

Unbounded Dependencies

There are two kinds of unbounded dependencies that are relevant to the grammar of interrogative clauses: those between fillers and gaps (‘extraction’ dependencies) and those involving *wh*-interrogative words whose presence (at arbitrary depth of embedding) is mandated in a particular kind of *wh*-constructions (so-called ‘pied piping’ effects). Before proceeding, we must consider how each phenomenon is to be treated.

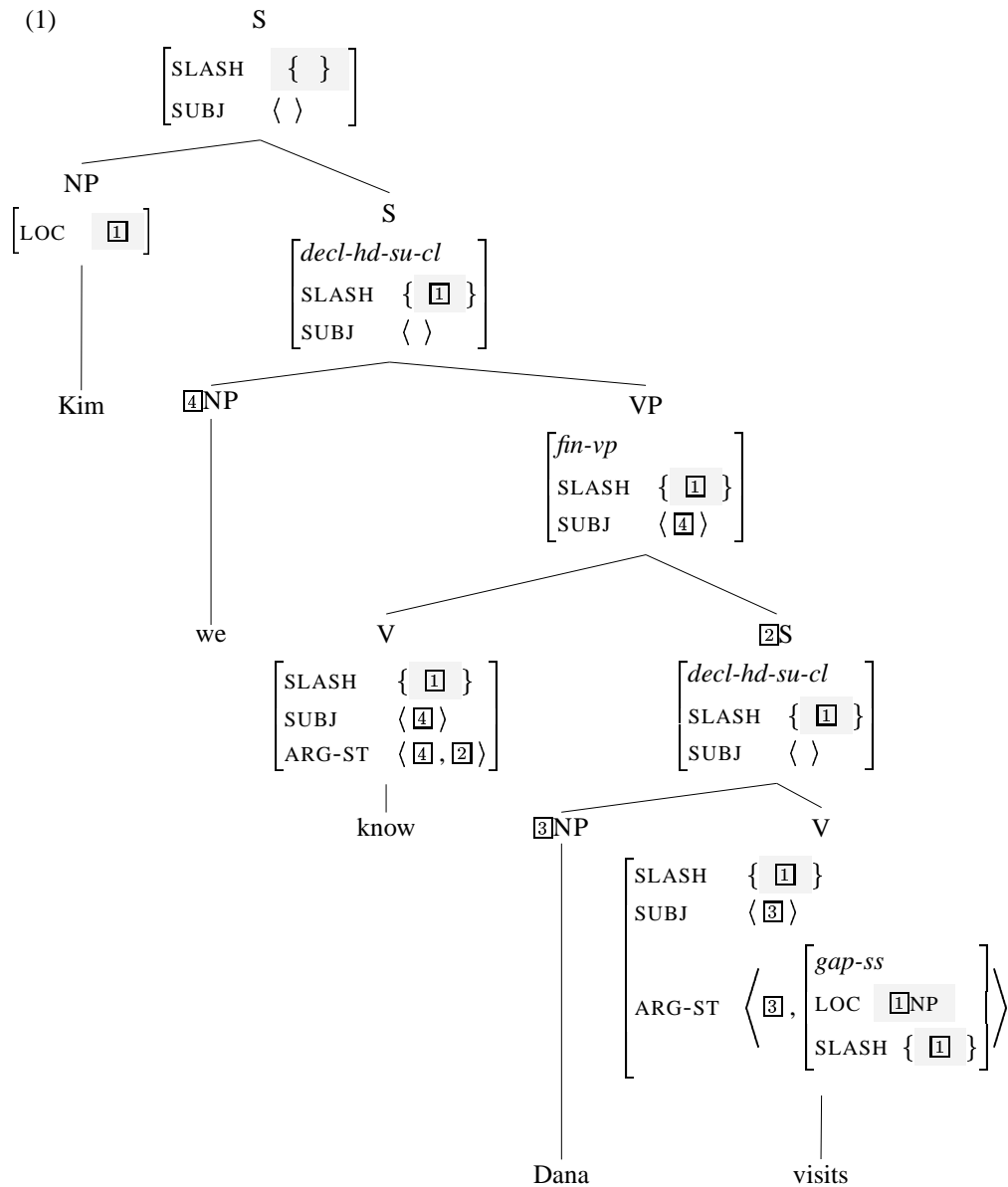
5.1 Extraction Dependencies

P&S–94 (Chap. 4) provide a uniform, if somewhat cumbersome characterization of NONLOCAL feature inheritance in terms of the features INHERIT and TO-BIND and their NONLOCAL Feature Principle. The present proposal, based on that of Bouma et al. (2001), presents a significant simplification of the relevant feature structures and provides solutions to a number of problems that were unsolved in the P&S–94 account, as noted by Hukari and Levine (1995, 1996a).

5.1.1 Extracted Arguments

The HPSG analysis of extraction, building on earlier work in the GPSG tradition, involves specifications for the feature SLASH that are projected upward in a syntactic structure, as indicated via shading in (1) on the following page. All signs must have a SYNSEM value of type *canonical*, according to the Principle of Canonicity presented in Chapter 2. The second argument of the verb *visits* in (1), however, is an object of type *gap-ss*, which must bear a nonempty value for the feature SLASH. This nonempty SLASH value is amalgamated by the verb, i.e. it is also the verb’s SLASH value. Further, the verb’s SLASH value is passed up from head daughter to mother throughout extraction structures, as indicated by the shading in (1). (This will be explained below.) Extraction is thus treated entirely in terms of the inheritance of SLASH specifications; ‘binding off’ of the SLASH specification occurs at an appropriate point HIGHER in the structure, where a compatible filler constituent must occur.¹

¹In fact, the analysis of extraction we adopt here extends to various cases of ‘subbinding’, where the binder is not in a superordinate position in the phrasal structure. Examples of this include *an easy person to please* __, *too tall for anyone to be able to dance with* __, and French *en*-cliticization (e.g. *La surface* __ *en-brille* ‘the surface of-it-shines’). For further discussion, see Bouma et al. 2001 and Miller and Sag 1997.



In the analysis of Bouma et al. (2001), words are subject to a constraint (originally suggested in Sag 1997) that defines their SLASH value in terms of the SLASH values of their arguments, i.e. the SLASH values of the members of their ARG-ST list.² This SLASH-‘amalgamation’ constraint can be stated as follows:³

²Bouma et al. (2001) use a further feature *DEPENDENTS*, whose value is a list consisting of the argument structure plus optionally selected adjuncts. We have eliminated this feature here, in favor of an analysis that distinguishes the ARG-ST of a lexeme from the extended ARG-ST of a word derived from that lexeme.

³Here and throughout, we use indexed Σ s as tags designating sets. Bouma et al. (2001) assume a slightly more complicated version of (2), where predicates like *tough* may ‘subtract’ an NP element from the amalgamation of the arguments’ SLASH values. For expository simplicity, we ignore this refinement here, though we assume that the lexical binding properties of such predicates simply supersede the default constraint in (2).

(2) SLASH-Amalgamation Constraint:

$$word \Rightarrow / \left[\begin{array}{l} SS | SLASH \ \Sigma_1 \cup \dots \cup \Sigma_n \\ ARG-ST \ \langle [SLASH \ \Sigma_1], \dots, [SLASH \ \Sigma_n] \rangle \end{array} \right]$$

According to (2), if all the arguments of a verb have an empty SLASH value, then (by default) so does the verb itself. By contrast, if any one of the complements of a verb is ‘slashed’ (i.e. has a nonempty SLASH value), then the verb itself is slashed. For example, the SLASH value of the verb *know* in (1) must contain the element $\boxed{1}$ because its sentential complement’s SLASH value is $\{\boxed{1}\}$.⁴ Lexicalized SLASH-amalgamation thus allows us to simplify the statement of the inheritance of SLASH specifications. In fact, the inheritance of SLASH specifications from the verb to the VP and the S that it projects, shown in (3), already follows from the GHFP, as it affects two constructions discussed in Chapter 2:

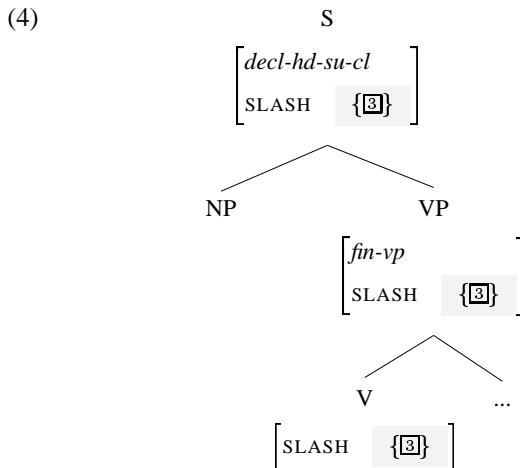
(3) a. *fin-vp*:

$$[SLASH \ \Sigma] \rightarrow \mathbf{H} \left[\begin{array}{l} \text{HEAD} \left[\begin{array}{l} \text{AUX} \ \boxed{1} \\ \text{POL} \ \boxed{1} \end{array} \right] \\ \text{SLASH} \ \Sigma \end{array} \right] \dots$$

b. *decl-hd-su-cl*:

$$[SLASH \ \Sigma] \rightarrow [], \left[\begin{array}{l} \text{HEAD} \left[\begin{array}{l} \text{VFORM} \ \textit{fin} \\ \text{INV} \ - \end{array} \right] \\ \text{SLASH} \ \Sigma \end{array} \right]$$

The GHFP thus guarantees the inheritance of SLASH values sketched in (4).



⁴The SLASH value of any word whose ARG-ST list is empty is the empty set, as guaranteed by an independent lexical constraint.

In any headed phrase whose SLASH value includes that of a non-head daughter, the inheritance is mediated by the head daughter, whose SLASH value includes that of the non-head daughter whenever the latter is a subject, complement, or specifier.⁵

A verb like *visits* in (1) has two notable properties: (1) it is slashed (as guaranteed by the SLASH-Amalgamation Constraint), giving rise to the inheritance of nonempty SLASH specifications, according to the GHFP and (2) it does not combine locally with its object NP. Our theory must guarantee that this absence of local realization and the inheritance of nonempty SLASH specifications are correlated. The key to understanding how this comes about is the type *gap-ss*—a subtype of *noncan-ss* which was introduced in Chapter 2.

The ARG-ST specifications in lexical entries in general require only that each argument be of type *synsem*. This leaves open the possibility that a given argument can be resolved to the type *canon-ss* or else to some subtype of *noncan-ss*, e.g. *gap-ss*. Such a resolution will cause the verb to be slashed, because an object of type *gap-ss* is subject to a further constraint identifying its LOCAL value with the single member of its SLASH set:

$$(5) \quad \textit{gap-ss} \Rightarrow \left[\begin{array}{ll} \text{LOC} & \boxed{\square} \\ \text{SLASH} & \{\boxed{\square}\} \end{array} \right]$$

Because a *gap-ss* argument is slashed, it always contributes an element to the verb's SLASH value, which is an amalgamation of the arguments' SLASH values, according to (2).

But if an element of a verb's argument structure is resolved to *gap-ss*, then that verb can never combine with an overt complement corresponding to the *gap-ss* argument. This is because overt elements are all of type *sign*, and the SYNSEM value of all signs must be of type *canonical* (according to the Principle of Canonicity). Hence, if the *gap-ss* argument were also to appear on the COMPS list, then no structure could be built. This is because the constraint on head-complement phrases given in (34) of Chapter 2 requires that each member of the head daughter's COMPS list be unified with the SYNSEM value of some complement daughter. Thus one of the arguments of a verb can be resolved to a *gap-ss*, but when this happens, this argument must not be included in the verb's COMPS list.

In order to allow *gap-ss* arguments to absent themselves from a verb's COMPS list,⁶ we reformulate the Argument Realization Principle (originally (7) in Chapter 2) as follows:⁷

⁵If, following P&S-94, the SLASH value of the mother of a head-adjunct phrases must include the SLASH value of the head daughter and that of the modifier daughter, then a constraint to this effect—which must override the GHFP—may be placed on the type *hd-adj-ph*. Alternatively, if gaps in adjunct phrase are possible, but are pronominal (Cinque 1990, Postal 1998) and parasitic on the presence of a distinct gap in the modified phrase, then the GHFP need not be overridden. Rather, a pronominal SLASH element coindexed with the head daughter's SLASH element must be allowed as an option. We make no attempt to resolve these options here. Note further that specific head-adjunct phrases may be extraction 'islands', in which case their adjunct daughter is constrained to be [SLASH { }].

⁶For English, the particular subtype of relevance is *gap-ss*, but argument-drop languages are naturally analyzed by generalizing the constraint we propose to allow *pro-ss* ARG-ST elements to be unrealized on valence lists, as well. Similarly, Miller and Sag (1997) treat French pronominal affixes (so-called 'clitics') in terms of affixal (*aff-ss*) arguments that do not appear on valence lists.

⁷Here ' \ominus ' designates a relation of contained list difference. If λ_2 is an ordering of a set σ_2 and λ_1 is a subordering of λ_2 , then $\lambda_2 \ominus \lambda_1$ designates the list that results from removing all members of λ_1 from λ_2 ; if λ_1 is not a sublist of λ_2 , then the contained list difference is not defined. For present purposes, \ominus is interdefinable with the sequence union operator (\circ) of Reape (1994) and Kathol (1995):

$$(A \ominus B = C) \Leftrightarrow (C \circ B = A)$$

(6) Argument Realization Principle (final version):

$$word \Rightarrow \left[\begin{array}{l} \text{SS|LOC|CAT} \left[\begin{array}{l} \text{SUBJ} \quad \boxed{A} \\ \text{SPR} \quad \quad \boxed{B} \\ \text{COMPS} \quad \boxed{C} \ominus list(gap-ss) \end{array} \right] \\ \text{ARG-ST} \quad \boxed{A} \oplus \boxed{B} \oplus \boxed{C} \end{array} \right]$$

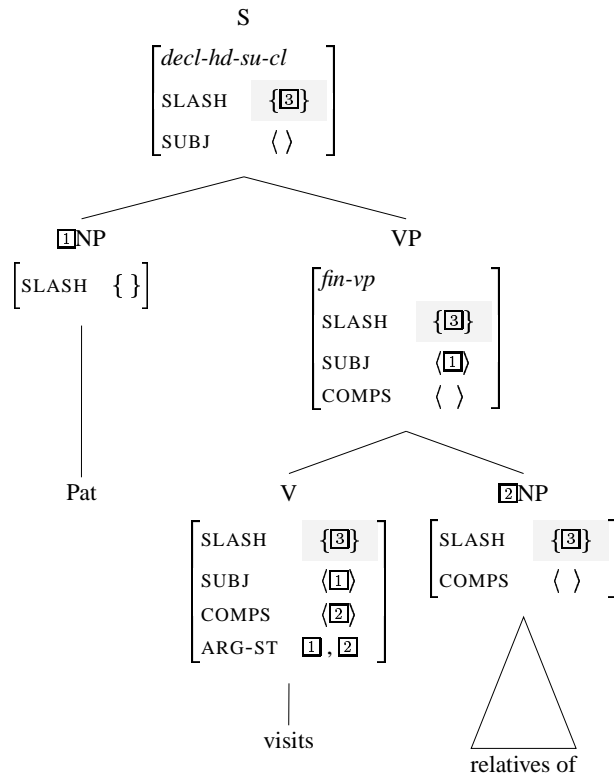
The effect of (6) is to constrain the ARG-ST value to be equal to the result of appending the COMPS list to the SUBJ and SPR lists, except for the possible difference that one or more elements of type *gap-ss* may be present in the ARG-ST list, but absent from the COMPS list. (As in Chapter 2, the empty SPR value of verbs will be ignored.) Note that (6) need not stipulate that all elements of type *gap-ss* be removed from the COMPS list—this follows immediately from the interaction of the Principle of Canonicity with the constraint on head-complement phrases, as just noted. The SLASH-Amalgamation Constraint in (2) and the revised ARP thus interact to ensure that when a verb's (nonsubject) argument is resolved to *gap-ss*, the verb's SLASH value must be nonempty and the *gap-ss* argument cannot be realized locally as a complement.

