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English relative clause constructions[1]

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This paper sketches a grammar of English relative clause constructions (including infinitival and reduced relatives) based on the notions of construction type and type constraints. Generalizations about dependency relations and clausal functions are factored into distinct dimensions contributing constraints to specific construction types in a multiple inheritance type hierarchy. The grammar presented here provides an account of extraction, pied piping and relative clause 'stacking' without appeal to transformational operations, transderivational competition, or invisible ('empty') categories of any kind.

1. Introduction

Within the tradition of transformational grammar, it is commonplace to assess developments in the field as a progression from 'construction-specific rules' to 'general principles', where the most significant effort has been spent in developing specific conditions that syntactic derivations or representations must satisfy. This body of investigation, however, has been largely programmatic, focussing on the development of principles of diminishing precision (e.g. principles of 'Greed', 'Procrastinate' or 'Economy'; operations such as 'Move α' or 'Affect α'). The richness of language-specific constructions has yet to receive a precise or comprehensive 'principle-based' account.

For certain lexicalist frameworks, including categorial grammar of all kinds, those that stem from the tradition of Lambek calculus (e.g. Morrill

[1] I have presented subsets of the material in this paper in a number of places, including Stanford and Essex (1992), Columbus (1993), Copenhagen, Edinburgh and Utrecht (1994), Texas, San Diego, Tübingen, Groningen and Seoul (1995), and Saarbrücken and Marseille (1996). Its appearance is (alas) long overdue. I want to acknowledge a special debt to Carl Pollard for detailed discussions and critical comments on more than one version of the ideas presented here. Thanks also to Anne Abeillé, Bob Borsley, Gosse Bouma, Ann Copestake, Elisabet Engdahl, Dan Flickinger, Jonathan Ginzburg, Danièle Godard, Adele Goldberg, Tom Hukari, Bob Kasper, Andreas Kathol, Jongbok Kim, Tibor Kiss, Shalom Lappin, Bob Levine, Rob Malouf, Philip Miller, Tsuneko Nakazawa, John Nerbonne, Susanne Riehemann, and Tom Wasow for reactions to earlier presentations or drafts. Finally, I am particularly grateful to Bob Carpenter, Dick Hudson, Georgia Green, members of the 1996 Ohio State HPSG seminar, and two anonymous referees for providing detailed comments on an earlier version. The usual exculpations apply to all of these people.

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1994) or that of combinatory categorial grammar (Steedman (to appear)), the existence of diverse constructions in individual languages presents a particularly strong challenge: how can lexically-specified types and general combinatory principles be restricted to achieve construction-specific effects? Relative clauses such as those discussed here have not (to my knowledge) been fully analysed in any version of categorial grammar, though the problem they pose has been noted by David Dowty and by Bob Carpenter (in contributions to the Categorial Grammar electronic distribution list).

Within the generative tradition of 'constraint-based' (or 'unification-based') grammar, by contrast, there has been a significant convergence of work theorizing about grammatical constructions and their properties. Early work in HPSG (Flickinger, Pollard & Wasow 1985, Flickinger 1987, Pollard & Sag 1987) adapted multiple inheritance hierarchies, familiar from computational work on nonlinguistic problems, to the task of expressing cross-classifying generalizations about words. This same general approach has subsequently been applied in various ways to the grammar of phrases, both by Hudson in his work on word grammar (Hudson 1991) and by Fillmore, Kay and their collaborators in the development of the framework of construction grammar (see Koenig 1994, Koenig & Jurafsky 1994, Goldberg 1995 and Fillmore & Kay (to appear); see also Zwicky 1994 and Kathol 1995). All of these researchers have treated generalizations about constructions in terms of cross-classifying type hierarchies.

In this paper, I develop a treatment of the syntactic and semantic properties of English relative clause constructions very much in the spirit of this tradition. That is, the power of multiple inheritance hierarchies is exploited in ways analogous to the applications of such hierarchies to lexical structure. In particular, the proposal to treat familiar kinds of phrases in terms of multiple dimensions of classification preserves the 'X-Bar' theoretic generalizations of other work in HPSG, while at the same time accommodating the idiosyncracies of individual constructions. Multiple inheritance, along with a restricted use of defaults, allows a succinct way of encoding generalizations about phrases that eliminates unnecessary stipulation and which, in addition, may have significant implications for language learning (Green (ms.)).

The chart in (1) presents a rough overview of the kinds of English relative clauses to be treated here.[2]

(1) *Wh*-Relative Clauses:
- Subject *Wh*-Relatives:
  [[who] visited Kim]; [[whose mother] visited Kim]

[2] For more detailed overviews, see Quirk et al. (1985) or McCawley (1988).

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- Nonsubject *Wh*-Relatives:
  - Finite:
    [[who] Kim visited __]; [[whose mother] Kim visited __];
    [[for whose mother] Kim gave a party __]
  - Infinitival:
    [[in which] to live __];

Non-*Wh* Relative Clauses:

- Bare Relatives (*That*-less Relatives):
  [we visited __]
- *That*-Relatives:[3]
  [that we visited __]; [that left]
- Simple Infinitival Relatives:
  [for us to visit __]; [to visit __]; [to do the job]

Reduced Relative Clauses:

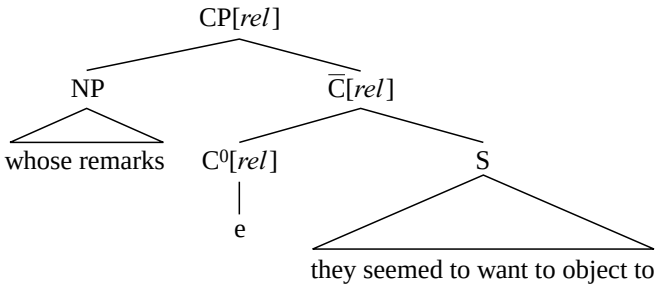
- standing in the doorway; hassled by the police; in the room

Although free relatives and (the distinction between restrictives and) appositives are left untreated, I believe the proposals set forth here can be naturally extended to include these types as well. A summary of the analyses discussed in this paper can be found in the four appendices.

