ⟨ ⟩], indicating that the gap has been filled, thanks to the GAP Principle: The Head-Filler Rule in (35) specifies that the head daughter's GAP list and STOP-GAP list both contain the filler daughter, so that element is subtracted from the head daughter's GAP value in determining the GAP value of the

[5] And further that the filler must not be gappy.

mother:
$(\langle\ \rangle \oplus \langle\boxed{1}\rangle) \ominus \langle\boxed{1}\rangle = \langle\ \rangle$.

It is important to see that our analysis entails that a filler NP can appear before a clause only when that clause is gappy, i.e. when that clause is missing an NP that would normally appear there. Moreover, the Head-Filler Rule does not require the filler to be an NP, but it does require that the filler's *synsem* be identified with the unique member of the head daughter's GAP list. From this it follows that topicalized sentences may contain PP fillers (and perhaps fillers of other categories) just as long as the gap within the clause matches the synsem of the filler. That is, if the filler is a PP, then the missing element must be a PP, not an NP. This is a consequence of the many identities triggered by the Head-Filler Rule and the GAP Principle, interacting with the Argument Realization Principle and particular lexically specified ARG-ST values.

We now turn to our other example of gap filling, adjectives like *easy* or *hard*. Most words don't fill gaps, so we will posit the following defeasible constraint on the type *lexeme*:

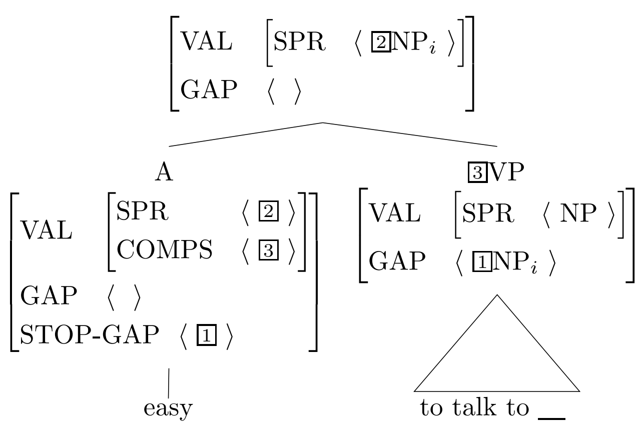
(36) $$\textit{lexeme} : \begin{bmatrix}\text{STOP-GAP} & / \ \langle\ \rangle\end{bmatrix}$$

Adjectives like *easy* or *hard* are the exceptions. We give them lexical entries which override this constraint, as shown for *easy* in (37):

(37) $$\left\langle \text{easy}\ ,\ \begin{bmatrix}\textit{adj-lxm} & \\ \text{SYN} & \begin{bmatrix}\text{STOP-GAP} & \langle\ \boxed{1}\ \rangle\end{bmatrix} \\ \text{ARG-ST} & \left\langle \text{NP}_i\ ,\ \overset{\text{VP}}{\begin{bmatrix}\text{INF} & + \\ \text{GAP} & \langle\ \boxed{1}\text{NP}_i\ ,\ ...\ \rangle\end{bmatrix}} \right\rangle\end{bmatrix} \right\rangle$$

Because the member of the STOP-GAP list in (37) is identified with the first member of the VP argument's GAP list, adjectives of this type must perform gap stopping of the sort shown in (38):

(38)



Notice that the GAP list is empty at the top node of this subtree. That is, the AP *easy to talk to* is treated as having no gap, even though the infinitival VP *to talk to* inside it has an NP gap. This may seem puzzling, since *easy to talk to* seems to be missing the same NP as *to talk to*. But at the level of the AP, the referent of the missing NP is fully determined: it is the same as the subject of the AP. Hence, the GAP list at the AP level no longer needs to register the missing NP. Instead, the first argument (that is, the subject) of the AP is coindexed with the NP in the GAP list.[6] This guarantees that, in a sentence like (39), the Pat is understood as the person who is followed:

(39) Pat is easy to continue to follow __ .

14.4.4 GAP and STOP-GAP in the Rest of the Grammar

We have added two features to our grammar (GAP and STOP-GAP) which are involved in passing information around the tree. As such, we must pause and ask whether the rest of our grammar (in particular, lexical rules, the rest of our grammar rules and the initial symbol) are currently doing the right thing with respect to these new features. The answer is (unsurprisingly) that we will need to make a few modifications.

First, with respect to the feature GAP: Nothing we have said so far ensures that all gaps ultimately get filled. We make sure that SPR and COMPS requirements are ultimately fulfilled by requiring that both be empty on the initial symbol. We can do the same for GAP. That is, our initial symbol is now the following:

(40)
$$\begin{bmatrix} \textit{phrase} & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{FORM} & \text{fin} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\ \rangle \\ \text{COMPS} & \langle\ \rangle \end{bmatrix} \\ \text{GAP} & \langle\ \rangle \end{bmatrix} \end{bmatrix}$$

Without this specification, we would license examples like (1), repeated here for convenience, as stand-alone utterances:

(41) a.*They handed to the baby.
b.*They handed the toy.
c.*You have talked to.
d.*The children discover.