So a lexeme like (7) will give rise to inflected words (related to it by inflectional rules) like the one illustrated in (8):

$$(7) \left[\begin{array}{l} v-lx \\ \text{PHON} \quad \langle \text{visit} \rangle \\ \text{CAT} \quad \left[\begin{array}{l} \text{HEAD} \quad \textit{verb} \\ \text{SUBJ} \quad \langle \text{XP} \rangle \end{array} \right] \\ \text{SS|LOC} \quad \left[\begin{array}{l} \textit{soa} \\ \text{CONT} \quad \left[\begin{array}{l} \textit{visit-rel} \\ \text{NUCL} \quad \left[\begin{array}{l} \text{VISITOR} \quad i \\ \text{VISITED} \quad j \end{array} \right] \end{array} \right] \end{array} \right] \\ \text{ARG-ST} \quad \langle \text{NP}_i, \text{NP}[\textit{acc}]_j \rangle \end{array} \right]$$

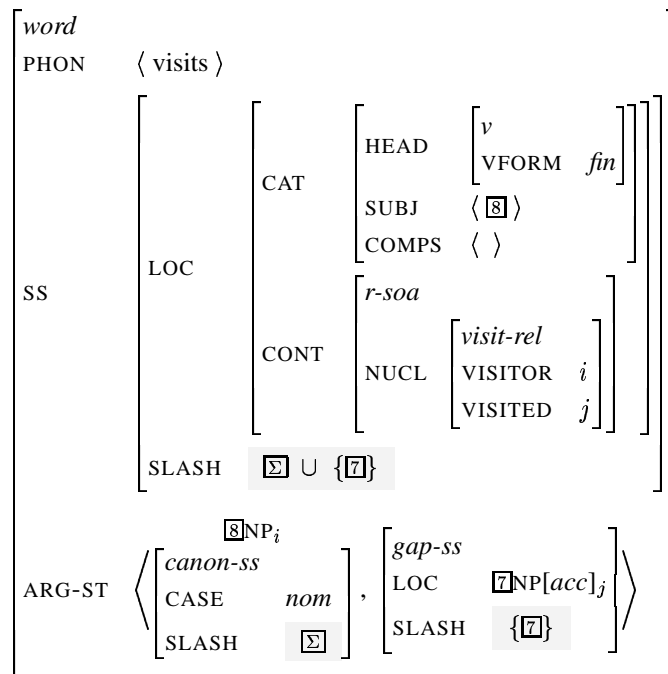
$$(8) \left[\begin{array}{l} \textit{word} \\ \text{PHON} \quad \langle \textit{visits} \rangle \\ \text{CAT} \quad \left[\begin{array}{l} \text{HEAD} \quad \left[\begin{array}{l} v \\ \text{VFORM} \quad \textit{fin} \end{array} \right] \\ \text{SUBJ} \quad \langle \text{XP} \rangle \end{array} \right] \\ \text{SS|LOC} \quad \left[\begin{array}{l} \textit{r-soa} \\ \text{CONT} \quad \left[\begin{array}{l} \textit{visit-rel} \\ \text{NUCL} \quad \left[\begin{array}{l} \text{VISITOR} \quad i \\ \text{VISITED} \quad j \end{array} \right] \end{array} \right] \end{array} \right] \\ \text{ARG-ST} \quad \langle \text{NP}[\textit{nom}]_i, \text{NP}[\textit{acc}]_j \rangle \end{array} \right]$$

(11)



A second way of satisfying the constraints in (8) and our other principles is shown in (12):

(12)



This is the instantiation of features that results when the word *visits* appears at the bottom of an extraction dependency (without any locally realized object NP), e.g. in *Kim, we know Dana visits*, which was illustrated in (1) above.⁸

5.1.2 ‘Topicalization’: an Extraction Construction

The phrasal type *head-filler-phrase* (*hd-fill-ph*) defines the general construction that introduces an ‘extracted’ element (the filler) followed by a sentential head that is missing an element corresponding to that filler. This phrase type has many subtypes in English, some of which are illustrated in (13) and (14):

- (13) a. *These bagels, I like.* (topicalization)
 b. *These bagels, they say they like.* (topicalization)
 c. *the baker whose bagels I like* (*wh*-relative)
 d. *the baker from whom I bought these bagels* (*wh*-relative)
 e. *Whose bagels do you like?* (*wh*-interrogative)
 f. *From whom did you buy these bagels?* (*wh*-interrogative)
 g. *What great bagels they bought!* (*wh*-exclamative)
- (14) a. *the baker in whom to place your trust* (*wh*-relative)
 b. *I wonder in whom to place my trust* (*wh*-interrogative)
 c. *I wonder who to trust* (*wh*-interrogative)

In this section, we will discuss just one of these—the so-called ‘topicalization’ construction.⁹

We treat all the clauses just illustrated in terms of the type *hd-fill-ph*, a subtype of *hd-ph* that is associated with the following constraint:¹⁰

(15) *hd-fill-ph*:

$$\left[\text{SLASH } \Sigma_2 \right] \rightarrow \left[\text{LOC } \mathbb{I} \right], \text{H} \left[\begin{array}{l} \textit{phrase} \\ \text{HEAD } v \\ \text{SLASH } \{ \mathbb{I} \} \uplus \Sigma_2 \end{array} \right]$$

The constraint in (15) says first that the head daughter (and hence the head-filler phrase itself) must be a verb projection. (15) also states that one member of the head daughter’s SLASH set is identified with the LOCAL value of the filler daughter and that whatever other elements might be in the head daughter’s SLASH must constitute the SLASH value of the mother of the head-filler phrase. Except in cases of multiple extraction, this SLASH value will be the empty set.¹¹

⁸Note that there is no VP constituent in (1)’s embedded clause. This is because transitive verbs whose object is extracted behave like strict-intransitive verbs; that is, they may function as the head daughter of a head-subject phrase.

⁹On the discourse properties of this construction, see Prince 1981.

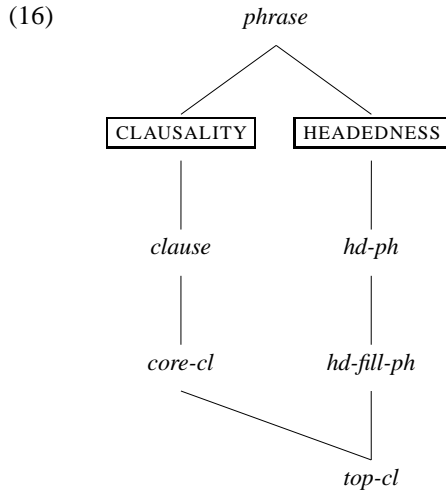
¹⁰Here ‘ \uplus ’ designates the operation of disjoint set union, which is just like familiar set union, except that the disjoint union of two sets with a nonempty intersection is undefined.

¹¹There is an issue as to whether the filler daughter should be able to contribute to the SLASH value of a head-filler phrase. At stake are examples like the following, where the filler contains a new gap associated with a distinct filler higher in the tree:

- (i) ??[Dignitaries this famous]_i, I never know [[how many pictures of _i] _j I should take _j].
 (ii) ??[Dignitaries this famous]_i, I never know [[how many pictures of _i] _j to take _j].
 (iii) ??[A Dignitary like this]_i, [[how many pictures of _i] _j do you think we should take _j]?
 (iv) ??[Gangsters that dangerous]_i, [[pictures of _i] _j, only a fool would take _j].

We will treat these examples as ungrammatical here. For a modification of (15) that allows the non-head daughter’s SLASH value to be included in that of the clause, and hence predicts that these examples are grammatical, see Bouma et al. 2001.

The first subtype of *hd-fill-ph* to consider is the topicalization construction, illustrated by the examples in (13a,b). To treat such examples, we posit a type *topicalized-clause* (*top-cl*). *Top-cl* is a subtype of both *hd-fill-ph* and *core-cl* (*n.b*—not of *decl-cl*):



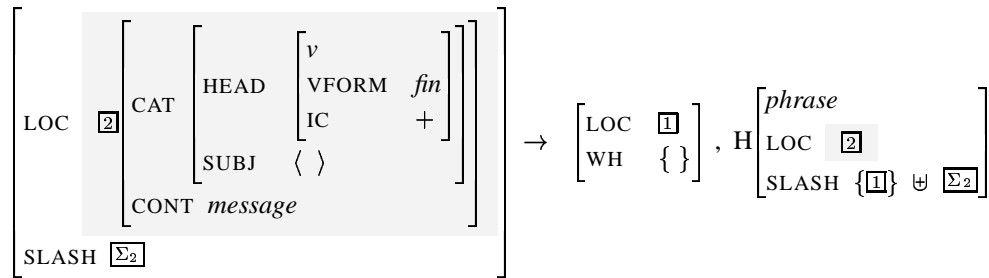
Instances of this type obey the following construction-particular constraint:

(17) *top-cl*:

$$[] \rightarrow [\text{WH } \{ \}], \text{ H } \begin{bmatrix} \text{VFORM} & \textit{fin} \\ \text{IC} & + \\ \text{SUBJ} & \langle \rangle \end{bmatrix}$$

Topicalized clauses can thus only be built from (i.e. have as a head daughter) independent ([IC +]) finite clauses, e.g. the declarative head-subject clauses discussed in Chapter 2. Additionally the ‘filler daughter’ of the topicalized clause construction is constrained to be [WH { }]. The effect of the latter constraint is to prevent any WH-specified interrogative or exclamative words from appearing as the filler or an element contained within the filler. This is a key difference between topicalized clauses and other kinds of head-filler phrase. Finally, the various identities will hold between the head daughter and mother of this type of phrase—courtesy of the GHFP. These identities include the CONTENT value, as well as the [IC +] and [SUBJ ⟨ ⟩] specifications illustrated in (18):

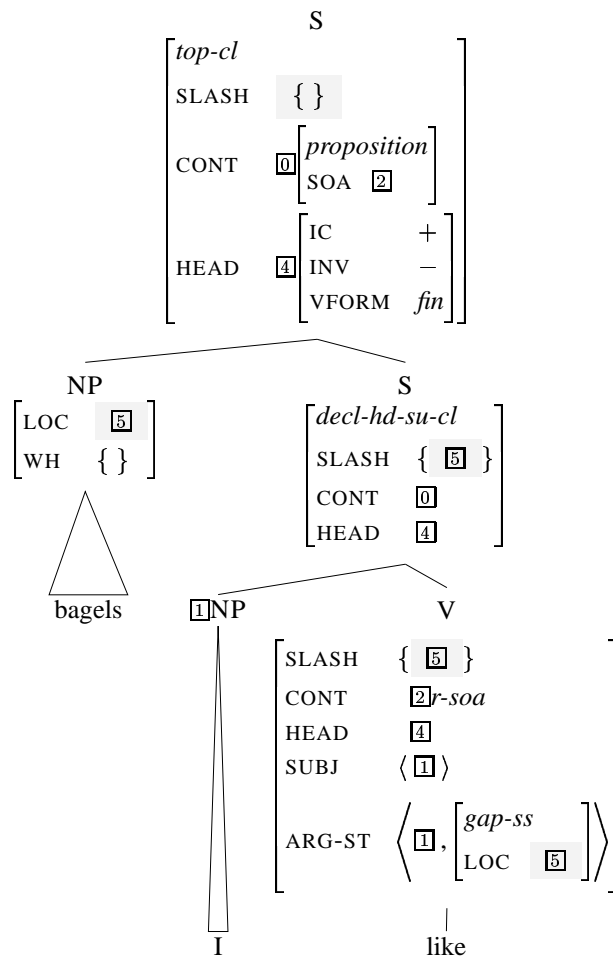
(18) GHFP & *hd-fill-ph* & *clause* & *top-cl*:



Note that the \uplus operation is undefined if its arguments have any member in common; hence ‘ $\{ \boxed{1} \} \uplus \Sigma_2$ ’ must be distinct from ‘ Σ_2 ’. The constraint in (15) thus entails that the mother and head daughter have distinct SLASH values. Given this, the effect of the GHFP is to ‘push down’ so as to require identity of the LOCAL value of mother and head daughter. This is the highest level within the synsem where identity is consistent with all inherited nondefeasible constraints.

A typical example of topicalization can now be analyzed as follows (where shading illustrates the percolation and ‘binding off’ of SLASH elements, rather than the effects of the GHFP):

(19)



Because the GHFP requires that the SUBJ value of mother and head daughter both be the empty list, there are no topicalized clauses produced via subject extraction. That is, examples like (20) have only one analysis: they are unambiguously instances of the type *decl-hd-su-cl*.

(20) Bagels(.) always upset my stomach.

This is precisely the result argued for on purely theoretical grounds by Lasnik and Saito (1992).

Because the only restriction placed upon the CONTENT value of a topicalized phrase (inherited from the type *clause*) is that it be some subtype of *message*, it is also possible for the head daughter to be a subjunctive clause. As noted in Chapter 2, though subjunctive instances of *decl-hd-su-cl* generally appear in embedded environments, there are certain environments where [IC +] subjunctives may appear. As it turns out, in just these environments, subjunctive topicalized clauses are well-formed:

- (21) a. We suggested that *people like that, he be wary of* __ .
 b. I prefer that *proposals of this kind, I be kept informed of* __
 c. Proposals of this kind, nobody be taken in by __ !

This is precisely as predicted by our analysis.

There are also instances of (subjectless) imperative topicalizations, as in (22a,b), as well as interrogative [(22c–e)] and exclamative [(22f,g)] topicalizations.

- (22) a. People that smart, always pay attention to __ !
 b. The Roman Forum, be sure to visit __ when you're in Rome!
 c. That kind of antisocial behavior, can we really tolerate __ in a civilized society?
 (Radford 1988)
 d. This report, shouldn't you have already read __ ?
 e. That kind of behavior, who could object to __ ?
 f. People that stupid, am I ever fed up with __ !
 g. (?)His valiant efforts, how many people have overlooked __ !

Because topicalized phrases are *clauses*, but not instances of *decl-cl*, they may have any subtype of *message* as their CONTENT value. Thus any independent clause can in principle serve as the head daughter of a topicalized phrase.¹² In addition, the head daughter of a *top-cl* can be a coordination of two clauses, as in examples like (23), as predicted.

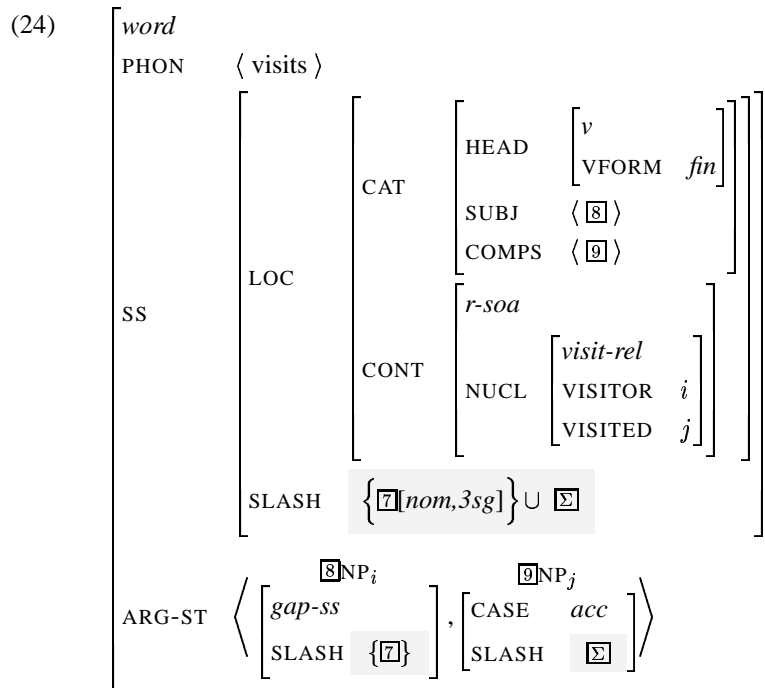
(23) Bagels, [[Kim likes __] and [Pat hates __]].

The generality of the topicalized clause construction thus appears to be adequately accommodated by our analysis.