2. A Question of Basic Structure

In the practice of Government Binding theory and its descendants, it is commonplace to assume that English relative clauses have the syntactic structure shown in (2), where the phrase is projected from an invisible C^0 that presumably passes up feature information that will distinguish relative CPs from other kinds of CP.

(2)



But these invisible elements, like others that are all too routinely assumed in modern syntactic discussions (X^0 traces, PRO, NP-trace, *wh*-traces), have at best GB-internal motivation. They are necessary, given various assumptions such as the Projection Principle, for the analysis of alternate verb

[3] *That*-relatives will be treated as *wh*-relatives in the analysis presented below.

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positions, raising, control and unbounded dependency constructions. These invisible constituents, however, can often be eliminated entirely in analyses of these same phenomena within CONSTRAINT-BASED LEXICALIST frameworks like HPSG, lexical-functional grammar (LFG), word grammar, categorial grammar or construction grammar.[4] Interestingly, the only kind of invisible constituent that has been assumed to have independent (i.e. theory-external) motivation is *wh*-trace, and this independent motivation has recently been called into question by Sag & Fodor (1994); see also Sag (in preparation).

Invisible complementizers, like *wh*-traces, have been widely assumed in the syntactic literature, but there have been (to my knowledge) no analogous attempts to offer independent justification for their existence. There is thus every reason to seek alternative analysis of the phenomena that they have been used to describe. This paper is an effort to provide a precise analysis of English relative clauses that makes no use of invisible C^0.

But if relative clauses are not projections of invisible C^0s, then what are they projections of (if anything)? Here, a cross-linguistic perspective may be revealing. There are many languages where the highest verb in a relative clause shows special morphology. Korean, for example, shows a contrast between the verb forms in (3) and (4).

(3) John-i chayk-ul ku sangca-ey neh-ess-ta.
John-NOM book-ACC that box-LOC put-PAST-DECL
'John put the book in the box.'

(4) [[John-i chayk-ul neh-un] sangca-ka] khu-ta.
John-NOM book-ACC put-REL box-NOM big-DECL
'The box in which John put the book is big.'

Interestingly, the pattern we find repeated in a number of the world's language families (strikingly in Bantu languages, for example) is that only the highest verb of a relative clause is morphologically distinguished. Thus in the equivalent of *The box [in which John said [they put the book]] is big*, only *said* would show distinctive relative morphology.

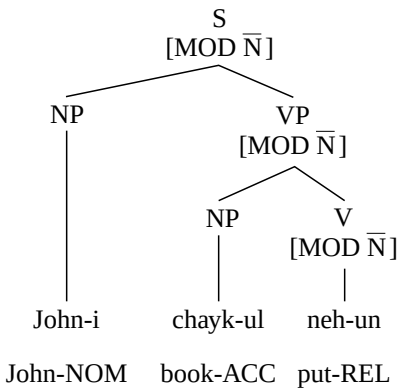
Facts like this can be analyzed straightforwardly if relative clauses are assigned a simple structure, where the highest verb, rather than a null relativizer, heads the clause. Under the further assumption (see Pollard & Sag (1994) [henceforth P&S-94]) that all modifiers bear a specification for the HEAD feature MOD, there is a natural way of predicting the existence of languages with morphological marking on the highest verb. In a relative (i.e. [MOD $\bar{N}$]) clause, $\bar{X}$ Theory (in particular the Head Feature Principle, central to all formulations of $\bar{X}$ Theory) will guarantee that the highest verb

[4] For framework overviews, see Pollard & Sag (1994) [HPSG], Bresnan (to appear) [LFG], Wood (1993) [categorial grammar], Hudson (1990) [word grammar] and Fillmore & Kay (to appear) [construction grammar].

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is the only one bearing the [MOD $\bar{N}$] specification relevant to the relative clause, as illustrated in (5).

(5)



On this view of relative clauses, the variation in verb forms in Korean (or Hausa) relatives are a simple consequence of the existence of particular morphological forms bearing a syntactic specification that is independently motivated for the analysis of other modifier phrases.

Alternative analyses are imaginable, including those that treat the relative suffix as a functional category (e.g. C^0). However, as argued at length by Kim (1994), such analyses fail to explain numerous facts that make sense under the assumption that inflected Korean verb forms like *neh-un* are syntactic atoms, constructed in the lexicon by independent principles governing the formation of Korean verb forms. Thus lexicalist assumptions of long standing about the autonomy of morphology and syntax (see, e.g. the Lexical Integrity Principle of Bresnan & Mchombo (1995)) lead to the conclusion that the structure in (5) is the right structure for the analysis of Korean relative clauses.