The other consideration with respect to the feature GAP is whether its value is sufficiently constrained. The GAP Principle applies to headed phrases, but not non-headed phrases. Thus, in our discussion so far, we have not constrained the GAP value of coordinate phrases or imperatives. We will return to coordination in Section 14.6 below. As for imperatives, in order to ensure that we don't allow gappy VPs as the daughter (as in (42)), we can identify the mother's and daughter's GAP values, as shown in (43). Since imperative phrases must also satisfy the initial symbol, they must be [GAP ⟨ ⟩] on the mother.

(42)*Hand the toy!

[6] More precisely, with the NP in initial position in the GAP list.

(43) Imperative Rule (Revised Version)

$$\begin{bmatrix} \textit{phrase} & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\ \rangle \end{bmatrix} \\ \text{GAP} & \boxed{\text{A}} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{MODE} & \text{dir} \\ \text{INDEX} & s \end{bmatrix} \end{bmatrix} \rightarrow \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{INF} & - \\ \text{FORM} & \text{base} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \left\langle \text{NP}[\text{PER 2nd}] \right\rangle \\ \text{COMPS} & \langle\ \rangle \end{bmatrix} \\ \text{GAP} & \boxed{\text{A}} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & s \end{bmatrix} \end{bmatrix}$$

Thanks to the GAP Principle and the two modifications given above, GAP values are now sufficiently constrained throughout our grammar. We haven't said much about STOP-GAP values, however, except to say that they are non-empty in two places: on the head daughter of a head-filler phrase, and in the lexical entries for adjectives like (*easy*). In addition, the defeasible constraint given in (36) above and repeated here ensures that all other lexical entries are [STOP-GAP ⟨ ⟩]:

(44) $$\textit{lexeme} : \begin{bmatrix} \text{STOP-GAP} & / \langle\ \rangle \end{bmatrix}$$

Since we want the STOP-GAP values given on lexemes to be reflected in the word-structures they license, we need to make sure that all lexical rules preserve that information. We do that by adding the following non-defeasible constraint to the type *l-rule*:

$$\textit{l-rule} : \begin{bmatrix} \text{INPUT} & \left\langle \text{X} , [\text{STOP-GAP} \ \boxed{\text{A}}] \right\rangle \\ \text{OUTPUT} & \left\langle \text{Y} , [\text{STOP-GAP} \ \boxed{\text{A}}] \right\rangle \end{bmatrix}$$

When STOP-GAP is non-empty, the GAP Principle subtracts the relevant element from the GAP list being passed 'up' the tree. It follows that we want to ensure that STOP-GAP is empty when there is no gap-filling going on. Gaps are never filled in head-specifier or head-modifier phrases, so we constrain the head daughters of the Head-Specifier and Head-Modifier Rules to be [STOP-GAP ⟨ ⟩]:

(45) Head-Specifier Rule (Revised Version)

$$\begin{bmatrix} \textit{phrase} & \\ \text{SPR} & \langle\ \rangle \end{bmatrix} \rightarrow \boxed{1} \quad \mathbf{H}\begin{bmatrix} \text{SPR} & \langle \boxed{1} \rangle \\ \text{COMPS} & \langle\ \rangle \\ \text{STOP-GAP} & \langle\ \rangle \end{bmatrix}$$

(46) Head-Modifier Rule (Revised Version)

$$[\textit{phrase}] \rightarrow \mathbf{H}\boxed{1}\begin{bmatrix} \text{COMPS} & \langle\ \rangle \\ \text{STOP-GAP} & \langle\ \rangle \end{bmatrix} \begin{bmatrix} \text{COMPS} & \langle\ \rangle \\ \text{MOD} & \langle \boxed{1} \rangle \end{bmatrix}$$

Gap-filling sometimes occurs in head-complement phrases (in particular, when the head is an adjective like *easy*), so we do not want to constrain the head daughter of the Head-Complement Rule to be [STOP-GAP ⟨ ⟩]. However, since the head daughter of this rule is always a *word*, the STOP-GAP value will be appropriately constrained by the lexical entries.

This completes our discussion of complement gaps.[7]

14.5 Subject Gaps

We have covered only the basic cases of long-distance dependencies. There are many additional complexities. For example, we have not discussed cases in which the gaps are not complements, but rather subjects or modifiers. In addition, we have not discussed the distribution of *wh*-words (such as *who, what, which*, etc.) in questions and relative clauses, nor the obligatory inverted order of subject and auxiliary verb in many *wh*-questions. There is a rich literature investigating these and many other questions associated with LDDs, but such matters are beyond the scope of this text. In this section we sketch the basics of an account of what is subject extraction – that is LDDs in which the gaps are in subject position.