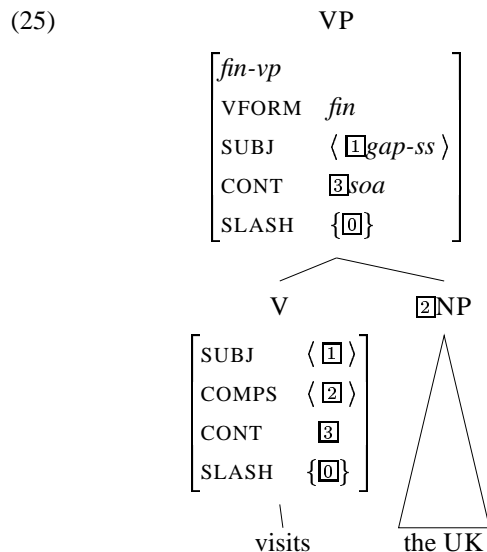
5.1.3 Some Constraints on Extraction

In our earlier discussion of the lexeme *visit* in (7) above, we failed to consider a third possible instantiation, shown in (24), which is the key to our treatment of subject extraction:

¹²We return to the analysis of exclamative clauses below and in the next chapter.



Here the subject argument is a *gap-ss*, yet it appears on the verb's SUBJ list (since the ARP does not subtract any argument from the SUBJ list). This instantiation is initially perplexing: Although it can give rise to an *r-soa*-denoting verb phrase of the kind shown in (25), this *fin-vp* cannot combine with an overt subject, whose *synsem* type would have to be *canon-ss*, which is in conflict with the *gap-ss* on the SUBJ list (of the verb and the VP) in (25).



Although a VP like (25) cannot combine with a subject in a declarative head-subject clause (or any other kind of *hd-subj-ph*), in fact nothing blocks such a VP from serving as head daughter of a declarative non-subject clause (introduced in section 2.4.3). To see this, consider (26), which

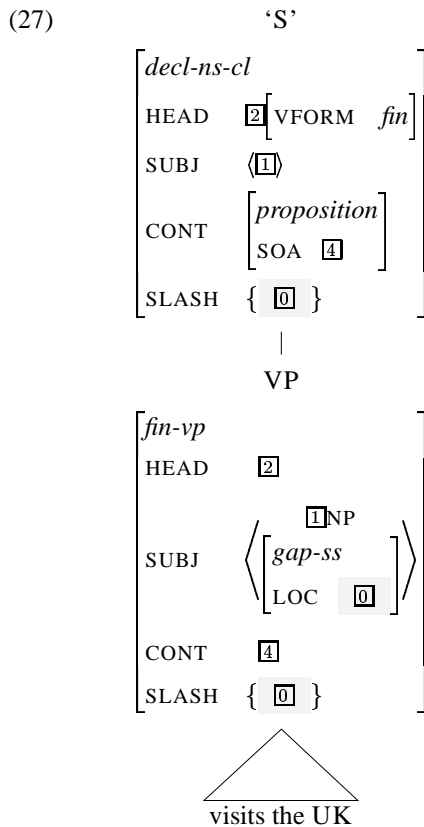
is the result of unifying the constraints on *decl-ns-cl* with relevant constraints inherited from its supertypes:

(26) GHFP & *decl-cl* & *hd-only-ph* & *decl-ns-cl*:

$$\left[\begin{array}{l} \text{CAT} \quad \left[\begin{array}{l} \text{HEAD} \quad \left[\text{VFORM} \quad \textit{fin} \right] \\ \text{SUBJ} \quad \langle \textit{noncan-ss} \rangle \\ \text{COMPS} \quad \langle \rangle \end{array} \right] \\ \text{CONT} \quad \left[\begin{array}{l} \textit{proposition} \\ \text{SOA} \quad \boxed{1} \end{array} \right] \\ \text{SLASH} \quad \boxed{\Sigma} \end{array} \right] \rightarrow \text{H} \left[\begin{array}{l} \text{CAT} \quad \boxed{2} \\ \text{CONT} \quad \boxed{1} \\ \text{SLASH} \quad \boxed{\Sigma} \end{array} \right]$$

Note that here the GHFP interacts with the constraint on *decl-cl* that embeds the head daughter's CONTENT value into that of the mother. Since the two CONTENT values must be distinct (circular structures are ill-defined), the default unification required by the GHFP identifies only the CATEGORY value of the mother and head daughter, as shown in (26).

In sum, the type *decl-ns-cl* was used in Chapter 2 to license infinitival clauses. This same type also licenses finite clauses like (27), where the SUBJ list of the mother contains not a *pro-ss* element, but rather an element of type *gap-ss* (Shading again illustrates inherited SLASH elements.):



This analysis of extraction is unusual in that extracted subjects are never cancelled from the SUBJ list and clauses whose subject is extracted are readily distinguishable from others (as [SUBJ ⟨ *gap-ss* ⟩] rather than [SUBJ ⟨ ⟩]). As Bouma et al. (2001) argue, this analysis provides an immediate account of such phenomena as the so-called ‘*that*-trace effect’. Because a complementizer like *that* selects a [SUBJ ⟨ ⟩] complement (see (67) in Chapter 2), examples like the following are correctly ruled out:¹³

- (31) a. *That’s the UN delegate that Terry thinks that [visits the UK twice a year].
 b. *Which UN delegate did you say Terry thinks that [visits the UK twice a year]?

That-trace facts are thus reduced to category selection of a familiar sort.

Bouma et al. (2001) also suggest that the present analysis can account for the so-called ‘adverb amelioration effect’ (see Culicover 1993, among others) illustrated in (32):

- (32) This is the kind of person who I doubt that, under normal circumstances, would have anything to do with such a scheme.

When an adverb intervenes between that *that* and a subject position, extraction of that subject is apparently possible.

One analysis of this phenomenon that is consistent with our overall extraction analysis involves simply positing a second entry for the complementizer *that*:

- (33)
$$\left[\begin{array}{l} \text{PHON} \quad \langle \text{that} \rangle \\ \text{ARG-ST} \quad \left\langle \text{ADV}, \left[\text{SUBJ} \quad \langle \textit{gap-ss} \rangle \right] \right\rangle \end{array} \right]$$

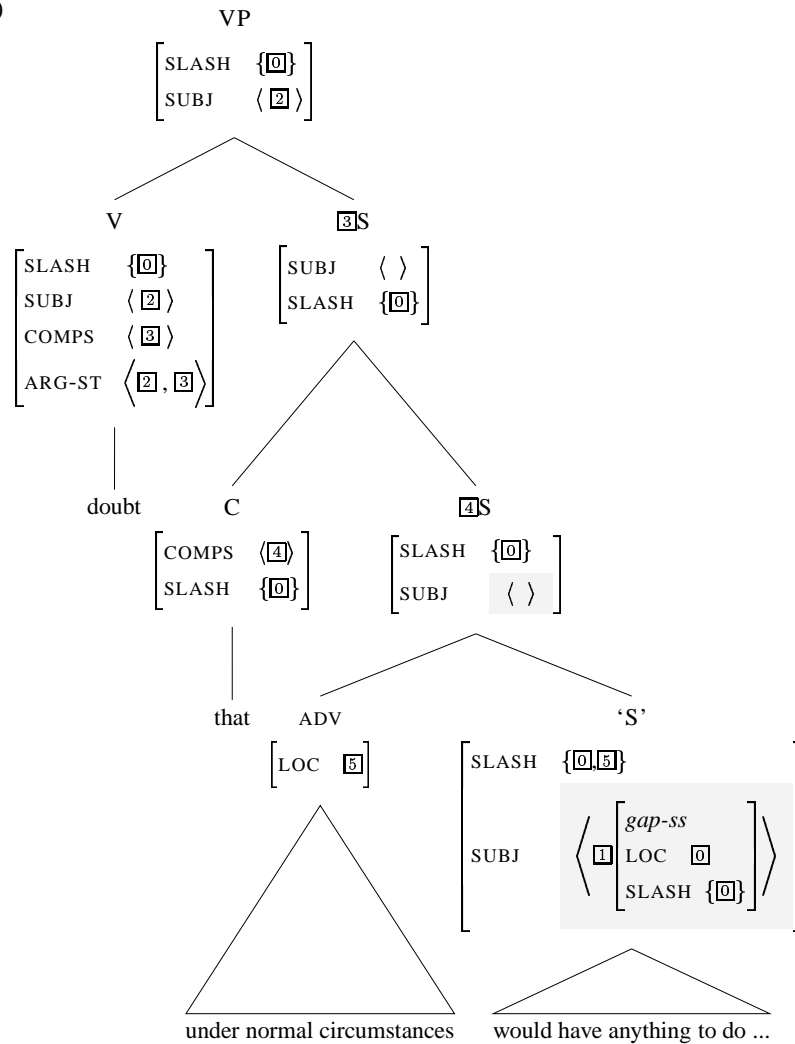
This lexical entry obligatorily selects an adverb and a clause whose subject is extracted.

More interesting than this ad hoc proposal, however, is one along the lines suggested by Bouma et al. (2001). This involves tuning the constraints on the adverb ‘preposing’ construction. Assume that this construction (a kind of *hd-fill-ph*) states that its mother is [SUBJ ⟨ ⟩], but that its head daughter is specified as [SUBJ ⟨ (*gap-ss*) ⟩].¹⁴ In this case, when there is adverb fronting within a clause, it is [SUBJ ⟨ ⟩], and hence selectable by the complementizer *that*, even if its subject is extracted. Examples like (33) would thus have a structure like (34):

¹³This account also extends to the analysis of the *que/qui* alternation in French filler-gap constructions, as Bouma et al. (2001) show.

¹⁴In order for this analysis to work, the SUBJ value of mother and head daughter must be ‘deidentified’, enabling the GHFP to be overridden. For discussion of a similar issue that arises in our treatment of in-situ interrogatives, see section 7.2.

(34)



Though there remains some residual worry about the generality of the adverb amelioration effect,¹⁵ it nonetheless seems that the basic phenomenon is amenable to treatment within our analysis.

In sum, our theory of extraction, unlike many of its GPSG and HPSG forbears, treats all cases of missing subjects in terms of a *gap-ss* element on the SUBJ list of a verb and the VP it projects. Because of the SLASH amalgamation that is central to our proposal, whenever a verb's subject is missing in an extraction construction, that verb is slashed. As Hukari and Levine (1995, 1996b) argue at length, this is precisely the generalization about subject extraction that is motivated on cross-linguistic grounds and precisely the generalization missed by earlier treat-

¹⁵For example the decreased acceptability of examples like the following:

- (i)?This is the kind of person who I doubt that last year had anything to do with such a scheme.
- (ii)?Who do you think that happily visited museums?
- (iii) *Which people at the conference did they think that in Paris visited museums?

ments in G/HPSG. Our analysis allows a uniform account of extraction-sensitive phenomena (Kikuyu downstep suppression, Chamorro/Palauan verb morphology, and related cross-linguistic phenomena) in terms of SLASH specifications.

There are other constraints on extraction (i.e. ‘island constraints’) that have a natural account in the extraction analysis outlined here. As Bouma et al. (2001) show, the Coordinate Structure Constraint and its ‘across-the-board’ exceptions are a consequence of the requirement that a coordinate structure and all its conjuncts must share a single value for the feature SLASH. In addition, since there are no *wh*-traces in this system, there is no sign that can serve as a conjunct in examples like (35), which either are left undiscussed or else are incorrectly generated in many extraction analyses.

- (35) a. *[Which of her books]_{*i*} did you find both [[a review of ___{*i*}] and ___{*i*}]?
 b. *[Which of her books]_{*i*} did you find [___{*i*} and [a review of ___{*i*}]]?
 c. *[Which rock legend]_{*i*} would it be ridiculous to compare [___{*i*} and ___{*i*}]?
 (cf. [Which rock legend] would it be ridiculous to compare ___{*i*} with himself_{*i*}?)

More generally, our extraction analysis is unusual in that it provides a natural account of the fact, emphasized by Postal (2001), that island phenomena are heterogeneous. Postal shows in detail, through an examination of an extensive and diverse set of syntactic phenomena, that islands are not a unified class. Rather, specific constructions constitute islands for certain kinds of syntactic dependencies, and not for others, a fact that is difficult to reconcile with many familiar treatments of extraction.

In the present account, by contrast, island phenomena are a consequence of particular type constraints. These constraints may be imposed on a high-level type—so as to affect a large class of constructions—or, in the limiting case, on a particular construction, as is the case, for example, with the Coordinate Structure Constraint. If a particular kind of phrase is an absolute extraction island, then it is subject to a type constraint requiring it to be specified as [SLASH { }]. An extraction non-island is left unconstrained with respect to the feature SLASH. A construction that allows, say, only pronominal extraction dependencies—terminated in a pronominal, rather than a gap—is specified as [SLASH *set(pron)*], where *pron* is the type of pronominal *local* objects proposed by Abeillé et al. (to appear) in order to explicate ‘Clitic Left Dislocation’ and related phenomena in French. Similarly, constructions that allow only NPs to be extracted from them (e.g. so called ‘weak islands’) are specified as [SLASH *set(NP)*].

There are further island phenomena that could be considered here, but these would take us too far afield. The bare-bones sketch of the grammar of extraction just outlined should provide a sufficient platform for the presentation of our treatment of interrogative constructions. For further discussion of the issues discussed in this section, see Bouma et al. 2001.

5.2 Pied Piping

The second unbounded dependency to be discussed in this chapter is pied piping. A number of *wh*-constructions are head-filler phrases whose initial (filler) daughter is typically simply an appropriate *wh*-word, as in (36).

- (36) a. I wonder [[*what*] inspired them]. (wh-interrogative)
 b. I wonder [[*why*] they did that __]. (wh-interrogative)
 c. [[*How*] they stink!] (wh-exclamative)
 d. the book [[*which*/**what*] inspired them]... (wh-relative)

Yet in all such constructions, the required *wh*-word may be properly contained within the filler daughter, as in (37).

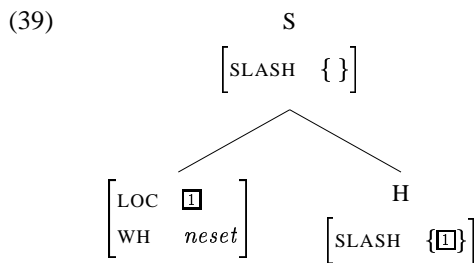
- (37) a. I wonder [[*whose* cousin] they like __ best].
 b. I wonder [[*how* quickly] they did that __].
 c. the person [[*whose* cousin] ate the pastry]...
 d. the person [[to *whom*] they dedicated the building __]...
 e. [[*How* tall] they are __]!
 f. [[[*What* a] fool] Pat is __]!

Moreover, there is no upper bound on how deeply the *wh*-word may be embedded within the filler daughter, as shown in (38).

- (38) a. I wonder [[[*whose* cousin]'s friend's ...dog] ate the pastry].
 b. I wonder [[[[[*how*] much] more] likely] Kim is __ to do that].
 c. the person [[[*whose* cousin]'s friend's ...dog] ate the pastry]...
 d. That's the very report [[the height [of [the [lettering [on [the [covers [of [*which*]]]]]]]]]] the CIA prescribes __].
 e. [[[[*How* honest] a] person] she is __]!

It is in this sense that the dependency between the top of the construction and the presence of the appropriate *wh*-word within the filler daughter is unbounded in nature.

This unbounded dependency, which (following Ross 1967) we refer to as 'pied piping', has been analyzed within HPSG just as extraction dependencies are treated—via the inheritance of feature specifications. For instance, the head-filler constructions we introduce in the next chapter for *wh*-interrogative and *wh*-exclamative clauses define structures like (39):



The *neset* in (39) will be resolved as $\{param(eter)\}$ for interrogative clauses and $\{unusual-rel\}$ for exclamative clauses, where *unusual-rel* is a kind of *generalized-quantifier* (*GQ*).¹⁶ As we will show directly, $\{param\}$ is an appropriate WH value for interrogative *wh*-words and $\{unusual-rel\}$ is the appropriate WH value for all exclamative *wh*-words. Thus the simple examples in (36a–c) are simply accounted for.

¹⁶The feature WH, as noted earlier, corresponds to the feature QUE utilized by P&S–94, who did not provide an account of exclamatives.

Similar lexical entries are assumed for all interrogative *wh*-words, including *what*, *which*, *whose*, *where*, *when*, *why*, and *how*.