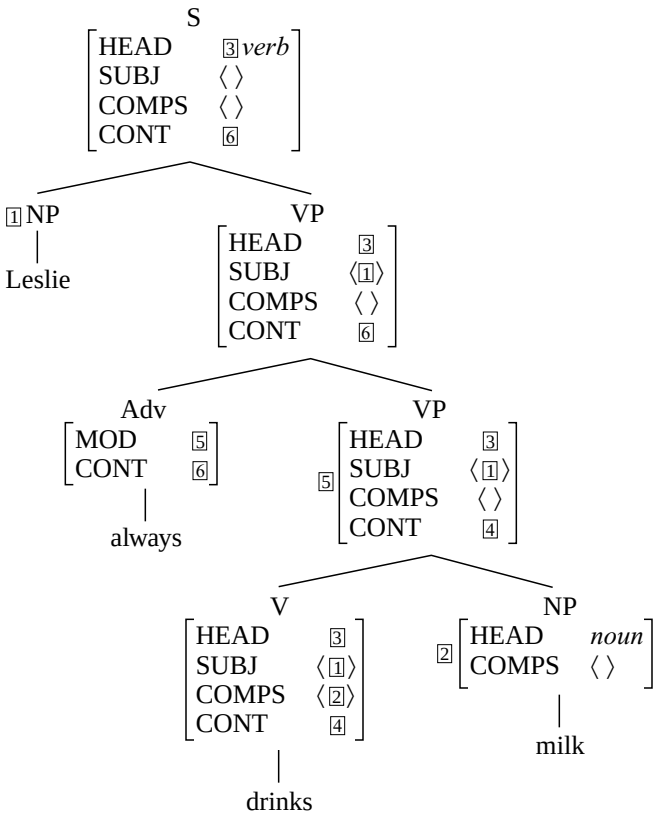
Of course English relative clauses lack the special relative morphology just illustrated for Korean, yet in other respects they exhibit parallel behavior. The present approach will have the virtue of treating English relatives in such a way as to allow this parallelism to be expressed, thus reducing cross-linguistic diversity in large part to lexical variation.

3. Feature Structures and Phrases

For expository purposes, HPSG is often presented in terms of the familiar trappings of generative grammar, where syntactic rules or schemata are formal devices that 'generate' word-terminated structures like (6):

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(6)



This tree illustrates many aspects of the HPSG analysis of English developed in P&S-94 (chapter 9). Each substructure of (6) corresponds to a type of phrase (*head-subject*, *head-adjunct*, or *head-complement*). Each of these phrases obeys the principles of HPSG theory, most importantly the Head Feature Principle and the Valence Principle. The Head Feature Principle identifies the HEAD value of any headed phrases with that of its head daughter and this is indicated in (6) by identical tags (boxed integers) on the HEAD values of the lowest VP and all the phrases that contain it. Likewise the Valence Principle requires that in each phrase the head daughter's relevant valence feature (here COMPS or SUBJ) specify an element that is identified with the appropriate non-head sister of the head daughter (list specifications are in angle brackets). A similar selection via the HEAD feature MOD guarantees that adjuncts (adverbs, certain prepositions, attributive adjectives, etc.) lexically select the kind of element they modify. Finally, the semantic content (CONT) of a phrase is identified with that of its adjunct daughter, if there is one, and with the content of the head daughter, otherwise.

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But this presentation of HPSG in terms of familiar phrase structure schemata is in fact just a convenient shorthand for a feature description of a particular kind. In HPSG, phrases are treated in essentially the same way as words, namely in terms of typed feature structures (directed graphs) that serve as models of utterance kinds. The fundamental utterance type recognized in HPSG is the *sign*, with its two immediate subtypes *word* and *phrase*. So, just as lexical entries are descriptions of (or constraints on) feature structures of type *word*, schemata are descriptions of feature structures of type *phrase*. The grammar of a language then is just the specification of its types and the constraints that govern those types, including the inventory of words that belong to the various lexical types.

There is nothing unfamiliar about thinking of words in terms of feature structures like (7).[5]

(7)
$$\begin{bmatrix} \textit{word} \\ \text{PHONOLOGY } \langle \text{drinks} \rangle \\ \text{SYNSEM} \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} \\ \text{VFORM } \textit{fin} \end{bmatrix} \\ \text{SUBJ} & \langle \text{NP}[\textit{nom, 3sing}]\boxed{1} \rangle \\ \text{COMPS} & \langle \text{NP}\boxed{2} \rangle \\ \text{CONT} & \begin{bmatrix} \textit{drink-rel(ation)} \\ \text{ACTOR} \quad \boxed{1} \\ \text{UNDERGOER} \quad \boxed{2} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

This is because words clearly specify complexes of phonological, syntactic and semantic information, organized according to a particular feature geometry.[6] Phrases, on the other hand, are not usually modelled in feature structure terms, for historical reasons having to do with the ubiquity of rewrite rules and phrase structure trees. The feature structure representation of the tree in (6) is something like (8).

[5] Readers familiar with HPSG should note that these diagrams are simplified in systematically omitting the features LOCAL and CATEGORY.

[6] *Synsem* objects (the syntactico-semantic complexes that serve as values of the feature SYNSEM) encapsulate precisely the information that heads can select for, and thus play a key role in the HPSG theory of locality, which unifies the account of subcategorization, case and role assignment, semantic selection, and head-dependent agreement. Very little of the information in (116) must be listed in the lexicon, in fact, as lexical types, type inheritance, and the theory of linking (Wechsler 1995, Davis 1996) allow complex lexical information such as that illustrated here to be deduced from the logic of the lexicon, rather than simply stipulated.