Our present account does not yet deal with examples like (47):

(47) a. Which candidates do you think like oysters on the half-shell?
b. That candidate, I think likes oysters on the half-shell.

This is because of an interaction between the ARP and the constraints (including the SHAC, inherited from *infl-lxm*) that all verb lexemes have SPR lists of length one. Together, these constraints require that the first member of a verb's ARG-ST list must appear on its SPR list. It may not belong to the rest of the list – i.e. to the list of elements that can appear on either COMPS or GAP, according to the ARP.

Rather than attempt to revise the ARP to handle these cases, we will treat them in terms of a post-inflectional lexical rule which provides [SPR ⟨ ⟩] lexical sequences for verbs, and puts the right information into the GAP list:

(48) Subject Extraction Lexical Rule

$$\begin{bmatrix} \textit{pi-rule} & \\ \text{INPUT} & \left\langle \text{X}\ , \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{FORM} & \text{fin} \end{bmatrix} \\ \text{VAL} & [\text{SPR} \ \ \langle \text{ Z } \rangle] \end{bmatrix} \\ \text{ARG-ST} & \boxed{\text{A}} \end{bmatrix} \right\rangle \\ \text{OUTPUT} & \left\langle \text{Y}\ , \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{VAL} & [\text{SPR} \ \ \langle\ \rangle] \\ \text{GAP} & \langle \boxed{1} \rangle \end{bmatrix} \\ \text{ARG-ST} & \boxed{\text{A}} \langle \boxed{1}\ , \ldots \rangle \end{bmatrix} \right\rangle \end{bmatrix}$$

This rule maps any finite verb form into a word with an empty SPR list and a GAP list containing an element identified with the first argument – the subject of the verb. The

[7] There are further constraints governing complement gaps that we will not treat here. For example, an ADV_{pol} like *not* or accented SO, which were analyzed as complements in Chapter 13, cannot serve as a topicalization filler:

(i) *Not, Kim will go to the store.
(ii) *So, Kim will go to the store.

This contrasts with the behavior of adverbial modifiers (left untreated in this text), which may be topicalized:

(iii) Tomorrow, (I think) Kim will go to the store __ .

lexical sequences that are the outputs of this rule are illustrated by the description in (49):

(49)
$$\left\langle \text{likes}\ , \left[\begin{array}{ll} \textit{word} & \\ \text{SYN} & \left[\begin{array}{ll} \text{HEAD} & \left[\begin{array}{ll}\textit{verb} & \\ \text{FORM} & \text{fin}\end{array}\right] \\ \text{VAL} & \left[\begin{array}{ll}\text{SPR} & \langle\ \rangle \\ \text{COMPS} & \langle \boxed{2} \rangle\end{array}\right] \\ \text{GAP} & \left\langle \boxed{1}\left[\begin{array}{ll}\text{CASE} & \text{nom}\\ \text{AGR} & \textit{3sing}\end{array}\right]\right\rangle \\ \text{STOP-GAP} & \langle\ \rangle \end{array}\right] \\ \text{ARG-ST} & \langle \boxed{1}\ , \boxed{2}\text{NP[acc]} \rangle \end{array}\right] \right\rangle$$

Note that the ARP (inherited from the type *word*) is satisfied in (49): the SPR list is empty, and the rest of the ARG-ST list (i.e. the whole ARG-ST list) is appropriately related to the list values of COMPS and GAP. That is, the COMPS value (⟨NP[acc]⟩) is just the ARG-ST value (50a) minus the GAP value (50b):

(50) a.
$$\left\langle \left[\begin{array}{ll}\text{CASE} & \text{nom}\\ \text{AGR} & \textit{3sing}\end{array}\right], \begin{array}{c}\text{NP}\\ \text{[CASE acc]}\end{array} \right\rangle$$

b.
$$\left\langle \left[\begin{array}{ll}\text{CASE} & \text{nom}\\ \text{AGR} & \textit{3sing}\end{array}\right] \right\rangle$$

14.6 The Coordinate Structure Constraint

One of the most discussed topics related to LDDs concerns restrictions on possible filler/gap associations. Although the position of filler and gap may be arbitrarily far apart, there are certain configurations that do not permit LDDs. Such configurations are known as 'islands' (a term due to Ross (1967)), and a major goal of syntactic research over the past three decades has been to understand where and why islands occur. In this section, we will look at one type of island and show how our grammar correctly predicts its existence and its properties.

The following examples illustrate what Ross called the 'Coordinate Structure Constraint':

(51) a.*Here is the student that [the principal suspended [__ and Sandy]].
b.*Here is the student that [the principal suspended [Sandy and __]].