The type *param* (roughly equivalent to the restricted parameters of the Situation Semantics literature and to the type *nom-obj* of P&S–94) is the type of the CONTENT value of all NPs. In (41), the index of the *wh*-word is identified with that of the parameter that is contributed to the STORE. Once a parameter is in the STORE, it is ‘passed up’ (via principles explained in the next section) to be incorporated into a question somewhere ‘higher’ in the sentence structure. In this way, an interrogative *wh*-word in a syntactically embedded context can receive wide scope in examples like the following:

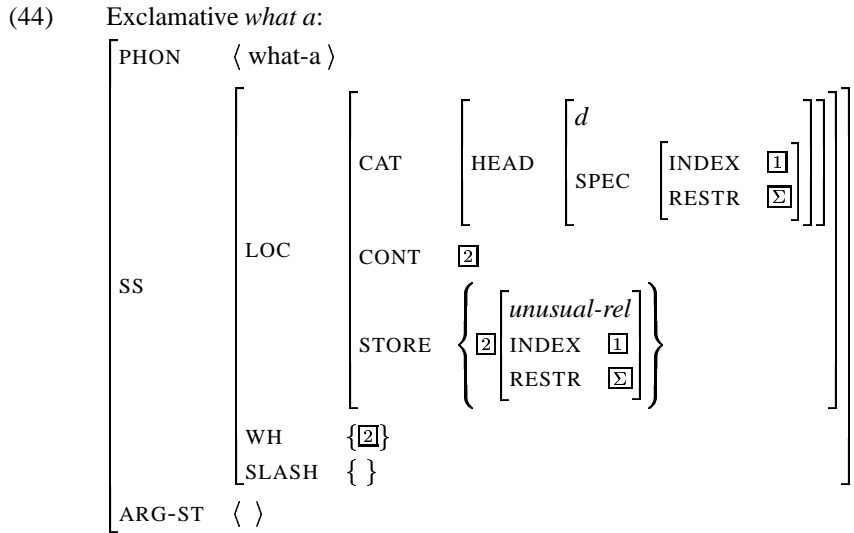
- (42) a. [You said [you believe [you saw WHO]]]?
 b.
$$\left[\begin{array}{l} \text{question} \\ \text{PARAMS} \left\{ \begin{array}{l} \text{param} \\ \text{INDEX } \boxed{1} \\ \text{RESTR } \{ \text{person}(\boxed{1}) \} \end{array} \right\} \\ \text{PROP} \quad \text{say}(\text{you}, [\text{believe}(\text{you}, [\text{see}(\text{you}, \boxed{1})])]) \end{array} \right]$$

Note further that according to (41) the WH value of a *wh*-interrogative word may also be the empty set, though a variety of constraints will interact to determine a unique value for a *wh*-word’s WH value in any given linguistic context. The generalization that follows from our analysis is that only the first interrogative *wh*-word in an interrogative clause will bear a nonempty WH value. All in-situ occurrences of interrogative *wh*-words—those in reprise questions like (43) or those in multiple *wh*-questions (section 6.6)—will be [WH { }]. This distinction is fundamental to the grammar of *wh*-interrogatives presented in subsequent chapters.

Exclamative *wh*-words are similar, except—according to Quirk, Greenbaum, Leech, and Svartvik (1985: 833)—there are only two of them: the degree element *how* and the predeterminer *what*. These words always have a quantifier as their WH value. We will name this quantifier *unusual-rel*. The intuition underlying this involves examples such as (43a,c,e), which can be paraphrased as in (43b,d,f):

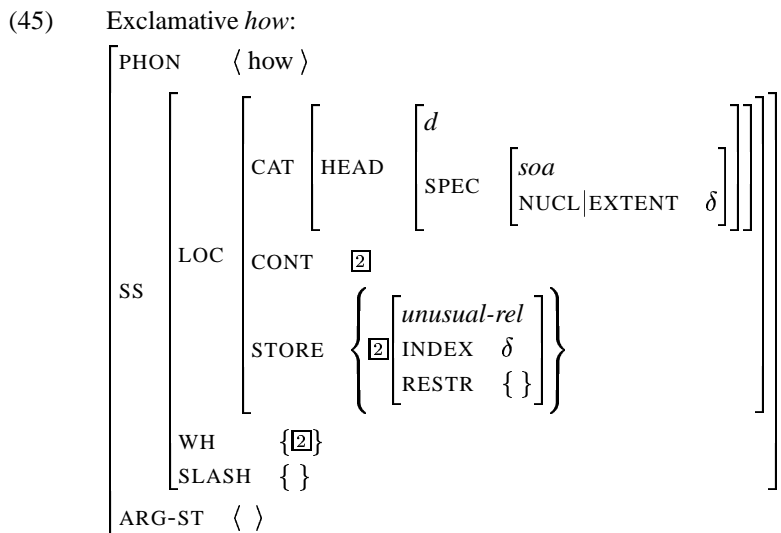
- (43) a. What a performance I’ve just heard!
 b. There’s an unusual performance I’ve just heard.
 c. What a sunset I’ve just seen.
 d. There’s an unusual sunset I’ve just seen.
 e. How hard this problem is!
 f. There’s an unusual extent such that this problem is hard to that extent.

This motivates the following lexical entry for exclamative *what a*:



This is a determiner very similar to *every*, *some* or *the*: it combines with an \bar{N} , which it selects via the feature SPEC and identifies that \bar{N} 's RESTR value with that of the stored quantifier. Exclamative *wh*-words also behave in a way that closely resembles their interrogative counterparts: they contribute a quantifier to the STORE and also to the WH-value. The stored exclamative quantifier is 'passed up' in accordance with constraints described in the next section and integrated into the meaning of an exclamative clause via a construction-specific constraint formulated in the next chapter. In contrast to interrogative *wh*-words, exclamative *wh*-words obligatorily have a non-empty WH specification. Since elements with non-empty WH specifications have a highly restricted distribution (as we will soon see), our analysis predicts that there are no in-situ uses of exclamative *wh*-words.

The lexical entry for exclamative *how* is sketched in (45):



Note that exclamative *how* is a specifier that also selects its head via the feature SPEC. However, since the value of SPEC must be a *soa* whose nucleus allows the feature EXTENT—i.e. it must be a gradable adjective or adverb, exclamative *how* combines as a specifier only with APs and ADVPs headed by semantically gradable items.

Relative pronouns are somewhat different from the previous two kinds of *wh*-word. They have an empty STORE and they are [WH { }]. They also must have a parameter as their REL value, as shown in (46):

(46) Relative *who*:

$$\left[\begin{array}{l} \text{PHON } \langle \text{who} \rangle \\ \left[\begin{array}{l} \text{LOC } \left[\begin{array}{l} \text{CAT } \text{NP} \\ \text{CONT } \boxed{1} \\ \text{STORE } \{ \} \end{array} \right] \\ \text{SS } \text{WH } \{ \} \\ \text{REL } \left\{ \begin{array}{l} \text{param} \\ \boxed{1} \text{IND } i \\ \text{RESTR } \{ \textit{person} (i) \} \end{array} \right\} \end{array} \right] \\ \text{ARG-ST } \langle \rangle \end{array} \right]$$

Similar entries are assumed for the other relative *wh*-words *which* and *whose*. A relative *wh*-word's nonempty REL value must be passed up through pied-piping structures in the same way that WH-specifications are, though there are slightly different constraints at work in the two cases.

Because *wh*-relative words have an empty STORE, they also do not contribute to the content of a phrase in the same way that interrogative and exclamative *wh*-words do. Their contribution will come entirely from constraints on the various types of relative clause identifying the index of the WH value with that of the nominal being modified. Moreover, because the distribution of expressions with nonempty REL values, like WH-specified expressions, is highly constrained, relative words do not have in-situ uses in English. As explicated in Chapters 6 and 7, this possibility exists for interrogative *wh*-words only because they also allow a [WH { }] specification (note the optionality of the WH member in (41)), an option that is unavailable for the REL value of relative *wh*-words.¹⁷

5.2.2 WH Percolation

We may now ask how WH-specifications are ‘percolated’ in pied piping structures. Put simply, the answer to this question is that the percolation is mediated by lexical heads. That is, a noun selecting a specifier takes on the specifier’s WH value because there is a constraint (similar to the SLASH-Amalgamation constraint discussed in the previous section) requiring words to amalgamate the WH values of their arguments (including specifiers). Thus once a noun combines with a [WH { *param*}] determiner, the noun itself is [WH { *param*}]. And once the noun is so specified, the phrases projected by that noun are also [WH { *param*}], courtesy of the GHFP. The GHFP thus interacts with lexical constraints to account for WH-percolation without introducing any

¹⁷For convenience, since we will have no further discussions of *wh*-relatives, we will henceforth omit all mention of the feature REL.

new mechanisms into our grammar. However, as we will see, there is more than one pattern of lexical constraint that we must recognize in order to predict the different properties of pied piping in nominal, verbal, prepositional and other structures.

We posit three constraints governing the distribution of WH specifications in lexical entries. The first of these is the WH-Amalgamation Constraint, which ensures that by default the WH value of any word is the union of the WH values of that word's arguments:

(47) WH-Amalgamation Constraint:

$$word \Rightarrow / \left[\begin{array}{l} SS|WH \quad \boxed{\Sigma_1} \cup \dots \cup \boxed{\Sigma_n} \\ ARG-ST \quad \langle [WH \boxed{\Sigma_1}], \dots, [WH \boxed{\Sigma_n}] \rangle \end{array} \right]$$

Note that the interrogative and exclamative *wh*-words just presented override the constraint in (47).¹⁸

The WH-Amalgamation Constraint applies to feature structures of type *word* (*n.b.*—not *lexeme*), as does the following constraint:

(48) WH-Subject Prohibition (WHSP):

$$word \Rightarrow \left[SS|LOC|CAT|SUBJ \quad list([WH \{ \}]) \right]$$

The WHSP prevents subjects from being WH-specified. This has the effect, for example, that all *wh*-phrases that appear to be WH-specified subjects (e.g. *Who left?*) are really extracted phrases. That is, any such *wh*-phrase is the filler of a head-filler construction, not the subject of a head-subject construction.

The final general constraint on WH specification is the following:

(49) WH-Constraint (WHC):

Any non-initial element of a lexeme's ARG-ST list must be [WH { }].

The WHC, which can be formalized in several ways,¹⁹ ensures that only the initial member of a lexeme's ARG-ST can be WH-specified. The three constraints just adumbrated interact with the properties of specific lexical classes to explain the subtly different pied piping behavior found in various kinds of phrases.

NPs

As argued by Pollard and Sag (1992, 1994), nominal specifiers must be part of a noun's argument structure in order to account for binding data like that in (50).²⁰

- (50) a. His_i picture of himself_i was pretty ugly.
 b. *Their_i pictures of them_i were on sale everywhere.
 c. *They_i knew my pictures of each other_i were on sale everywhere.

¹⁸In section 5.4 below, we collapse the SLASH-Amalgamation Constraint and the WH-Amalgamation Constraint into a single principle amalgamating the values of non-LOCAL features.

¹⁹For example, the WHC could be formulated as an RSRL-style implicational constraint. The alternative that we will adopt involves positing a list type *arg-st-list* with two subtypes: *elist* and *n(on)e(mpty)-arg-st-list*. The latter is constrained as follows:

$$(i) \quad ne\text{-}arg\text{-}st\text{-}list \Rightarrow \left[REST \quad list([WH \{ \}]) \right]$$

²⁰For a recent critical discussion of binding effects in nominal phrases, see Keller and Asudeh 2000.

Hence, the lexical entry for a common noun lexeme like *cousin* is as shown in (51):²¹

$$(51) \left[\begin{array}{l} cn-lx \\ PHON \quad \langle \text{cousin} \rangle \\ SS|LOC|CAT|HEAD \quad n \\ ARG-ST \quad \langle \text{Det} \rangle \end{array} \right]$$

This lexeme gives rise to the (nonpredicative) singular word shown in (52) via a lexical rule that we may formulate as in (53):

$$(52) \left[\begin{array}{l} word \\ PHON \quad \langle \text{cousin} \rangle \\ SS \left[\begin{array}{l} LOC|CAT \\ SPR \quad \langle \text{[2]Det} \rangle \\ \quad \left[\text{WH} \quad \Sigma \right] \end{array} \right] \\ \quad \left[\begin{array}{l} SUBJ \quad \langle \rangle \\ COMPS \quad \langle \rangle \end{array} \right] \\ \quad \left[\begin{array}{l} HEAD \quad \left[\begin{array}{l} PRED \quad - \\ AGR \quad \left[\text{NUM} \quad sg \right] \end{array} \right] \end{array} \right] \\ WH \quad \Sigma \\ ARG-ST \quad \langle \text{[2]} \rangle \end{array} \right]$$

(53) Singular Attributive Noun Lexical Rule:

$$\left[\begin{array}{l} lx \\ SS|LOC|CAT|HEAD \quad n \end{array} \right] \Rightarrow_{LR} \left[\begin{array}{l} word \\ SS|LOC|CAT \quad \left[\begin{array}{l} HEAD \quad \left[\begin{array}{l} AGR|NUM \quad sg \\ PRED \quad - \end{array} \right] \\ SPR \quad \langle \text{[1]} \rangle \\ SUBJ \quad \langle \rangle \end{array} \right] \\ ARG-ST|FIRST \quad \text{[1]} \end{array} \right]$$

Several points are noteworthy. First, the LR in (53) produces a singular word as its output.²² Second, the LR also identifies the noun's first argument with the specifier that the noun selects. Because of the WH-Amalgamation Constraint, this specifier and the noun share their WH value, as indicated in (52). Third, because the LR preserves the ARG-ST of the input lexeme in the output word, the noun in (52) has a singleton ARG-ST list. Hence, because the LR also specifies an empty SUBJ value for the derived word, the Argument Realization Principle guarantees that the latter's COMPS value is also empty, as indicated.

The effect of WH-amalgamation is to ensure that a noun like (52) is WH-specified whenever it combines with a WH-specified determiner. The WH-specified noun then passes up its nonempty

²¹We use 'Det' to abbreviate the synsem of a sign (either *word* or *phrase*) whose HEAD value is of category *d*.

²²We adopt an AGR-based analysis of agreement here merely for convenience.

WH value to the nominal phrases it projects, as required by the GHFP. This provides an account of simple pied piping in NPs like (37a) above.

Not all noun lexemes have singleton argument structures, however. The lexical entry for the lexeme *picture* is illustrated in (54):

$$(54) \left[\begin{array}{l} cn-lx \\ PHON \quad \langle \text{picture} \rangle \\ SS|LOC|CAT|HEAD \quad n \\ ARG-ST \quad \langle \text{Det} (\text{, PP}[of]) \rangle \end{array} \right]$$

Such lexemes give rise to nonpredicative singular words in like fashion. Note, however, that the WHC requires that the PP[*of*] must be [WH { }].

The lexemes just described also give rise (again by inflectional rule) to plural words that differ from their singular counterparts only in their number specification. The interaction with WH-amalgamation again accounts for the pied piping effect, this time in NPs like (55).

- (55) a. I wonder [[*whose* pictures (of Sandy)] Pat likes].
 b. I wonder [[[*whose* friend's] pictures (of Sandy)] Pat likes].

Plural and mass singular nouns may also give rise to determinerless phrases like (56):

- (56) [Pictures (of Sandy)] are cheap.