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(8)
$$\left[\begin{array}{ll}
\textit{hd-subj-ph} & \\
\text{PHON} & \langle \boxed{1}, \boxed{2}, \boxed{3}, \boxed{4} \rangle \\
\text{SYNSEM} & \text{S} \\
\text{NON-HD-DTRS} & \left\langle \left[\begin{array}{ll} \text{PHON} & \langle \boxed{1}\text{Leslie} \rangle \\ \text{SYNSEM} & \text{NP} \end{array}\right] \right\rangle \\
\text{HD-DTR} & \left[\begin{array}{ll}
\textit{hd-adjunct-ph} & \\
\text{PHON} & \langle \boxed{2}, \boxed{3}, \boxed{4} \rangle \\
\text{SYNSEM} & \text{VP} \\
\text{NON-HD-DTRS} & \left\langle \left[\begin{array}{ll} \text{PHON} & \langle \boxed{2}\text{always} \rangle \\ \text{SYNSEM} & \text{ADV} \end{array}\right] \right\rangle \\
\text{HD-DTR} & \left[\begin{array}{ll}
\textit{hd-comp-ph} & \\
\text{PHON} & \langle \boxed{3}, \boxed{4} \rangle \\
\text{SYNSEM} & \text{VP} \\
\text{HD-DTR} & \left[\begin{array}{l} \textit{word} \\ \text{PHON} \langle \boxed{3}\text{drinks} \rangle \end{array}\right] \\
\text{NON-HD-DTRS} & \left\langle \left[\begin{array}{ll} \text{PHON} & \langle \boxed{4}\text{milk} \rangle \\ \text{SYNSEM} & \text{NP} \end{array}\right] \right\rangle
\end{array}\right]
\end{array}\right]
\end{array}\right]$$

It may not be obvious that there is any significant difference between these two conceptions of linguistic structure. However, there are several potential advantages to this 'sign-based' approach to phrases over the more familiar alternative that makes phonology and semantics derivative of antecedently generated syntactic structures. First, the latter, tree-based conception of phrase structure is a special case of the sign-based approach – one that uses only concatenation to relate the PHON values of mother and daughters. But generalizing such operations to include wrapping[7] or other operations that permit interleaving (for example Reape's SEQUENCE UNION operation, Reape (1994, in press)) has proven to be an interesting and promising approach to the analysis of many problems of word order variation, extraposition, and coordination that have proved challenging for purely concatenative approaches.[8] Second, heads, subjects and complements play an explicit role in the theory, permitting the construction of hybrid structural-functional data structures that allow constraints about linear order, feature 'percolation', etc. to be stated in a simple and uniform way. Third, the bundling of syntactic, semantic and even contextual information into each SYNSEM value makes such information ubiquitous in phrase structure. This flexible access to contextual information is of considerable value, e.g. in the

[7] Various kinds of wrapping have been investigated. See Bach (1979) and Pollard (1984), inter alia.

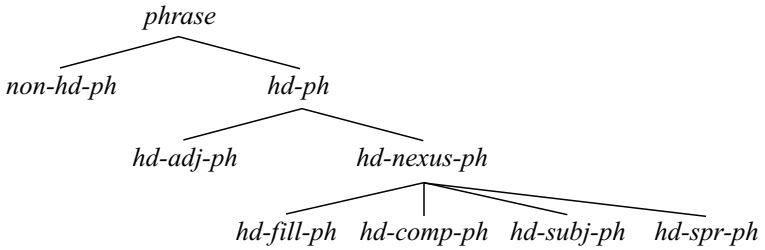
[8] See Reape (1994), Kathol & Levine (1992), and Kathol (1995), for example. These approaches all utilize unordered trees as 'tectostructure'.

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treatment of focus placement and focus inheritance, as demonstrated by Engdahl & Vallduví (1996), who exploit this crucially in explaining differences between the focus systems of, inter alia, English and Catalan. Finally, since the sign-based approach involves hierarchical classification of phrases, it is possible to encode previously unexpressible generalizations about phrasal signs using the same multiple inheritance techniques that have proven useful in the analysis of lexical signs. This last property of sign-based descriptions of phrase structure will play a central role in the treatment of English relative clauses.

It will be useful to assume that phrases in English and other languages can be classified according to the following hierarchy:

(9)



Thus phrases are classified as either *headed-phrase* (*hd-ph*) or *non-headed-phrase* (*non-hd-ph*), each type exhibiting a variety of subtypes. Among the headed phrases, a distinction is drawn between *head-adjunct-phrase* (*hd-adj-ph*) and *head-nexus-phrase*, the latter being broken down into the four subtypes *head-filler-phrase* (*hd-fill-ph*), *head-subject-phrase* (*hd-subj-ph*), *head-complement-phrase* (*hd-comp-ph*), and *head-specifier-phrase* (*hd-spr-ph*), as indicated. I make no use here of the type *hd-marker-ph*, although this may in fact be needed for the treatment of conjunctions.[9]

Just as in the case of the lexicon, phrasal types obey type-specific constraints. For example the Head Feature Principle can be formulated as a constraint on phrases of the type *hd-ph*:

(10) Head Feature Principle (HFP):

$$\textit{hd-ph} \Rightarrow \begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{HD-DTR} & [\text{HEAD } \boxed{1}] \end{bmatrix}$$

The Valence Principle, introduced in chapter 9 of P&S-94, can also be

[9] And following Warner (1993), there is no special type of phrase for inverted clauses, the relevant work being done instead by a lexical rule that applies to finite auxiliary verbs, allowing them to select their nominative NP dependent via the COMPS feature, rather than SUBJ. Inverted structures are thus instances of *hd-comp-ph* (despite the objections raised by P&S-94 (chapter 9), all of which can be avoided in the present system).