(52) a.*Here is the student that [[the principal suspended __] and [the student council passed new rules]].
b.*Here is the student that [[the student council passed new rules] and [the principal suspended __]].

(53) a.*Apple bagels, I can assure you that [[Leslie likes __] and [Sandy hates lox]].
b.*Apple bagels, I can assure you that [[Leslie likes lox] and [Sandy hates __]].

Translating Ross's transformation-based formulation of the constraint into the language of fillers and gaps that we have been using, it can be stated as follows:

(54) Coordinate Structure Constraint (CSC)
In a coordinate structure,
(a) no conjunct can be a gap,
(b) nor can a gap be contained in a conjunct if its filler is outside of that conjunct.

(54a) is often referred to as the Conjunct Constraint, while (54b) is sometimes called the Element Constraint.

Ross also noticed a systematic class of exceptions to the Element Constraint, illustrated by (55):

(55) a. This is the dancer that we bought [[a portrait of __] and [two photos of __]].
b. Here is the student that [[the school suspended __] and [we defended __]].
c. Apple bagels, I can assure you that [[Leslie likes __] and [Sandy hates __]].

To handle examples like these, he appended an additional clause to the constraint, which we can formulate as follows:

(56) 'Across-the-Board' Exception (addendum to CSC):
. . . unless each conjunct properly contains a gap paired with the same filler.

As presented, the Coordinate Structure Constraint seems quite arbitrary, and the Across-the-Board Exception is just an added complication. And most analyses of these phenomena – specifically those that handle LDDs transformationally – have never come to grips with the full range of facts, let alone derived them from general principles.

Note first of all that the Conjunct Constraint is already explained by our grammar. Examples like (51) are ungrammatical for the simple reason that the elements on GAP lists must also be on ARG-ST lists, and coordinate conjunctions like *and* have empty ARG-ST lists. Unlike many other analyses (in particular, transformational approaches) our grammar does not employ empty elements (usually referred to as 'traces') to occupy the position of the gap in the syntactic structure. Since there are no empty NPs in our analysis, there is no empty element that could serve as a conjunct in a coordinate structure. That is, the Conjunct Constraint follows directly from the decision to treat the bottoms of LDDs in terms of an unrealized argument, rather than the presence of an empty element.

Now reconsider the grammar rule for coordination last updated in Chapter 8:

(57) Coordination Rule (Chapter 8 Version)

$$\begin{bmatrix} \text{FORM} & \boxed{1} \\ \text{VAL} & \boxed{0} \\ \text{IND} & s_0 \end{bmatrix} \rightarrow$$

$$\begin{bmatrix} \text{FORM} & \boxed{1} \\ \text{VAL} & \boxed{0} \\ \text{IND} & s_1 \end{bmatrix} \ldots \begin{bmatrix} \text{FORM} & \boxed{1} \\ \text{VAL} & \boxed{0} \\ \text{IND} & s_{n-1} \end{bmatrix} \begin{bmatrix} \text{HEAD} & \textit{conj} \\ \text{IND} & s_0 \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{ARGS} \ \langle s_1 \ldots s_n \rangle \end{bmatrix} \right\rangle \end{bmatrix} \begin{bmatrix} \text{FORM} & \boxed{1} \\ \text{VAL} & \boxed{0} \\ \text{IND} & s_n \end{bmatrix}$$

As stated, this rule doesn't say anything about the GAP values of the conjuncts or of the mother. (Note that the GAP Principle doesn't apply to subtrees licensed by this rule, as it is not a headed rule.) In our discussions of coordination so far, we have seen that some features must be identified across conjuncts (and with the mother) in coordination and that others should not. The Element Constraint examples cited above in (52) and (53) show that GAP is one of the features that must be identified. We thus modify our Coordination Rule slightly to add this constraint:

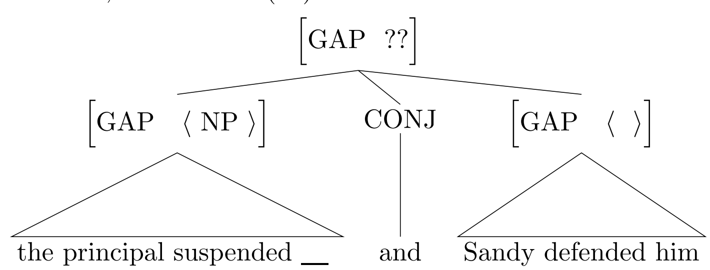
(58) Coordination Rule (Final Version)

$$\begin{bmatrix} \text{FORM} & \boxed{1} \\ \text{VAL} & \boxed{0} \\ \text{GAP} & \boxed{A} \\ \text{IND} & s_0 \end{bmatrix} \rightarrow$$