These are analyzed in terms of a non-branching construction (a *hd-only-ph*) in which a [SPR < Det >] head daughter projects an NP that is [SPR < >], as shown in (57):

(57) *bare-nom-ph*:

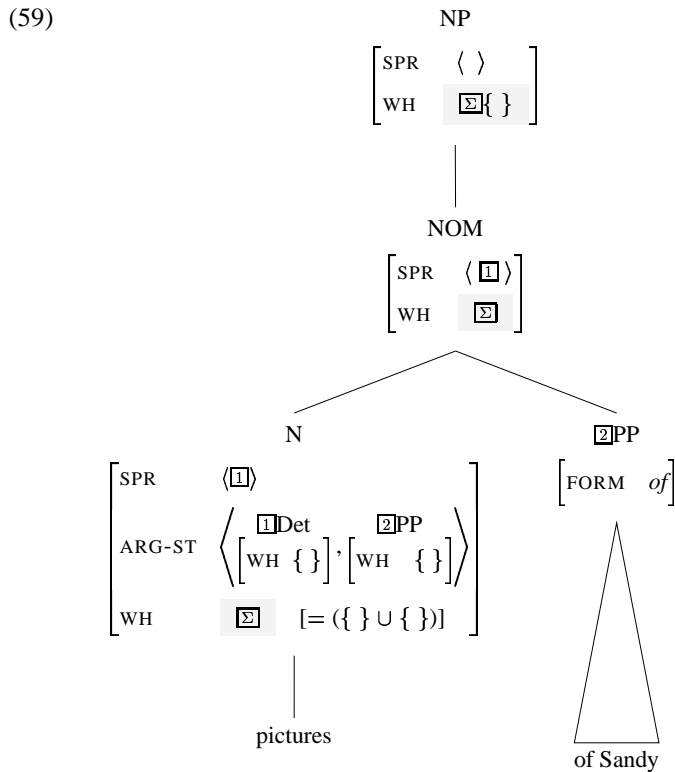
$$[\text{SPR} \langle \rangle] \rightarrow \mathbf{H} \left[\begin{array}{l} \text{HEAD} \quad n \\ \text{SPR} \quad \left\langle \begin{array}{l} \text{Det} \\ \left[\text{WH} \{ \} \right] \end{array} \right\rangle \end{array} \right]$$

Note the interaction with the GHFP, which ensures, *inter alia*, that specifications for all valence features other than SPR are percolated from head daughter to mother:

(58) ECC & GHFP & *hd-only-ph* & *bare-nom-ph*:

$$\left[\begin{array}{l} \text{CAT} \left[\begin{array}{l} \text{HEAD} \quad \boxed{1} \\ \text{COMPS} \quad \boxed{A} \langle \rangle \\ \text{SUBJ} \quad \boxed{B} \\ \text{SPR} \quad \langle \rangle \end{array} \right] \\ \text{CONT} \quad \boxed{4} \\ \text{SLASH} \quad \boxed{\Sigma_1} \\ \text{WH} \quad \boxed{\Sigma_2} \\ \text{BCKGRND} \quad \boxed{\Sigma_4} \end{array} \right] \rightarrow \mathbf{H} \left[\begin{array}{l} \text{CAT} \left[\begin{array}{l} \text{HEAD} \quad \boxed{1}n \\ \text{COMPS} \quad \boxed{A} \\ \text{SUBJ} \quad \boxed{B} \\ \text{SPR} \quad \left\langle \begin{array}{l} \text{Det} \\ \left[\text{WH} \{ \} \right] \end{array} \right\rangle \end{array} \right] \\ \text{CONT} \quad \boxed{4} \\ \text{SLASH} \quad \boxed{\Sigma_1} \\ \text{WH} \quad \boxed{\Sigma_2} \\ \text{BCKGRND} \quad \boxed{\Sigma_4} \end{array} \right]$$

The analysis provided for a 'bare plural' NP is thus as shown in (59):



The *bare-nom-ph* construction imposes the further requirement that the head daughter's SPR value is $\langle [WH \{ \}] \rangle$, as indicated. This further ensures (courtesy of WH-amalgamation and the GHFP) that the head noun and its projections are all $[WH \{ \}]$, and hence unsuitable as fillers in *wh*-interrogative clauses like (60), even though another interrogative *wh*-word may be present:²³

- (60) a. *I wonder [[pictures of *Pat*] they were admiring __.]
b. *I wonder [[pictures of *whom*] they were admiring __.]

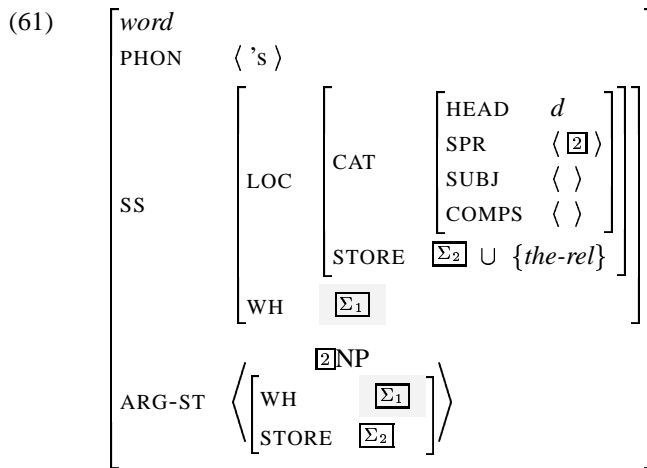
In (60b), the PP *of whom* and the NP *whom* must both be $[WH \{ \}]$, as required by the WHC and its interaction with the other principles already illustrated.

We now make the further proposal that possessive 's is a determiner that obligatorily selects an NP specifier argument. From this it follows, again by the Argument Realization Principle and WH-amalgamation, that 's must be WH-specified whenever its specifier is, as shown in (61):²⁴

²³Note further that examples like (i) are blocked because proper nouns are lexically specified as $[WH \{ \}]$.

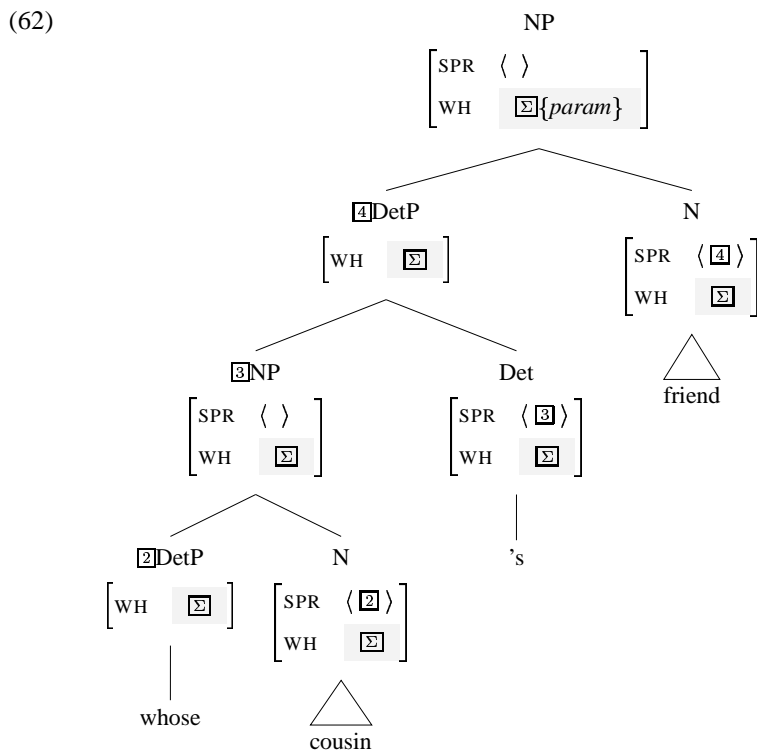
(i) *I wonder [[*Pat*] they were admiring __.]

²⁴This analysis of possessive 's is proposed independently by Fillmore et al. (to appear). An alternative account of pied piping in possessive phrases, based on the ideas of Zwicky (1987), is also possible within our approach.



Therefore, again by the GHFP, the determiner 's must pass up its WH value to the DetP it projects.

Our treatments of common nouns and the possessive determiner interact to account for unbounded pied piping within NPs, as illustrated in (62):



Our system of constraints also ensures that when *whose* is replaced by the [WH { }] determiner *my*, the resulting phrase—*my cousin's friend*—is [WH { }], which makes it unsuitable as a filler in any *wh*-construction.

Similarly, the exclamative determiner *how*—lexically specified as [WH {unusual-rel}]—may be selected as a specifier by a gradable determiner like *few*. Again it follows from the interaction

of the Argument Realization Principle and WH-amalgamation that the WH value of *few* will in this case also be *unusual-rel*. Hence the DetP *how few* will be [WH {*unusual-rel*}], as will any noun that selects *how few* as its specifier. Therefore, again via the GHFP, NPs like those bracketed in (63a,b) are all [WH {*unusual-rel*}] and may serve as the filler daughter in a *wh*-exclamative clause. Similar further identifications ensure unbounded pied piping in exclamatives as well, providing an account of (63c,d).²⁵

- (63) a. [[How few books] they've read]!
 b. [[How many people] have remembered your birthday]!
 c. [[How many people's birthdays] she remembers __]!
 d. (?)[[How many students' parents' suggestions] you take __ into account]!

There is a further point about pied piping in the NP that must be noted. An adequate analysis must ensure that all other (i.e. non-initial) arguments of nouns be specified as [WH { }]. It is not that multiple *wh*-expressions are impossible within an NP, as examples like (64) show.²⁶

- (64) I wonder [[*whose* pictures of *whom*] they were admiring __].

The point is rather that the second *wh*-expression in (64) is not WH-specified—it is in situ. This claim can be verified by the test discussed at length in the next chapter, involving the possibility of modification by *the hell*, *the devil*, *in the world*, etc. Expressions such as these can only modify words that are [WH {*param*}]. Hence the following contrasts confirm that the second *wh*-expression in (64), but not the first, is [WH { }].

- (65) a. I wonder [[*who the hell's* pictures] they were admiring __].
 b. *I wonder [[*whose* pictures of *who the hell*] they were admiring __].

The WHC in (49) above ensures that noninitial members of a noun lexeme's ARG-ST list must be [WH { }]. This renders them unsuitable for modification by *the hell* and similar expressions. The WHC also plays a role in our account of key contrasts in the interpretation of multiple *wh*-interrogatives. Both of these matters are taken up in detail in the next chapter. Finally, since exclamative *wh*-words are never specified as [WH { }], the WHC also predicts that there are no in-situ exclamatives within NPs. This is a correct prediction, as the following examples show:

- (66) a. *[[Pictures of how few churches] they've seen __]!
 b. *[[How few pictures of how few churches] they've seen __]!
 c. *[[Letters to what a great senator] they've written __]!
 d. *[[What a great letter to what a great senator] they've written __]!

We also treat predicative NPs lexically. That is, we assume that common noun lexemes also give rise to predicative nominal words. But the lexical rule that creates predicative nouns prefixes a subject argument to the noun lexeme's ARG-ST list. This allows predicative NPs to function like other subject-selecting predicating expressions (e.g. VPs). Unifying in the effects of the

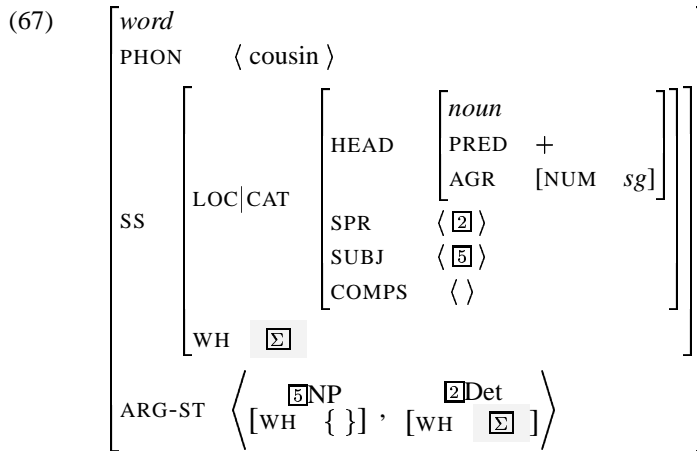
²⁵For some speakers, it appears that acceptability decays with depth of embedding more rapidly in the case of exclamatives than with interrogatives or relatives. We have no explanation for this fact at present.

²⁶Note that examples like (i) are already properly accounted for, as the noun *picture* must be [WH { }], agreeing with its specifier *Pat's*.

(i) *I wonder [[*Pat's* pictures of whom] Sandy likes __].

Since *picture* is [WH { }], so is the NP it projects, rendering that NP unsuitable as a filler daughter in a *wh*-interrogative clause, e.g. the one bracketed in (i).

Argument Realization Principle, WH-amalgamation, and the WHSP [(48)] we have the following description for the predicative noun *cousin*:



Note that in (67), the noun’s WH value is identified with that of the specifier (the second member of the ARG-ST list). This follows because WHSP ensures that the first argument’s WH value is { } (and because { } ∪ [Σ] = [Σ]). Note further that this analysis provides an account of examples like the following, if we assume that complements of the identity copula are also predicative NPs.

(68) I wondered [*whose cousin*] she was pretending to be __.

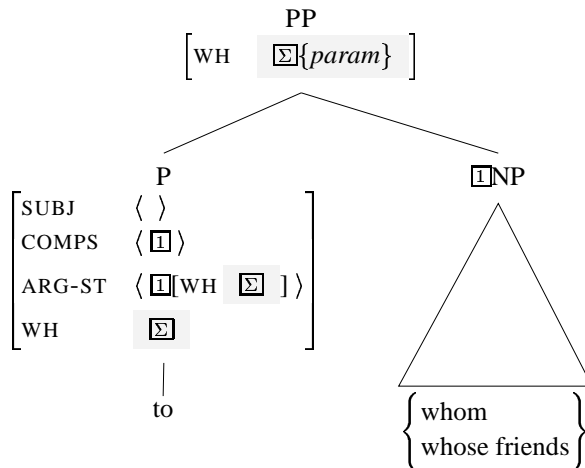
Below we show how this analysis extends to pied piping in uncontroversially predicative NPs like the one italicized in (69).

(69) I wonder [*how good a candidate*] he would be __.

PPs

Different lexical classes exhibit different constraints vis à vis the feature WH. ‘Case-marking’ prepositions, for example, take on the WH value of their first argument (their object NP), as illustrated in (70).

- (70) a. I wonder [[to *whom*] they sent presents __.]
 b. I wonder [[to *whose* friends] they sent presents __.]
 c.



‘Head-object’ WH-agreement in the case of case-marking prepositions is a consequence of WH-amalgamation. This lexical agreement interacts with the GHFP to ensure that examples like (70a,b) are correctly treated. In addition, the proposed treatments of nouns and prepositions interact to account for a distinct pattern of unbounded pied piping in interrogatives, as illustrated in (71)–(72).²⁷

- (71) a. I wonder [[to [*whose* friends]] they sent presents _].
 b. I wonder [[to [[*whose* friends’] children]] they sent presents _].
 c. I wonder [[to [[[*whose* friends’] children’s] pets]] they sent presents _].

Exclamatives in PPs work similarly, though acceptability again decays more rapidly with depth of embedding:

- (72) a. [[To [[*how* many] children]] they’ve sent presents _]!
 b. [[To [[[*how* many] children’s] schools]] they’ve sent donations _]!

Predicative prepositions—those with two NPs on their ARG-ST list, have lexical entries like the following:

- (73)
$$\left[\begin{array}{l} \text{PHON} \quad \langle \text{in} \rangle \\ \text{SS} \left[\begin{array}{l} \text{LOC|CAT} \left[\begin{array}{l} \text{HEAD} \quad \left[\begin{array}{l} p \\ \text{PRED} \quad + \end{array} \right] \\ \text{SUBJ} \quad \langle \boxed{1} \rangle \\ \text{COMPS} \quad \langle \boxed{2} \rangle \end{array} \right] \\ \text{WH} \quad \{ \} \end{array} \right] \\ \text{ARG-ST} \quad \left\langle \left[\begin{array}{l} \boxed{1}\text{NP} \\ \left[\text{WH} \{ \} \right] \end{array} \right], \left[\begin{array}{l} \boxed{2}\text{NP} \\ \left[\text{WH} \{ \} \right] \end{array} \right] \right\rangle \end{array} \right]$$

The effect of the WHC is indicated in (73) (the object NP must be [WH { }], as it is a non-initial argument of the prepositional lexeme). In addition, predicative prepositions, like all other predicatives, select for a subject that is identified with the first member of the ARG-ST list. Thus under our analysis it follows—from the interaction of the WHSP and WH-amalgamation—that predicative prepositions are always [WH { }]. (since $\{ \} \cup \{ \} = \{ \}$) and hence do not appear in pied piping structures. This prediction also appears to be correct, as the following data suggest.²⁸

- (74) a. ?*I wonder [[in [[*how* many] synagogues]] they have been _].
 b. *I wonder [[about [*what*]] this book is _].
 (75) a. I wonder [[[*how* many] synagogues] they have been in _].
 b. I wonder [[*what*] this book is about _].

²⁷Some case marking prepositions allow non-*wh* specifiers such as *right* or *straight*. Assuming these to be specified as [WH { }], the WH-Amalgamation Constraint and the WHC would interact to ensure that any preposition cooccurring with such a specifier would also be specified as [WH { }]. This leads to the prediction that these specifiers cannot appear in pied piping structures. As examples like (i) show, this prediction appears to be correct.