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formulated as a constraint on the type *hd-ph*, one that makes use of default values indicated by '/':[10]

(11) Valence Principle (VALP):

$$\textit{hd-ph} \Rightarrow \begin{bmatrix} \text{SUBJ} & /\boxed{1} \\ \text{SPR} & /\boxed{2} \\ \text{COMPS} & /\boxed{3} \\ \text{HD-DTR} & \begin{bmatrix} \text{SUBJ} & /\boxed{1} \\ \text{SPR} & /\boxed{2} \\ \text{COMPS} & /\boxed{3} \end{bmatrix} \end{bmatrix}$$

The effect of the VALP is to guarantee that a phrase's value for a valence feature will be identical to that of the phrase's head daughter, unless it is an instance of some more specific subtype of *hd-ph* that says otherwise.

We may assume one further default constraint on headed phrases, namely the following:

(12) Empty COMPS Constraint (ECC):

$$\textit{hd-ph} \Rightarrow \left[\text{HD-DTR} \ [\text{COMPS} /\langle\,\rangle]\right]$$

The effect of (12) is to guarantee that the head daughter of a headed phrase has 'already consumed' all complements, unless it is an instance of some subtype of *hd-ph* (such as the *hd-comp-ph*) that says otherwise, in which case the COMPS list of the head daughter may 'still' be nonempty.

We may thus sketch part of the grammar of English phrases in terms of the following type hierarchy and associated type constraints. Together, these function as an X-Bar Theory, but one that is based on degree of saturation defined in terms of valence features, rather than exponential categories defined in terms of bar levels.

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[10] I follow in the main the framework for default unification outlined in Lascarides et al. (1996). (117), it should be noted, bears a certain resemblance to the formulation of the HFP offered by Borsley (1993).

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(13) Phrasal types:

TYPE	CONSTRAINTS	ISA
phrase		*sign*
hd-ph	HFP, VALP, ECC	*phrase*
hd-nexus-ph	[CONT [1] HD-DTR [CONT [1]]]	*hd-ph*
hd-comp-ph	[COMPS ⟨ ⟩ HD-DTR [COMPS ⟨[1], … , [n]⟩] NON-HD-DTRS ⟨[SS [1]], …, [SS [n]]⟩]	*hd-nexus-ph*
hd-spr-ph	[SPR ⟨ ⟩ HD-DTR [SPR ⟨[1]⟩] NON-HD-DTRS ⟨[SYNSEM [1]]⟩]	*hd-nexus-ph*
hd-subj-ph	[SUBJ ⟨ ⟩ HD-DTR [SUBJ ⟨[1]⟩ SPR ⟨ ⟩] NON-HD-DTRS ⟨[SYNSEM [1]]⟩]	*hd-nexus-ph*
fin-hd-subj-ph	[HEAD [*verb* VFORM *fin*]]	*hd-subj-ph*
hd-adj-ph	(see sec. 7)	*hd-ph*