$$\begin{bmatrix} \text{FORM} & \boxed{1} \\ \text{VAL} & \boxed{0} \\ \text{GAP} & \boxed{A} \\ \text{IND} & s_1 \end{bmatrix} \ldots \begin{bmatrix} \text{FORM} & \boxed{1} \\ \text{VAL} & \boxed{0} \\ \text{GAP} & \boxed{A} \\ \text{IND} & s_{n-1} \end{bmatrix} \begin{bmatrix} \text{HEAD} & \textit{conj} \\ \text{IND} & s_0 \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{ARGS} \ \langle s_1 \ldots s_n \rangle \end{bmatrix} \right\rangle \end{bmatrix} \begin{bmatrix} \text{FORM} & \boxed{1} \\ \text{VAL} & \boxed{0} \\ \text{GAP} & \boxed{A} \\ \text{IND} & s_n \end{bmatrix}$$

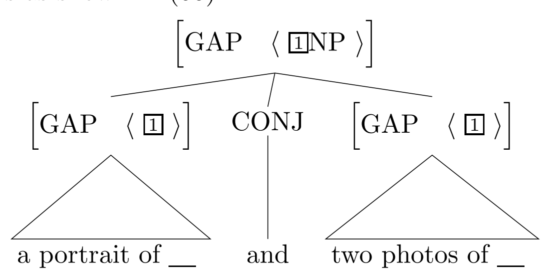
This revision guarantees that two conjuncts in a coordinate structure cannot differ in their GAP value. If one has an empty GAP list and the other has a nonempty GAP list (as in (51)–(53)), then the structure is not licensed. The GAP values that must be identical cannot be, as shown in (59):

(59)



On the other hand, it is possible for conjuncts to have nonempty GAP lists if they are all nonempty and all share the same value. This is what is illustrated in (55), whose structure is as shown in (60):

(60)



In short, both the Element Constraint and the Across-the-Board exceptions to it are treated properly in this revision of our analysis of coordination.

We close this discussion with one final observation about LDDs and coordinate structures. There is an exception to (56), illustrated by (61):

(61)*Which rock legend would it be ridiculous to compare [[__] and [__]]?

Our statements of the generalizations in (54) and (56), like Ross's original formulations of them, would in fact permit (61), whose deviance should have a syntactic (rather than a semantic) explanation, it would appear, because the meaning of this putative sentence could certainly be expressed as (62):

(62) Which rock legend would it be ridiculous to compare __ with himself?

But our analysis correctly rules out any sentences in which a gap constitutes a full conjunct. As noted above, this is because nonempty GAP values in the lexicon are licensed by the Argument Realization Principle, which allows ARG-ST elements not to be expressed as complements, rather than allowing them to appear as a phonetically empty element, or 'trace'. The difference is subtle, but the predictions are quite striking: our traceless analysis of gaps provides an immediate account of the deviance of (61) as well as an explanation of the examples in (51)–(53), which motivated Ross's Conjunct Constraint. The Coordinate Structure Constraint and its exceptions are thus properly accounted for in the analysis of coordination we have developed. Many alternative approaches – particularly those involving movement transformations to account for LDDs – have been unable to account for them at all.

14.7 Summary

Deducing the Conjunct Constraint from the interaction of our analyses of coordination and LDDs is an elegant result, providing significant support for our general approach to syntax. We also showed that we could extend our account of coordination in order to account for the Element Constraint as well.[8]

We will not examine other island constraints in this text. As with the Coordinate Structure Constraint, linguists have not been content to catalog the environments in which filler-gap pairings are impossible. Rather, a great deal of effort has gone into the search for explanations of syntactic islands, either in terms of the interaction of independently motivated elements of the theory (as in the example given above), or in terms of such factors as the architecture of the human language-processing mechanisms. This is a fertile area of research, in which definitive answers have not yet been found.

14.8 Changes to the Grammar

In this chapter, we developed an analysis of long-distance dependencies involving 'fillers' and unrealized elements, or 'gaps'. Our analysis involved two new features, GAP and STOP-GAP, both appropriate for feature structures of type *syn-cat*:

$$syn\text{-}cat : \begin{bmatrix} \text{HEAD} & pos \\ \text{VAL} & val\text{-}cat \\ \text{GAP} & list(expression) \\ \text{STOP-GAP} & list(expression) \end{bmatrix}$$

[8] Essentially this account was first developed by Gazdar (1981), within the framework of Generalized Phrase Structure Grammar.