(i) *I wonder [right [to [*whom*]] they threw the ball _].

²⁸It should be noted that there is some variation in judgment across speakers with respect to certain of these examples.

In examples (75a–b), the preposition’s second argument is of type *gap-ss*, a type which is constrained to be [WH { }]. Hence in these examples, the WHC is not violated.

APs

Let us now turn to adjectives, which also project phrases that contain pied piping of unbounded depth, as shown in (76).

- (76) a. I wonder [[how happy] Sandy is __].
 b. [[How happy] is Sandy __]?
 c. I wonder [[[how much] smarter (than Pat)] Sandy really is __].
 d. [[[How much] smarter (than Pat)] do you think Sandy really is __]?
 e. (?)I wonder [[[[how many] times] smarter than Pat] Sandy really is __].
 f. (?)[[[[How many] times] smarter than Pat] do you think Sandy really is __]?
 (77) a. [[How happy] Sandy is __]!
 b. [[How much] smarter (than Pat)] Sandy is __]!
 c. (?)[[[How many] times] smarter than Pat] Sandy seems to be __]!

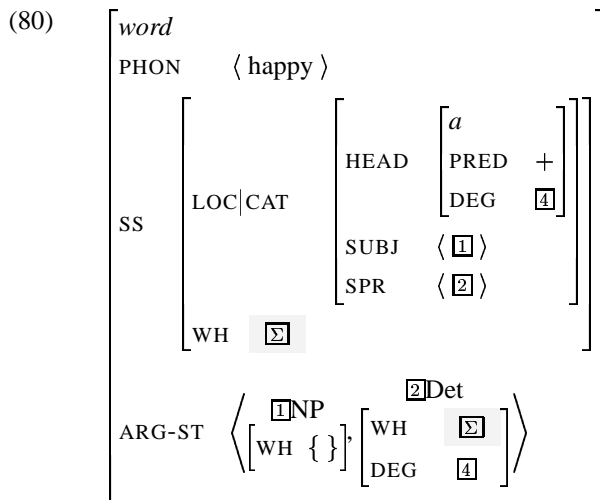
Like pied piping within the NP, pied piping in an AP is possible only if the *wh*-word is the adjective’s specifier or a specifier within the adjective’s specifier. Thus examples like the following are systematically ill-formed.

- (78) a. *I wonder [[(so) proud of whom] Sandy really is __].
 b. *[Proud of whom] do you think Sandy really is __]?

As noted in section 2.2, there are argument structure parallelisms between adjectives and verbs. To capture these similarities, we proposed there, following standard practice in HPSG, that adjective lexemes should be assigned ARG-ST values parallel to those of verbal lexemes. On this view, the ARG-ST of a strict intransitive adjective, e.g. *big*, is analogous to that of a simple intransitive verb, i.e. ⟨NP⟩, while that of a subject control adjective like *eager* is ⟨NP_i, [SUBJ ⟨NP_i⟩]⟩, analogous to that of the verb *try*. This account of adjectival lexemes accounts for subcategorizational generalizations cross-cutting the two lexical classes, but it leaves no room for specifiers, which all gradable adjectives (but no verbs) can select for.

Our approach to this discrepancy is to formulate the lexical rules deriving adjectival words so that they insert a specifier into the second position of the argument structure. On this view, an adjective lexeme like *happy* in (79) is mapped into the predicative word described in (80) (again with the effects of the Argument Realization Principle, WHSP and WH-amalgamation unified in):

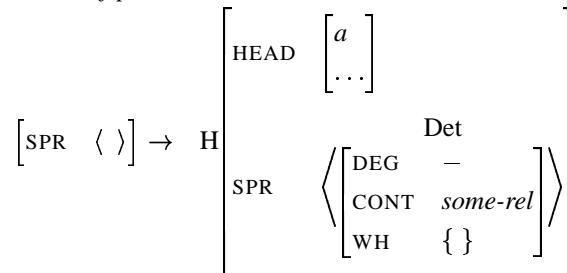
- (79)
$$\left[\begin{array}{l} a-lx \\ \text{PHON} \quad \langle \text{happy} \rangle \\ \text{SS|LOC|CAT|HEAD} \quad a \\ \text{ARG-ST} \quad \langle \text{NP} \rangle \end{array} \right]$$



Note that the predicative adjective in (80) shares its WH value with its second argument. This follows from the WHSP and WH-amalgamation ($\{ \} \cup \Sigma = \Sigma$). In addition, we have introduced a feature DEG for which degree determiners like *so*, *too*, and *how* are positively specified. Because of the agreement for DEG indicated in (80), an adjective will be [DEG +] whenever it combines with such a determiner.

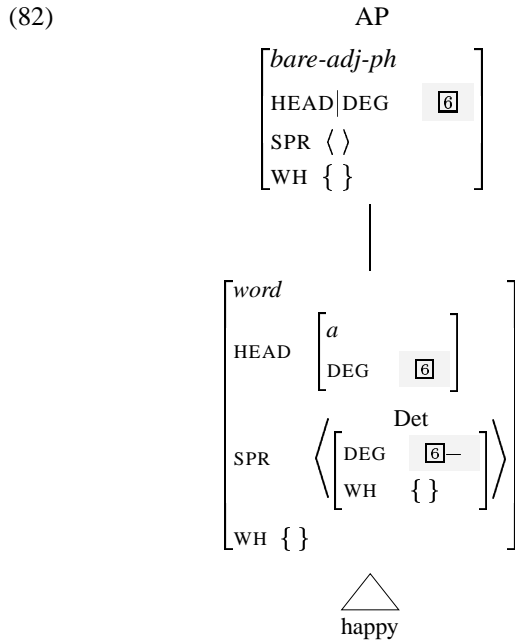
Although (gradable) adjectives and nouns do not always cooccur with an overt specifier, on our analysis their ARG-ST list always includes an appropriate degree phrase specifier. A non-branching construction, similar to that used for bare plural constructions, will sanction [SPR $\langle \rangle$] APs whose head daughter is [SPR $\langle \text{Det} \rangle$]:

(81) *bare-adj-ph*:



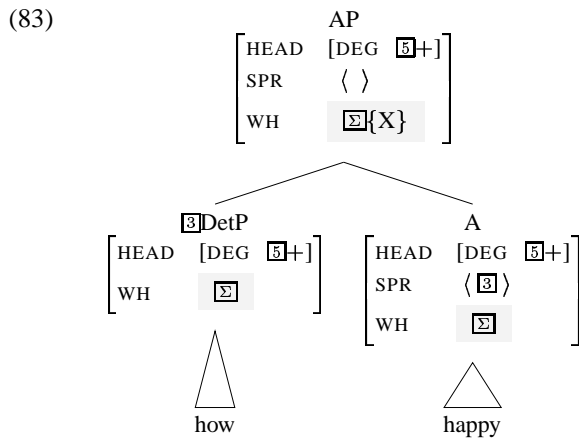
This construction provides the requisite existential interpretation for the unexpressed quantifier (lexically amalgamated by the adjectival head daughter). The sentence *Kim is tall* is assigned a content roughly paraphrasable as ‘there is a degree δ , sufficient in the relevant context, such that Kim is tall to degree δ ’.

This analysis provides an account of bare adjective phrases like the one sketched in (82).



The inheritance of DEG specifications shaded in (82) follows from the interaction of the DEG value identity specified in (80) and the GHFP.

Given that gradable adjectives always have a nonempty SPR value, obligatorily selecting a (degree) determiner as specifier, WH-amalgamation and the GHFP interact to provide an account of pied piping in APs like (83) as well.



This structure can be the filler daughter of a *wh*-interrogative or *wh*-exclamative clause. In the interrogative clause of (84a), the WH element X is a parameter; in the exclamative cases [(84b)], it is the quantifier unusual.

- (84) a. I wonder [[*how* happy] they really are _].
 b. [[*How* happy] they seem _]!

The structure for *too happy* is the same as (83), except that the WH value is { }, a consequence of the differing lexical WH-specification of the non-*wh*-degree word *too*. In addition, gradable adverbials like those in (85) allow all the same WH possibilities as gradable adjectives and may be given an analogous treatment.

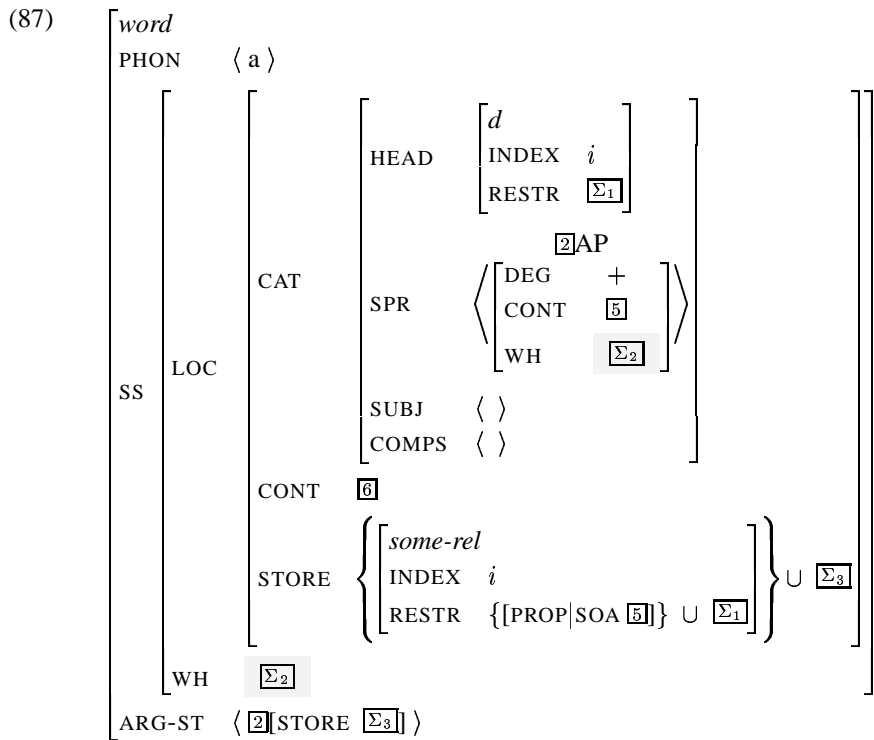
- (85) a. [[*How* quickly] can they get the job done _]?
 b. [[*How* quickly] they get the job done _]!
 c. [They got the job done [*too* quickly].]

Predeterminers

An AP like (83) can also serve as the specifier of the determiner *a* in examples like (86).²⁹

- (86) a. I wonder [[[*how* big] a risk] they really are/took _].
 b. They are/took [[*too* big] a risk].
 c. They are/took [[*such*] a risk].

To account for the complex phrases in examples like (86), we allow the determiner *a* to optionally select a gradable AP as its specifier. When this option is exercised, we derive (unifying in the Argument Realization Principle and the WH-Amalgamation Constraint once again) the constraints shown in (87):

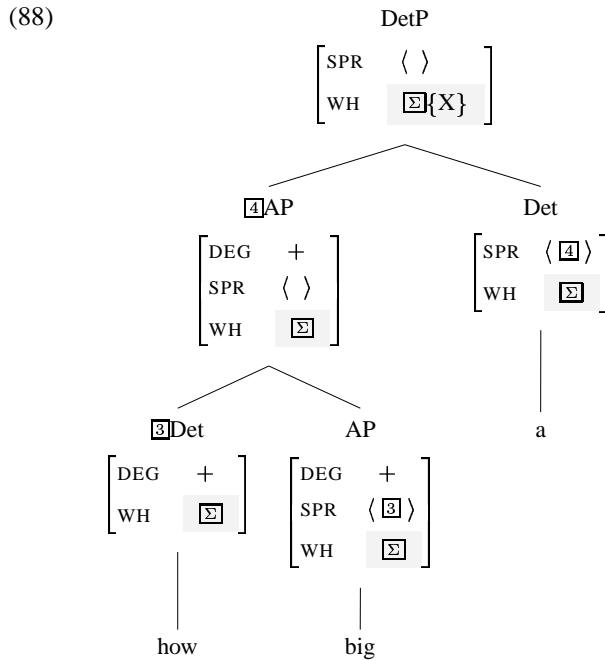


²⁹Steps must be taken to prevent such APs from appearing between the determiner and the noun:

- (i) *I wonder [[a [*how* big] risk] they really are/took _].
 (ii) *They are/took [a [*too* big] risk].
 (iii) *They are/took [a [*such*] risk].

A constraint on the prenominal adjective construction requiring the modifier daughter to be [DEG –] may well suffice for this purpose.

The STORE value of determiners and their inheritance in larger grammatical structures are discussed in the next section. Here, the important point to see is that the lexical entry in (87) allows *a* to combine with a [DEG +] AP as ‘predeterminer’, giving rise to determiner phrases like the following, where the AP *how big* functions as the specifier of *a*:



And this DetP can be selected as a specifier by a noun like *risk*, whose WH value is shared with the DetP in (88) (again by WH-amalgamation) and then passed up via the GHFP, producing an analysis of *how big a risk* as an NP whose WH value is either a parameter (in interrogative clauses) or the quantifier *unusual* (in exclamatives). A similar analysis is provided for *too big a risk*, except the shared WH value is { }. Note that exactly the same pattern of feature inheritance is true of *such a risk*, under the assumption that *such* leads a life as an appropriate specifier, lexically specified as [WH { }].

By treating predeterminers as AP specifiers selected by the determiner *a*, we make the further correct prediction that other determiners disallow such predeterminers. That is, we predict the impossibility of examples like (89).

- (89) a. *I wonder [[[[*how big*] some] eater] he is _].
 b. *We like [[[[*too big*] all] eaters].
 c. *[[[[*How big*] the] eater] he is _]!

This same distributional pattern appears to be true of *what*-exclamatives:

- (90) a. [[[[*What a*] fool] he is _]!
 b. [[*What* fools] they are _]!

On our analysis, this is because exclamative *what a* and its plural analog *what* uniformly function as the specifier of a nominal phrase. There is thus a fundamental asymmetry in the analysis

of exclamative *how*—the specifier of a specifier in *how big a...* and *what a*, which is simply lexicalized as a complex determiner.

VPs

Finally, let us turn to the matter of WH percolation in verb phrases. As the following data show, interrogative and exclamative pied piping is impossible in VPs:

- (91) a. *I wonder [[*who(m)* leaving] upset Sandy].
 b. *I wonder [[(Kim) talking to *who(m)*] upset Sandy].
 c. *I wonder [[to love *who(m)*] would please Sandy].
- (92) a. *It's amazing [[*what* a nice guy] leaving] Sandy was upset by __].
 b. *[[*What* a nice guy] leaving] Sandy was upset by __ !
 c. *[Talking to [*what* a nice guy]] Sandy was upset by __ !
 (cf. *What* a nice guy Sandy was upset by talking to __ !)

It already follows from our analysis that none of the indicated *wh*-words can be WH-specified, as each of them is either a subject, and hence required to be [WH { }] by the WHSP, or else a non-initial argument of a verbal lexeme, and hence [WH { }], according to the WHC. Hence it follows from WH-amalgamation that subject-selecting verbs are themselves all [WH { }]. And since verbs and the phrases they project are all [WH { }], it follows from WH-amalgamation that a complementizer like *that*, which selects an S as its only argument, must also be [WH { }], thus blocking pied piping in examples like (93).

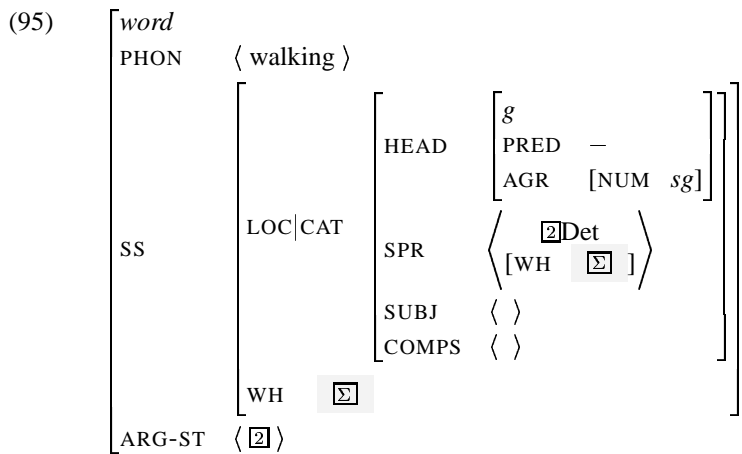
- (93) a. *I wonder [[that who left] upset Sandy].
 b. *I wonder [[that Kim loves *who(m)*] upset Sandy].