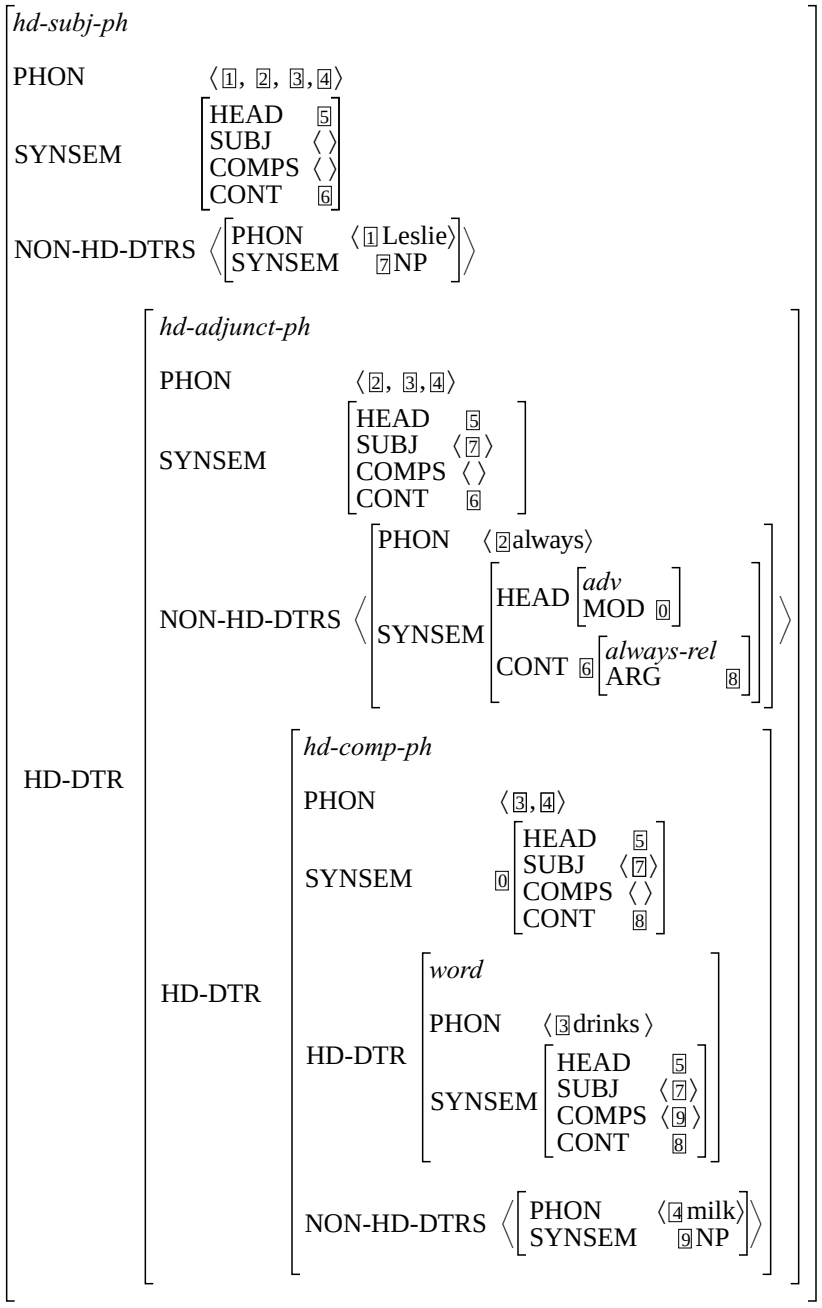
Note that each type in (13) is an immediate subtype of the phrase listed in its ISA ('is a') field. The ISA specifications are what make this a hierarchy. Phrases inherit constraints from all their supertypes, but if a default value is in conflict with a non-default specification, the latter 'wins'. Thus all headed phrases inherit the ECC, except for head-complement phrases, whose head daughter always has a nonempty COMPS list. Similarly, no cancellation from the head daughter's valence features happens unless sanctioned by the constraints specified for *hd-comp-ph*, *hd-subj-ph*, and *hd-spr-ph*, which override the default specified by the VALP. The HFP is a 'hard' constraint, inherited by all its subtypes, as are the two constraints indicated for *hd-nexus-ph* and *hd-adj-ph*, which identify the semantic content of the phrase with that of the appropriate daughter.[11] Here I restrict my attention to finite head-subject phrases, though a more fully developed theory of clause types must clearly also allow for several other subtypes of *hd-subj-ph*.

The constraints just spelled out interact to define the properties of phrases like (14).

[11] Of course, the relevant 'semantic head' of the phrase actually contributes further semantic content to its mother in virtue of identities that cause the content of other elements to be integrated. For example, because a verb's lexical entry assigns a semantic role to the index of its SUBJ value, the index of the subject NP *phrase* gets identified with the appropriate index in the semantics of the sentence. I am ignoring the issue of quantification here.

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(14)



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These feature structures differ from most previous work in HPSG in that nonbranching structure is eliminated throughout.[12] Thus a sentence like *Kim walks* on this approach contains a noun and a verb, but neither an NP nor a VP.

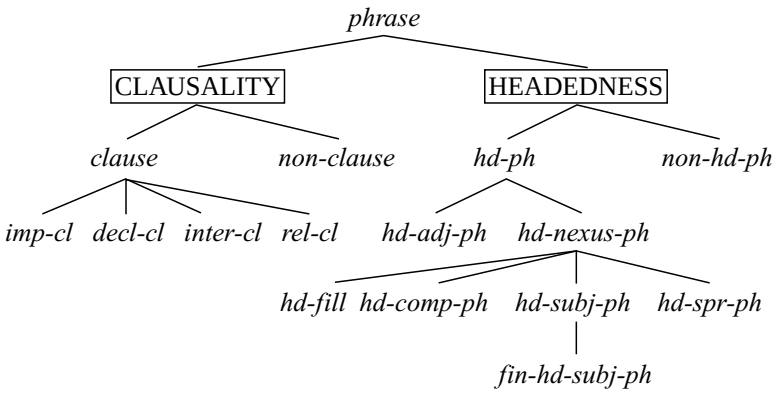
3.1 *Clause types*

There is little reason to doubt that the following sentences exhibit a single phrase structure, namely the one illustrated in (14):

(15) (a) Leslie always drinks milk. (declarative)
(b) {who, whose brother} always drinks milk (relative)
(c) {Who, Whose sister} always drinks milk? (interrogative)

This unity is captured by treating all of these phrases as instances of a common type, namely the type *hd-subj-ph* introduced above. To express the differences among the three types of phrase, I propose a further dimension of phrasal classification that will distinguish clauses from nonclauses, and in addition at least the following subtypes of the type *clause*: *decl*(*arative*)-*cl*(*ause*), *inter*(*rogative*)-*cl*(*ause*), *imp*(*erative*)-*cl*(*ause*) and *rel*(*ative*)-*cl*(*ause*). This multidimensional organization of phrasal types is sketched in (16):

(16)



Each type of phrase is thus cross-classified. That is, individual phrase types inherit both from a CLAUSALITY type and a type of HEADEDNESS. This mode of analysis lets us express generalizations about phrases in just the same way as in research on hierarchical lexicons. The phrasal multiple inheritance hierarchy also makes it possible to eliminate invisible C^0s (see section 2), whose work will be done by type constraints associated with the various clausal subtypes.