We treated the introduction of gaps at the bottom of LDDs in terms of the following modification of the Argument Realization Principle:

Argument Realization Principle:

$$\textit{word}: \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{VAL} & \begin{bmatrix} \text{SPR} & \boxed{\text{A}} \\ \text{COMPS} & \boxed{\text{B}} \ominus \boxed{\text{C}} \end{bmatrix} \\ \text{GAP} & \boxed{\text{C}} \end{bmatrix} \\ \text{ARG-ST} & \boxed{\text{A}} \oplus \boxed{\text{B}} \end{bmatrix}$$

To introduce subject gaps, we created the following lexical rule:

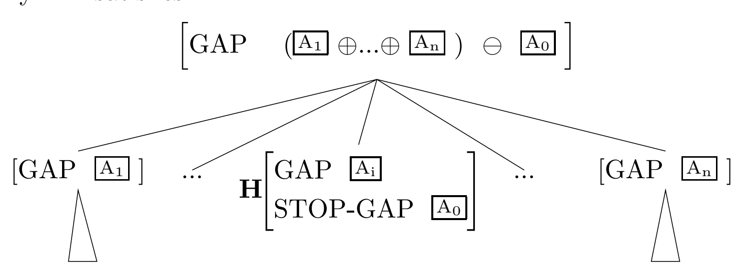
Subject Extraction Lexical Rule

$$\begin{bmatrix} \textit{pi-rule} & \\ \text{INPUT} & \left\langle \text{X}, \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} \\ \text{FORM} & \text{fin} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle \text{Z} \rangle \end{bmatrix} \end{bmatrix} \\ \text{ARG-ST} & \boxed{\text{A}} \end{bmatrix} \right\rangle \\ \text{OUTPUT} & \left\langle \text{Y}, \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\ \rangle \end{bmatrix} \\ \text{GAP} & \langle \boxed{1} \rangle \end{bmatrix} \\ \text{ARG-ST} & \boxed{\text{A}}\langle \boxed{1}, ... \rangle \end{bmatrix} \right\rangle \end{bmatrix}$$

We also introduced a new principle, which has the effect of passing GAP specifications from daughter to mother within headed phrase structures, while subtracting out any GAP elements that are bound within the phrase:

The GAP Principle

A local subtree Φ satisfies the GAP Principle with respect to a headed rule ρ if and only if Φ satisfies:



The value of STOP-GAP is assigned in the lexicon by the following defeasible constraint that is overridden by the lexical entries for adjectives like *easy* and *hard*:

$$\textit{lexeme}: \begin{bmatrix}\text{STOP-GAP} & / \ \langle\ \rangle\end{bmatrix}$$

$$\left\langle \text{easy}\ , \begin{bmatrix}\textit{adj-lxm} & \\ \text{SYN} & \begin{bmatrix}\text{STOP-GAP} & \langle \boxed{1} \rangle\end{bmatrix} \\ \text{ARG-ST} & \left\langle \text{NP}_i\ , \begin{matrix}\text{VP}\\ \begin{bmatrix}\text{INF} & + \\ \text{GAP} & \langle \boxed{1}\text{NP}_i\ , \ldots \rangle\end{bmatrix}\end{matrix} \right\rangle \end{bmatrix} \right\rangle$$

And we added the following nondefeasible constraint on the type *l-rule*:

$$\textit{l-rule}: \begin{bmatrix}\text{INPUT} & \left\langle \text{X}\ , \begin{bmatrix}\text{STOP-GAP} & \boxed{A}\end{bmatrix} \right\rangle \\ \text{OUTPUT} & \left\langle \text{Y}\ , \begin{bmatrix}\text{STOP-GAP} & \boxed{A}\end{bmatrix} \right\rangle\end{bmatrix}$$

To handle the top of LDDs, we introduced lexical entries for *easy*-type adjectives and we also introduced one new grammar rule – the Head-Filler Rule, which licenses sentences with a 'topicalized' initial element:

Head-Filler Rule

$$[\textit{phrase}] \ \rightarrow \ \boxed{1}\begin{bmatrix}\text{GAP} & \langle\ \rangle\end{bmatrix} \quad \mathbf{H}\begin{bmatrix}\text{HEAD} & \begin{bmatrix}\textit{verb} & \\ \text{FORM} & \text{fin}\end{bmatrix} \\ \text{VAL} & \begin{bmatrix}\text{SPR} & \langle\ \rangle \\ \text{COMPS} & \langle\ \rangle\end{bmatrix} \\ \text{STOP-GAP} & \langle \boxed{1} \rangle \\ \text{GAP} & \langle \boxed{1} \rangle\end{bmatrix}$$

To properly constrain the values of GAP and STOP-GAP throughout our trees, we made minor revisions to the 'initial symbol' clause of the definition of well-formed tree structure and to the Head-Specifier, Head-Modifier and Imperative Rules:

Φ is a Well-Formed Tree Structure according to G if and only if:

...