The only apparent exception to the pattern shown in (92) is verbal gerunds with possessive determiners, illustrated in (94).

- (94) a. I wonder [[whose leaving the room] upset Sandy].
 b. *I wonder [[my talking to *who(m)*] upset Sandy].
 c. *I wonder [[*who(m)* leaving the room] upset Sandy].
 d. *I wonder [[me talking to *who(m)*] upset Sandy].

As the contrast in (94) shows, when these gerunds take specifiers (typically possessors), they follow the same pattern as NPs, allowing pied piping of the specifier argument only. But when gerunds take NP[*acc*] subjects, they behave like other nonfinite verbal forms: they and all their arguments are [WH { }].

Our account of the contrasts in (94) builds on the analysis of verbal gerunds developed by Malouf (1998, 2000), who assigns verbal gerunds to a distinct part of speech, referred to earlier as *g*. Words assigned to this part of speech share properties with (and form a natural class with) both nouns and verbs. For example verbal gerunds, like nouns, identify their first ARG-ST member with the specifier that the gerund selects, as shown in (95):



Crucially, such words also obey the WH-Amalgamation Constraint (as indicated in (95)) and hence may take on the [WH {*param*}] specification of an appropriate determiner like *whose*. This is sufficient to predict that gerunds exhibit pied piping behavior analogous to nouns, i.e. to predict the grammaticality of examples like (94a).

But gerunds may also, like verbs, select a first argument via SUBJ, rather than SPR. In this case, gerunds obey the same constraints as other verbal forms. That is, because of the WHSP, the SUBJ value—corresponding to the subject *who(m)* in (94c) and *me* in (94d)—must be [WH { }]. Similarly, the object *who(m)* in (94d) must be [WH { }], according to the WHC. And finally (again by WH-amalgamation), the gerund, like all other verbal words, must itself be [WH { }]. For these reasons, there is no way for a subject-selecting verbal gerund to appear in a pied piping construction.

The analysis we have developed in this section provides a unified picture of phrases containing interrogative and exclamative *wh*-words. The filler daughter of a *wh*-construction must be WH-specified and the WH value of the filler phrase is identified with exactly one *wh*-word within it—the leftmost *wh*-word. Our theory of WH-specification ensures that all non-initial interrogative *wh*-words within a clause are [WH { }]. This fact enables us to predict certain restrictions on the interpretation of multiple *wh*-constructions and related constraints on the distribution of *the hell* modifiers, as detailed in the next chapter. It also provides the basis for distinguishing those *wh*-expressions that induce reprise interpretations, as explained in Chapter 7.

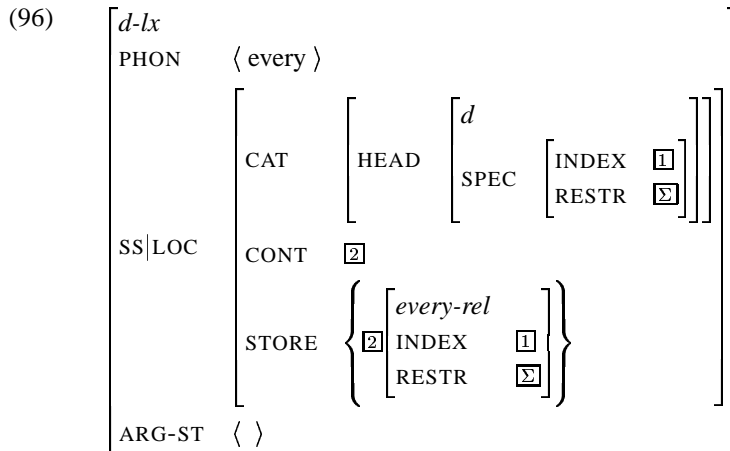
5.3 Quantifier Scope

The theory of quantifier scope presented in Chapter 8 of P&S–94 is based on the technique of quantifier storage pioneered by Cooper (1975, 1983). ‘Cooper storage’ is a method allowing a variable to go proxy for a quantifier’s contribution to the semantic content of a sentence, while the quantifier which binds that variable is placed in a ‘store’.³⁰ Stored quantifiers are gathered up and passed up to successively higher levels of structure until an appropriate scope assignment locus is reached—for example a clause (as in the version of Cooper storage developed by P&S–94). There, quantifier(s) may be retrieved from storage and integrated into the meaning, receiving a wide scope interpretation. Quantifier scoping is thus treated as a semantic unbounded

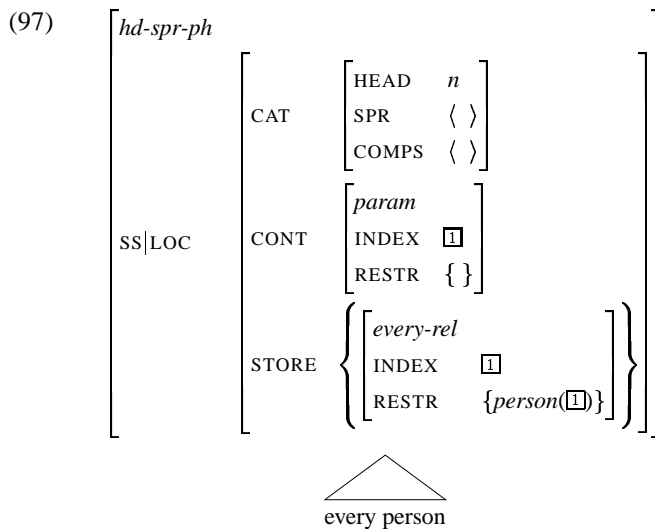
³⁰The highly procedural character of this discussion is entirely metaphorical, though hopefully intuitive. The effects of ‘storage’, ‘inheritance’ and ‘retrieval’ are all consequences of declarative constraints.

dependency, though many orthogonal factors obscure its fundamentally unbounded nature. Our version of storage is slightly different from the standard one. It incorporates the innovations we introduced in Chapters 3 and 4, including our generalization of storage to admit parameters as possible members of the set values of the feature STORE.

We may assume that a determiner like *every* introduces a generalized quantifier in its STORE value, as shown in (96):



This will serve as the specifier of a nominal element with which it combines (via a nominal *hd-spr* construction) to form an NP like (97):



Note that this NP has the indicated CONTENT and STORE values because the INDEX and RESTR of the stored quantifier in (96) are identified with those of the determiner's SPEC value, which in turn is identified with (the synsem of) the head daughter *person*.

This treatment incorporates many features of the analysis developed by Pollard and Yoo (1998), who modify the treatment of storage developed in P&S-94 in order to overcome a number of difficulties originally pointed out by Bob Carpenter in unpublished work. First, as shown in (97), they make STORE a feature of *local* objects, rather than a feature of the highest level

of grammatical structure—the *sign*, as P&S proposed. This revision has the consequence that stored quantifiers are identified within raising and extraction constructions. That is, the STORE value of the subject of *seems* in a nest of raising structures like (98) is also the STORE value of the (unexpressed) subjects of *to*, *be*, and the verb *approaching*.

(98) A unicorn [seems [to [be [approaching]]]].

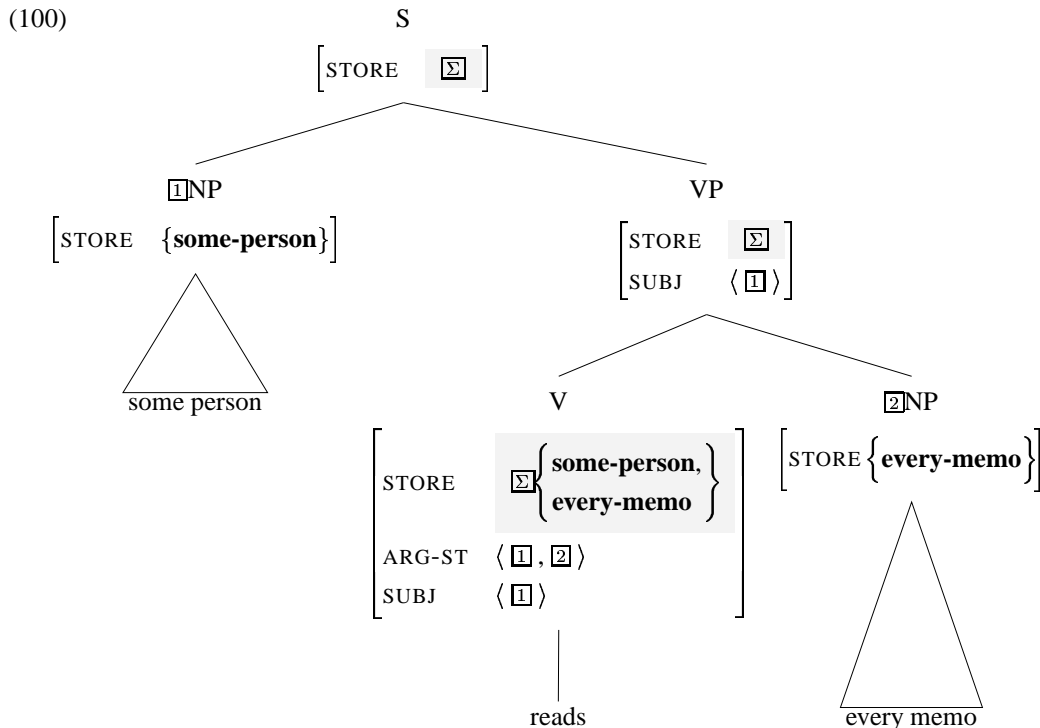
Thus if the NP *a unicorn* in (98) has an existential quantifier in its STORE, so does the SUBJ value of the lowest verb in (98)—the verb that assigns a semantic role to the index bound by that quantifier.

Pollard and Yoo also propose to change the way storage works, so that unscoped quantifiers are passed up to the mother in a headed structure not from all the daughters (as in Cooper’s account or in that of P&S), but only from the semantic head daughter (the adjunct-daughter, if there is one; the syntactic head daughter, otherwise). To achieve this, they constrain the STORE value of a verb, requiring that it be the set union of the STORE values of the verb’s ARG-ST members. We may adapt this proposal in terms of the Store Amalgamation Constraint formulated in (99).³¹

(99) Store Amalgamation Constraint (preliminary version):

$$word \Rightarrow / \left[\begin{array}{l} SS|LOC|STORE \ \Sigma_1 \cup \dots \cup \Sigma_n \\ ARG-ST \ \langle [STORE \ \Sigma_1], \dots, [STORE \ \Sigma_n] \rangle \end{array} \right]$$

On this approach, the STORE of the verb in (100) is nonempty and is passed up the tree (according to a store inheritance principle) from head daughter to mother as shown in (100):



³¹This proposal is somewhat more general than the one Pollard and Yoo actually propose, in that it applies to all words (by default).

Note that exactly the same amalgamation will allow common nouns to incorporate into their own STORE value the stored quantifiers of the determiner specifier that they select for:

$$(101) \left[\begin{array}{l} cn-lx \\ \text{PHON} \quad \langle \text{person} \rangle \\ \\ \text{SS|LOC} \quad \left[\begin{array}{l} \text{CAT} \quad \left[\begin{array}{l} \text{HEAD} \quad n \\ \text{SPR} \quad \langle [] \rangle \\ \text{COMPS} \quad \langle \rangle \end{array} \right] \\ \\ \text{CONT} \quad \left[\begin{array}{l} param \\ \text{INDEX} \quad \boxed{1} \\ \text{RESTR} \quad \{ person(\boxed{1}) \} \end{array} \right] \\ \\ \text{STORE} \quad \boxed{\Sigma} \end{array} \right] \\ \\ \text{ARG-ST} \quad \left\langle \begin{array}{l} \text{Det} \\ \left[\text{STORE} \quad \boxed{\Sigma} \right] \end{array} \right\rangle \end{array} \right]$$

Let us continue to ignore adjuncts for present purposes, considering only the case where the syntactic head and ‘semantic head’ are the same, as in a structure like (100). S-level retrieval of stored quantifiers is always in accordance with the constraint sketched in (102):

(102) Pollard/Yoo Quantifier Retrieval:

$$\left[\begin{array}{l} \text{QUANTS} \quad \boxed{A} \oplus \boxed{B} \\ \text{NUCL} \quad \boxed{5} \\ \text{STORE} \quad \boxed{\Sigma_2} \\ \text{RETRIEVED} \quad \boxed{A} = \text{order}(\boxed{\Sigma_1}) \end{array} \right]$$

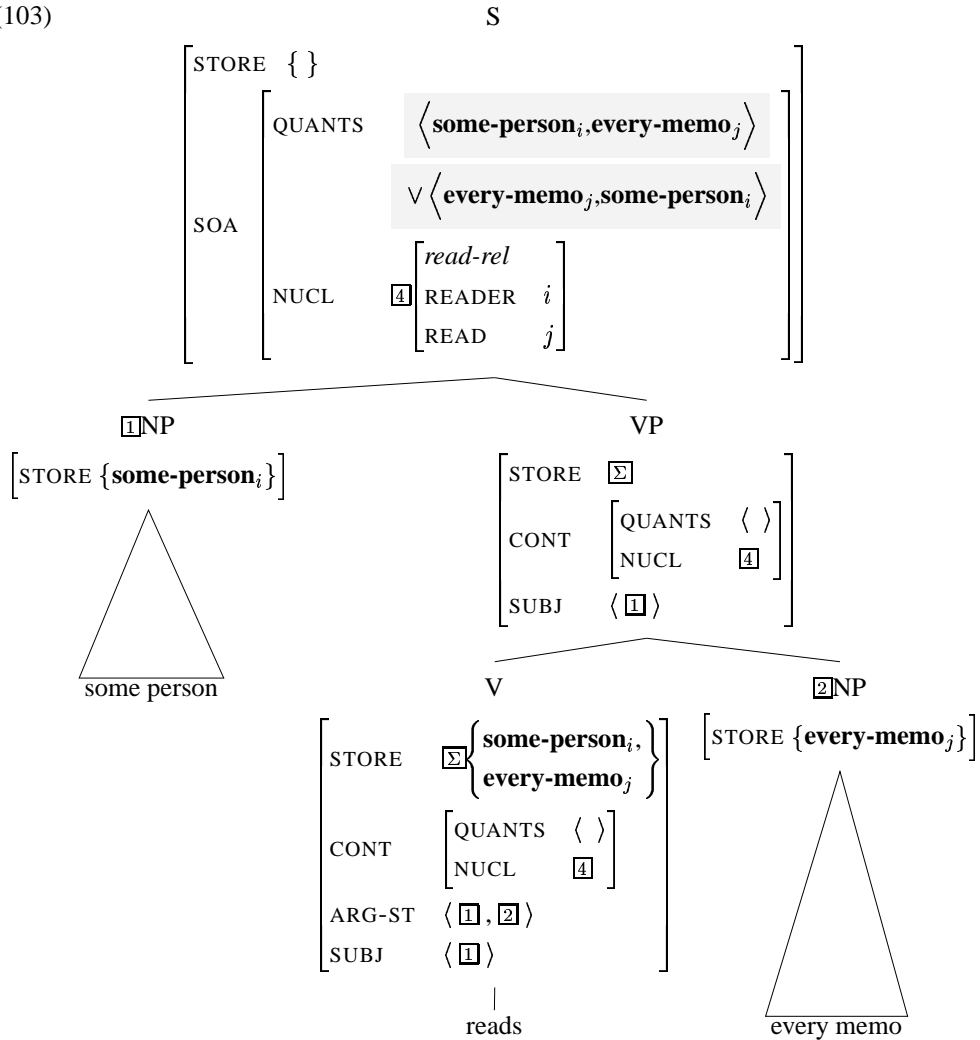
| HD-DTR

$$\left[\begin{array}{l} \text{QUANTS} \quad \boxed{B} \\ \text{NUCL} \quad \boxed{5} \\ \text{STORE} \quad \boxed{\Sigma_2} \uplus \boxed{\Sigma_1} \end{array} \right]$$

(102) says that the mother’s QUANTS value is a list differing from the head daughter’s QUANTS list (\boxed{B}) only in that a list of quantifiers (\boxed{A}) has been prepended to the latter. This preserves the daughter’s quantifiers in the meaning of the mother. Moreover, the list of additional quantifiers (the RETRIEVED value) must be an ordering of the set of quantifiers ($\boxed{\Sigma_1}$) that constitutes the difference between the head daughter’s STORE value and the mother’s STORE value ($\boxed{\Sigma_2}$). This ensures that the extra quantifiers in the mother’s meaning all come from the daughter’s STORE. In addition, it guarantees that any element removed from the daughter’s STORE is integrated into the mother’s meaning.