[12] Here I neglect issues of linear ordering (v. Pollard & Sag (1987: chap. 7) and Kathol (1995)), whose analysis is affected by the decision not to 'pump' words into nonbranching phrases. Also not discussed here is the lexical analysis of adverbials, which is what determines how the modified element in (14) enters into the adverb's semantic content.

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The subtypes of *clause* may be individuated as follows:

(17) Clause types:

TYPE	CONSTRAINTS	ISA
decl-cl	[CONTENT *proposition*]	*clause*
inter-cl	[CONTENT *question*]	*clause*
imp-cl	[CONTENT *directive*]	*clause*
rel-cl	[HEAD [MC –, INV –, MOD [HEAD *noun*]], CONTENT *proposition*]	*clause*

Here it is assumed that semantic theory will distinguish among kinds of messages, as indicated. I suspect that these types, named so as to respect the form/content distinctions urged by Quirk et al. (1985), may be universal. The feature MC (MAIN-CLAUSE) is taken from Uszkoreit (1987); the [MC –] constraint is intended to ensure that relative clauses are not main clauses, and hence have no status as independent utterances. [MOD [HEAD *noun*]] ensures that any relative clause introduced into a head-adjunct phrase will modify a nominal head daughter (see section 7). Finally, [INV –] imposes the language-particular constraint that relative clauses never exhibit inverted word order.[13]

It is intended that the various constraints sketched here interact in such a way that each basic-level phrase type (i.e. each phrase type that has no subtypes) will have associated with it a set of hard constraints. The theory of phrases is thus essentially monotonic in nature.

4. Two Kinds of Unbounded Dependencies

There are two kinds of unbounded dependencies that are relevant to the grammar of relative clauses: those between fillers and gaps ('extraction' dependencies) and those involving relative pronouns whose presence (at arbitrary depth of embedding) is mandated in a particular kind of relative construction ('Pied Piping' effects). Before proceeding, we must consider how each phenomenon is to be treated. P&S-94 (chapter 4) provide a uniform, but somewhat cumbersome characterization of NONLOCAL feature inheritance in terms of the features INHERIT and TO-BIND and their NONLOCAL Feature Principle. Under the present proposal, these two attributes are eliminated and the NONLOCAL Feature Principle is discussed

[13] Clauses are specified as [MOD/*none*]; nonrelative clauses thus do not modify. On the feature INV, see Gazdar et al. (1982) and Green & Morgan (1996).

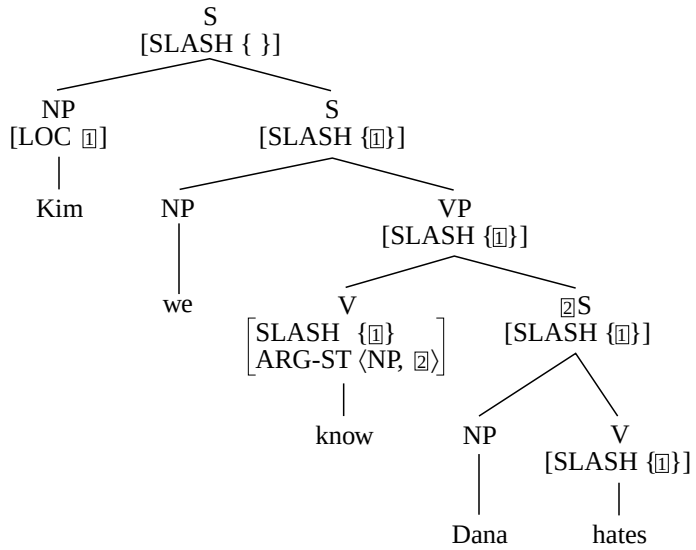
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in terms of two distinct constraints – one governing extraction; the other governining 'pied piping'.[14]

4.1 *Extraction*

HPSG analyses of extraction, building on earlier work in GPSG, involve feature specifications for the feature SLASH that are projected upward in a syntactic structure, as shown in (18).[15]

(18)



Extraction is thus treated entirely in terms of the inheritance of SLASH specifications, with 'binding off' of the SLASH specification occurring at an appropriate point *higher* in the structure.

For present purposes, any SLASH-based analysis of extraction would suffice. Here I will assume [see Sag (in preparation)] that words are subject to a constraint that defines their SLASH value in terms of the SLASH values of their arguments, that is, the SLASH values of the members of their ARGUMENT-STRUCTURE (ARG-ST) list. English words amalgamate the SLASH values of all their arguments, obeying a constraint that may be stated as in (19).[16]

---

[14] I leave open the possibility of collapsing these into a single principle.

[15] The use of the feature ARG-ST will be explained directly. Henceforth I will render phrase descriptions in familiar tree notation. The reader should bear in mind however, that the sign-based nature of phrases is essential to the theory of phrasal types as it is developed here.

[16] $\uplus$ designates disjoint set union, which is like familiar set union, except that its result is undefined if its set arguments are not disjoint.

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(19) Lexical Amalgamation of SLASH:

$$word \Rightarrow \begin{bmatrix} \text{ARG-ST} & \langle [\text{SLASH } \boxed{1}], \ldots, [\text{SLASH } \boxed{n}] \rangle \\ \text{SLASH} & (\boxed{1} \cup \ldots \cup \boxed{n}) - 0 \ \square \\ \text{BIND} & \boxed{0} \end{bmatrix}$$

Only SLASH-binding elements like *tough* specify a nonempty value for BIND. For all other words, nothing is subtracted from the disjoint union of the arguments' SLASH values (i.e. for all other words, $\boxed{0}$ in (19) is the empty set). In this way, if a a verb's complement is 'slashed', the verb itself is slashed (so the verb *know* becomes slashed in (18)), allowing us to simplify the statement of the inheritance of SLASH specifications in terms of the following constraint on head-nexus phrases.