the label of Φ's root node satisfies the constraint:

$$\begin{bmatrix}\textit{phrase} & \\ \text{SYN} & \begin{bmatrix}\text{HEAD} & \begin{bmatrix}\textit{verb} & \\ \text{FORM} & \text{fin}\end{bmatrix} \\ \text{VAL} & \begin{bmatrix}\text{SPR} & \langle\ \rangle \\ \text{COMPS} & \langle\ \rangle\end{bmatrix} \\ \text{GAP} & \langle\ \rangle\end{bmatrix}\end{bmatrix}$$

Head-Specifier Rule

$$\begin{bmatrix} \textit{phrase} & \\ \text{SPR} & \langle\ \rangle \end{bmatrix} \rightarrow \boxed{1} \quad \mathbf{H}\begin{bmatrix} \text{SPR} & \langle \boxed{1} \rangle \\ \text{COMPS} & \langle\ \rangle \\ \text{STOP-GAP} & \langle\ \rangle \end{bmatrix}$$

Head-Modifier Rule

$$[\textit{phrase}] \rightarrow \mathbf{H}\boxed{1}\begin{bmatrix} \text{COMPS} & \langle\ \rangle \\ \text{STOP-GAP} & \langle\ \rangle \end{bmatrix} \begin{bmatrix} \text{COMPS} & \langle\ \rangle \\ \text{MOD} & \langle \boxed{1} \rangle \end{bmatrix}$$

Imperative Rule

$$\begin{bmatrix} \textit{phrase} & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\ \rangle \end{bmatrix} \\ \text{GAP} & \boxed{A} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{MODE} & \text{dir} \\ \text{INDEX} & s \end{bmatrix} \end{bmatrix} \rightarrow \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{INF} & - \\ \text{FORM} & \text{base} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \left\langle \text{NP}[\text{PER} \quad \text{2nd}] \right\rangle \\ \text{COMPS} & \langle\ \rangle \end{bmatrix} \\ \text{GAP} & \boxed{A} \end{bmatrix} \\ \text{SEM} & [\text{INDEX} \quad s\ ] \end{bmatrix}$$

Finally, to deal with the Element Constraint (part of Ross's Coordinate Structure Constraint), we modified the Coordination Rule as follows:

Coordination Rule

$$\begin{bmatrix} \text{FORM} & \boxed{1} \\ \text{VAL} & \boxed{0} \\ \text{GAP} & \boxed{A} \\ \text{IND} & s_0 \end{bmatrix} \rightarrow$$

$$\begin{bmatrix} \text{FORM} & \boxed{1} \\ \text{VAL} & \boxed{0} \\ \text{GAP} & \boxed{A} \\ \text{IND} & s_1 \end{bmatrix} \dots \begin{bmatrix} \text{FORM} & \boxed{1} \\ \text{VAL} & \boxed{0} \\ \text{GAP} & \boxed{A} \\ \text{IND} & s_{n-1} \end{bmatrix} \begin{bmatrix} \text{HEAD} & \textit{conj} \\ \text{IND} & s_0 \\ \text{RESTR} & \langle[\text{ARGS}\ \langle s_1 \dots s_n \rangle]\rangle \end{bmatrix} \begin{bmatrix} \text{FORM} & \boxed{1} \\ \text{VAL} & \boxed{0} \\ \text{GAP} & \boxed{A} \\ \text{IND} & s_n \end{bmatrix}$$

14.9 Further Reading

Ross 1967 is probably the most influential work to date on the topic of long-distance dependencies. Chomsky (1973, 1977, 1986a) developed one of the most influential approaches to analyzing these constructions, using transformations. The treatment presented here is based loosely on that developed in Pollard and Sag 1994, which is compared with transformational approaches in Levine and Sag 2003. This analysis is unusual in not positing an empty category (a trace) in the position of the gap. Arguments for such a traceless analysis are discussed by Sag and Fodor (1994). Other nontransformational treatments are presented in Gazdar 1981, Kaplan and Zaenen 1989, Steedman 2000, and Bouma et al. 2001.

14.10 Problems

Problem 1: A Tree with a Gap

Draw a tree for (9b). Use abbreviations for the node labels, and show the value of GAP on all nodes. Show the value of STOP-GAP on any node where it is non-empty.

Problem 2: Blocking Filled Gaps

Examples (i) and (ii) are well-formed, but example (iii) is ungrammatical:

(i) Pat thinks that I rely on some sort of trick.

(ii) This mnemonic, Pat thinks that I rely on.

(iii) *This mnemonic, Pat thinks that I rely on some sort of trick.

Explain in detail why the mechanisms that license (i) and (ii) do not also permit (iii).

Problem 3: Subject Gaps

This problem is to make sure you understand how our analysis accounts for examples like (47).

A. Sketch the family of lexical sequences for *likes* that is the input to the Subject Extraction Lexical Rule.

B. Sketch the family of lexical sequences for *likes* that is the corresponding output to the Subject Extraction Lexical Rule.