If we now reconsider the tree in (100) in light of the constraints on retrieval sketched in (102), we can see the possibility of S-level quantifier retrieval of the sort shown in (103):

(103)



This correctly allows for both possible scopings of (103). It also assigns to (98) a reading where the subject has narrow scope with respect to *seems*. This follows because STORE is part of the LOCAL value and the SUBJ value of *seems* (which includes the LOCAL value) is the SUBJ value of *to*, *be* and *approaching*.

There is a difficulty with this approach, however: it allows retrieval in too many places. That is, unless one adds further constraints, this system (like the one in P&S–94) produces multiple analyses of every available reading. For example, allowing both S and VP retrieval in structures like (103) produces each possible scoping in three different ways (each retrieval order at one node, or one quantifier retrieved at each node).

This problem is noted and addressed by Manning et al. (1999), who propose to eliminate the redundancy by making retrieval and scope assignment entirely lexical in nature. They state lexical constraints to the effect that a word’s QUANTS value is an ordering of some set of generalized quantifiers subtracted from the union of the STORE values of the verb’s arguments. (The feature

RETRIEVED is eliminated entirely.) A lexical head passes up in its STORE value whatever quantifiers from its arguments are not already scoped in that word's QUANTS value. These unscoped quantifiers are thus passed up into the STORE value of the phrase projected by the lexical head. At this point, they can be retrieved in the next higher syntactic domain.

This proposal assumes the following modified Store Amalgamation Constraint.³²

(104) Store Amalgamation Constraint (final version):

$$word \Rightarrow / \left[\begin{array}{l} SS|LOC \quad \left[\begin{array}{l} CONT \quad [QUANTS \quad order(\Sigma_0)] \\ STORE \quad (\Sigma_1 \cup \dots \cup \Sigma_n) \div \Sigma_0 \end{array} \right] \\ ARG-ST \quad \langle [STORE \Sigma_1], \dots, [STORE \Sigma_n] \rangle \end{array} \right]$$

Note that words whose ARG-ST list is empty override this constraint. Some such words (e.g. determiners, as described above) have a nonempty store; others (e.g. proper nouns) have an empty store. Words whose CONTENT value is not of type *soa* also override this constraint.

In consequence of the revision in (104), the lexical entry for *reads* is constrained as shown in (105).

$$(105) \left[\begin{array}{l} word \\ PHON \quad \langle reads \rangle \\ SS|LOC \quad \left[\begin{array}{l} STORE \quad (\Sigma_1 \cup \Sigma_2) \div \Sigma_0 \\ CONT \quad \left[\begin{array}{l} r-soa \\ QUANTS \quad order(\Sigma_0) \\ NUCL \quad \left[\begin{array}{l} read-rel \\ READER \quad i \\ READ \quad j \end{array} \right] \end{array} \right] \end{array} \right] \\ ARG-ST \quad \langle [STORE \Sigma_1], [STORE \Sigma_2] \rangle \end{array} \right]$$

Other aspects of the Pollard/Yoo theory remain unchanged, though we may in addition require of semantically vacuous (non role-assigning) elements—like *to*, *be*, and *do*—that their content be identified with the content of their non-subject complement. These elements continue to satisfy STORE-amalgamation, but they are prevented from subtracting out any quantifiers from their complement's STORE. Thus, a lexical head other than *to*, *be* and *do*, gets a chance to scope the quantifiers of its role-assigned arguments, and the quantifiers from those arguments that are not scoped remain in the verb's STORE to be passed up to higher levels of structure.³³ Finally, notice

³²We use the symbol ' \div ' to designate a relation of contained set difference that is identical to the familiar notion of set difference ($\Sigma_1 - \Sigma_2 =$ the set of all elements in Σ_1 that are not in Σ_2), except that $\Sigma_1 \div \Sigma_2$ is defined only if Σ_2 is a subset of Σ_1 .

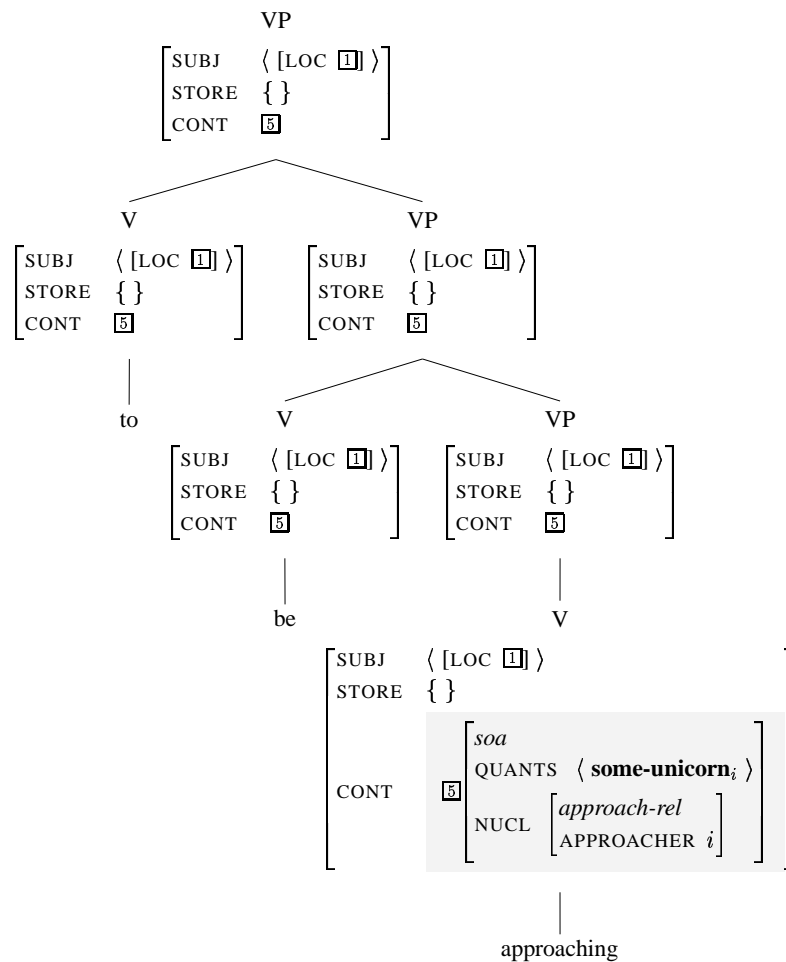
³³A caveat should be added here about raising verbs. Some steps must be taken to ensure that elements in the STORE of raised arguments, e.g. the subject argument of *seem*, do not enter into the semantics of a sentence twice. One could, following Przepiórkowski (1998), formulate a constraint requiring that quantifiers be amalgamated from all but the 'raised' argument of the verb (the one not assigned a semantic role by the raising predicate). In this way, quantifiers in the STORE of a raised argument would be amalgamated by the lowest predicate in a raising construction and could be scoped there or higher. The raising verb, because it does not amalgamate the stored quantifiers of the raised argument could never 'reintroduce' such quantifiers into the semantic analysis.

However, the stipulations involved in any such proposal seem unnecessary, once we introduce independently motivated

that the inheritance of STORE specifications from head daughter to mother is already accounted for by the GHFP. This is the last piece of our treatment that needs to be put into place.

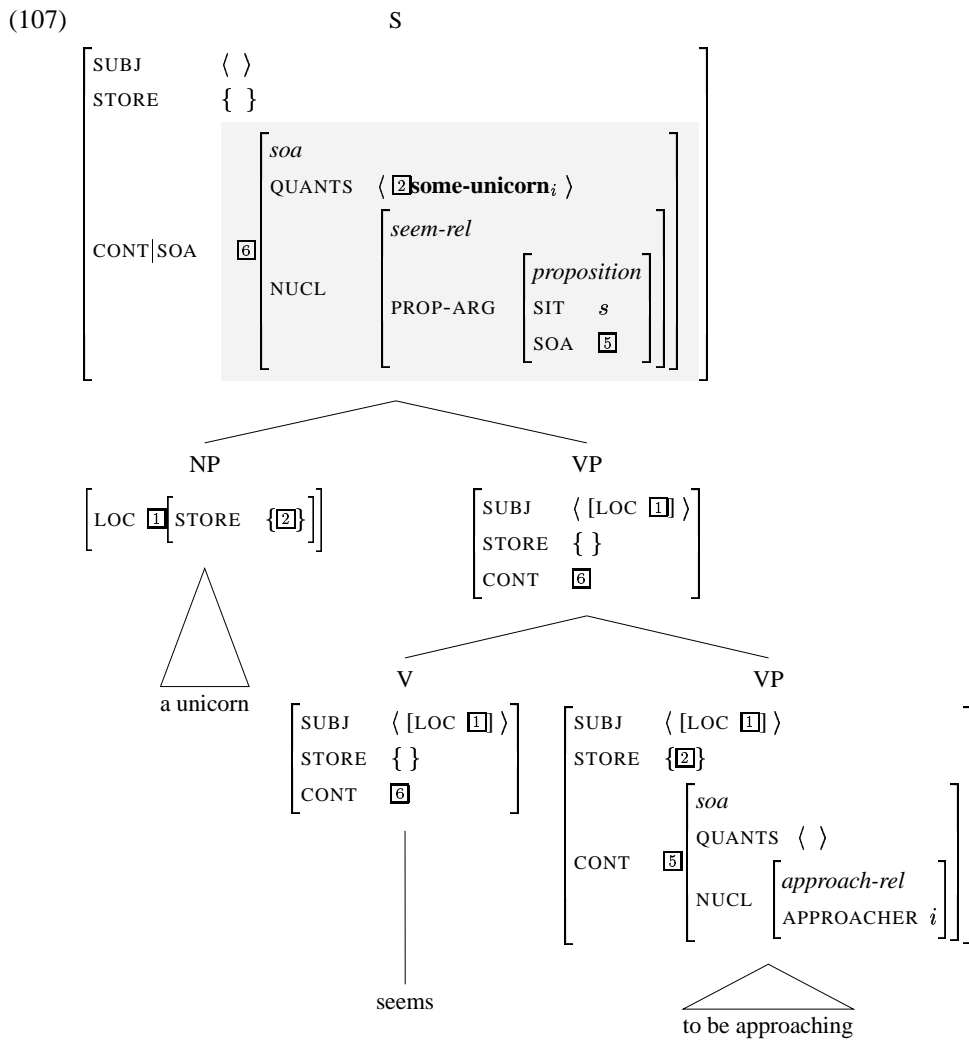
In our analysis, there are exactly as many scope assignment points in a sentence as there are role-assigning verbs (or other lexical heads with a *soa* as their semantic type). And since there is no structure-based retrieval of quantifiers, sentences like those we have just been considering have no spurious semantic derivations. The constraints that are part of the lexical entry of the word *reads* can simply be satisfied in two distinct ways, allowing the two scopal readings (corresponding to two distinct orderings of the quantifiers on the verb's QUANTS list). Note further that the modification of the Pollard/Yoo theory proposed by Manning et al. (1999) still guarantees the correct two readings for *A unicorn seems to be approaching*, either *seems* or *approaching* is allowed to assign scope to **some-unicorn**. The latter option is illustrated in (106):

(106)



modifications of our semantic analysis to take into account the resource-sensitive nature of quantification. One such proposal, which immediately explains the observed behavior of raised quantifiers, is the analysis in terms of ‘minimal recursion semantics’ introduced by Copestake et al. (2000). Under their proposal, quantifier scope is underspecified and a given quantifier can enter into the resolution of scope only once. Unfortunately, incorporating such a far-reaching (though otherwise harmonious) modification of our semantic analysis is beyond the scope of the present study. We must therefore leave this issue unresolved here.

The alternate scoping is illustrated in (107):³⁴



Given the nonquantificational treatment of interrogative *wh*-expressions justified in Chapter 4 and the requirement that all lexically scoped elements be generalized quantifiers (not parameters), it follows that ordinary quantifiers never outscope a *wh*-expression within a question. Hence, there is no need for 'structural' retrieval of ordinary quantifiers. In our analysis of *wh*-interrogatives, all and only ordinary quantifiers are lexically scoped.³⁵

³⁴Recall that raising verbs like *seems* must not amalgamate their 'raised' argument's (in this case the subject's) stored quantifiers.

³⁵For a distinct (but related) account of lexical scoping in which *wh*-expressions are treated as quantifiers, not as parameters, see Przepiórkowski 1998.

5.4 Context

Certain kinds of utterances have particular usage restrictions because they contain certain words or phrases (e.g. honorific pronouns or verb forms). In order to allow the appropriateness conditions associated with individual words and constructions to be passed up within linguistic structures, P&S–94 (p. 333) propose the following principle:

- (108) Principle of Contextual Consistency:
 The $\text{CONTEXT|BACKGROUND}$ value of a given phrase is the union of the $\text{CONTEXT|BACKGROUND}$ values of the daughters.

The idea here is that a given word, e.g. French *vous* ('you (sg.,polite)') or German *du* ('you (sg.,familiar)'), introduces appropriateness conditions that are inherited by the phrases that contain them and ultimately by entire utterances like those in (109).

- (109) a. Vous amusez vous, n'est-ce pas? "You are having fun, aren't you?" [appropriately uttered only to someone to whom politeness is owed]
 b. Bist du müde? "Are you tired?" [appropriately uttered only to someone with whom a certain intimacy is established]

As Wilcock (1999) observes, however, a certain uniformity is gained if the BACKGROUND value of a given head is defined to be the amalgamation of the BACKGROUND values of its arguments, just as we have proposed for the values of the features SLASH , WH and STORE . Integrating Wilcock's proposal into our analysis turns out to be straightforward. In fact, if we depart from P&S–94's analysis slightly and make BACKGROUND , like SLASH and WH , a non- LOCAL feature of *synsem* objects, then we may generalize the amalgamation of SLASH , WH and BACKGROUND as follows:³⁶

- (110) Non- LOCAL Amalgamation Constraint:
 For every non- LOCAL feature \mathbf{F} :
- $$\text{word} \Rightarrow / \left[\begin{array}{l} \text{SS|}\mathbf{F} \left[\Sigma_1 \right] \cup \dots \cup \left[\Sigma_n \right] \\ \text{ARG-ST} \left\langle \left[\mathbf{F} \left[\Sigma_1 \right] \right], \dots, \left[\mathbf{F} \left[\Sigma_n \right] \right] \right\rangle \end{array} \right]$$

Once we have a principle like (110), we have no need for P&S–94's Principle of Contextual Consistency or for Wilcock's proposed alternative constraint. The inheritance of BACKGROUND specifications (a set of facts), will be successively inherited from head daughter to mother within headed structures by the GHFP. Moreover, since the GHFP is a default constraint, we leave open the possibility that some construction might override the default, adding appropriateness conditions of its own to the set of pooled background conditions. In Chapter 7, we will treat certain uses of in-situ interrogatives in terms of a construction that does precisely this.

5.5 Summary

In this chapter we have outlined the basic treatment of three kinds of unbounded dependency: filler-gap (or extraction) dependencies, pied piping, and quantifier scoping. These dependencies are encoded via the features SLASH , WH , and REL , each of which is subject to particular constraints. However, the bulk of the analytic burden throughout this chapter has been carried by a

³⁶This proposal excludes STORE amalgamation from the proposed generalization. Note also that BACKGROUND has been removed from CONTEXT , which we take to be a *sign*-level feature (See Chapter 2).

single theoretical principle—the GHFP, which unifies the account of the inheritance of feature specifications. We believe that the analyses we have presented have the virtue of reconciling analytic generality and explanation with the need to scale up to matters of detail that are usually left undiscussed in the literature.