C. Sketch the tree for the sentence in (47b). Use abbreviations for node labels, but show the value of GAP on all nodes and the value of STOP-GAP on any node where it is non-empty. You may abbreviate the structure over the NP *oysters on the half-shell* with a triangle.

D. Does our analysis correctly predict the contrast between (47b) and (i)?
(i) *Those candidates, I think likes oysters on the half-shell.
Explain why or why not.

Problem 4: Irish Complementizers

Consider the following example that shows the typical word order pattern of Modern Irish (data from McCloskey 1979):

(i)	Shíl	mé	goN	mbeadh	sé	ann.
	thought	I	COMP	would-be	he	there

‘I thought that he would be there.’

Irish is a VSO language. One way of analyzing such languages is to posit a Head-Specifier-Complement Rule that introduces both kinds of dependents as sisters of the lexical head. In addition, we’ll need a Head-Complement Rule that realizes only complements, and requires the head daughter to be [SPR $\langle\ \rangle$].

A. Formulate these two rules and show the structure for sentence (i). You may use abbreviations such as NP, S, etc., but be sure to show the value of COMPS and SPR on each node.

Now consider some further Irish data:

(ii) Dúirt mé gurL shíl mé goN mbeadh sé ann.
said I goN.PAST thought I COMP would-be he there
'I said that I thought that he would be there.'

(iii) an fear aL shíl mé aL bheadh ann
the man COMP thought I COMP would-be __ there
'the man that I thought would be there'

(iv) an fear aL dúirt mé aL shíl mé aL
the man COMP said I COMP thought I COMP
bheadh ann
would-be __ there
'the man that I said I thought would be there'

(v) an fear aL shíl goN mbeadh sé ann
[the man]$_j$ COMP thought __ COMP would-be he$_j$ there
'[the man]$_j$ that thought he$_j$ would be there'

(vi) an fear aL dúirt sé aL shíl goN
the man COMP said he COMP thought __ COMP
mbeadh sé ann
would-be he there
'the man that he said thought he would be there'

The complementizers *goN* and *aL* are in complementary distribution. That is, wherever *goN* is possible in these examples, *aL* is not, and vice versa.[9] Assume that both these elements are heads of CPs similar to those headed by *that* complementizers in English. If we then make the further assumption that LDDs in Irish work much as they do in English, we have all the tools we need to analyze the contrasts in (i)–(vi).[10]

B. Provide lexical entries for these two complementizers. [*Note: You may assume for purposes of this problem that the type comp-lxm which we proposed for English is applicable to Irish as well.*]

C. Show how your analysis successfully explains the distributional differences between the two complementizers. Be sure to cite the data given in the problem.

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[9] For the purposes of this problem, you should ignore the difference between *gurL* and *goN*.

[10] Examples (iii)–(vi) involve relative clauses, which we have not discussed in much detail. Assume that the complementizers are the same whether they appear in relative clauses or in CP complements to verbs.

Problem 5: Nested Dependencies
We have made GAP a list-valued feature, which leaves open the possibility of multiple GAPs. This problem considers sentences which instantiate this possibility, such as (i) and (ii):

(i) Problems this involved, my friends on the East Coast are hard to talk to __ about __ .

(ii) Violins this well crafted, these sonatas are easy to play __ on __ .

A. Indicate which NP is interpreted as the filler for each of the gaps in (i) and (ii).

B. Draw a tree for sentence (i), indicating the value of GAP and STOP-GAP on every node. You do not need to include other features, though you should have a node label (e.g. VP, PP, etc.) on each node, and use tags and coindexing as appropriate. You may abbreviate the structure of the NPs *problems this involved* and *my friends on the East Coast* with triangles.

The PP complements of *talk* can actually appear in either order:

(iii) Dana tried to talk about it to everyone in the building.

(iv) Dana tried to talk to Leslie about this problem.

For the sake of this problem, we will assume that this is dealt with by allowing two distinct ARG-ST lists for *talk*: $\langle$ NP , PP[about] , PP[to] $\rangle$ and $\langle$ NP , PP[to] , PP[about] $\rangle$.

However, when we switch the order of the PPs in the multiple gap example, we get a sentence with a bizarre meaning (in which someone is talking to problems about people):

(v) Problems this involved, my friends on the East Coast are hard to talk about __ to __ .

C. Is this predicted by our analysis of LDDs? Why or why not?
[*Hint: Remember that the value of GAP is a list, and the order of the GAP list on phrasal nodes is determined by the GAP Principle.*]

Problem 6: Binding and LDDs
Assuming that reciprocals are [MODE ana], does our analysis of LDDs interact with the Binding Theory to predict that (i) should be grammatical? Why or why not?

(i) [Those people]$_i$ I tend to believe will tell [each other]$_i$ everything.