(20) SLASH Inheritance Principle (SLIP):

$$hd\text{-}nexus\text{-}ph \Rightarrow \begin{bmatrix} \text{SLASH} & /\boxed{1} \\ \text{HD-DTR} & [\text{SLASH } /\boxed{1}] \end{bmatrix}$$

SLIP, like VALP and ECC, is a defeasible constraint that is obeyed by all the types of head-nexus phrase considered thus far. It guarantees that (except in SLASH-binding contexts that we turn to in a moment) the SLASH value of a phrase is the SLASH value of its head-daughter. Note that in this analysis, a subject daughter, complement daughter, etc. never passes its SLASH value to its mother. Any SLASH inheritance that appears to be an instance of such 'passing', is in fact mediated by the head daughter, whose SLASH value contains that of the relevant non-head daughter.[17]

The slashed elements that occur at the bottom of an extraction dependency are derived by a lexical rule that differs from earlier formulations. Since basic lexemes already obey the amalgamation constraint on their SLASH value, the role of the Complement Extraction Lexical Rule is to remove a complement and assign the corresponding ARG-ST element to the type *gap*(*-synsem*).[18] A *synsem* element of type *gap* is subject to the further constraint that identifies its LOCAL value with the single member of its SLASH set:

(21) $$gap\text{-}synsem \Rightarrow \begin{bmatrix} \text{LOCAL} & \boxed{1} \\ \text{SLASH} & \{\boxed{1}\} \end{bmatrix}$$

[17] In head-adjunct phrases, SLASH is inherited from the nonhead-daughter, whose lexical head in fact is constrained so as to incorporate any element present in the SLASH set of its MOD value, thus amalgamating the SLASH information of the phrase modified by the adjunct. For further discussion, see Sag (in preparation).

[18] This is crucially distinct from the type *canonical-synsem*, which is the *synsem* subtype associated with all overt expressions (i.e. with all signs – see the appendix).

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Thus the Complement Extraction Lexical Rule, somewhat surprisingly, has no need to make explicit reference to the verb's SLASH value and can be stated simply as in (22):[19]

(22) Complement Extraction Lexical Rule (CELR):

$$\begin{bmatrix} word \\ \text{COMPS } \boxed{1} \bigcirc \langle gap \rangle \end{bmatrix} \mapsto [\text{COMPS } \boxed{1}]$$

The rule in (22) has the side effect of identifying one member of the ARG-ST of the rule output as being of type *gap*.[20] Since elements of this type must obey the constraint in (21), it follows that they have a non-empty SLASH value that will be amalgamated into the rule output's SLASH value. CELR will thus operate as illustrated in (23). ('/' here abbreviates SLASH.)

(23)

$$\text{hates}_1 \begin{bmatrix} \text{SUBJ} & \langle \boxed{1}\text{NP}_{3sing} \rangle \\ \text{COMPS} & \langle \boxed{2} \rangle \\ \text{ARG-ST} & \langle \boxed{1}/\boxed{4}, \boxed{2}/\boxed{5} \rangle \\ \text{SLASH} & \boxed{4} \uplus \boxed{5} \end{bmatrix} \mapsto \text{hates}_2 \begin{bmatrix} \text{SUBJ} & \langle \boxed{1}\text{NP}_{3sing} \rangle \\ \text{COMPS} & \langle\ \rangle \\ \text{ARG-ST} & \left\langle \boxed{1}/\boxed{4}, \begin{bmatrix} gap \\ \text{LOC} \quad \boxed{3} \\ \text{SLASH } \{\boxed{3}\} \end{bmatrix} \right\rangle \\ \text{SLASH} & \boxed{4} \uplus \{\boxed{3}\} \end{bmatrix}$$

In this CELR output, the LOCAL value tagged 3 contains all the local information about the verb's direct object NP (the second member of the verb's ARG-ST), including category, case, content, and agreement information. A CELR output thus appears only at the bottom of an extraction dependency.[21]

---

[19] See Sag (in preparation). Here ○ designates the 'sequence union' or 'shuffle' operation employed by Reape (1994) and Kathol (1995). Its effect is to constrain the COMPS list of the input to contain exactly one more member (the element further identified as *gap*) than the COMPS list of the output. Note that all feature specifications of the input's SYNSEM value are preserved in the rule output, except for those specifications that are explicitly made in the right hand side of the rule. I am making the crucial assumption that lexical rules are to be formalized as relations between linguistic objects, i.e. I am adopting the 'description-level' view of such rules, rather than the 'meta-level' view. See Meurers (1995) for discussion.

[20] Note that this rule does not require that the 'input' have a complement that is 'already' specified as a *gap*. Rather, it 'applies' to an item whose COMPS list contains an element compatible with that specification, in the process rendering the corresponding ARG-ST element in the input of type *gap*, and hence, by preservation of unchanged information, the relevant ARG-ST member of the rule output is also of type *gap*.

[21] This presentation is simplified in that it does not allow for parasitic gaps. The formulation of SLASH amalgamation in the text is inconsistent with the analysis of parasitic gaps

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4.2 *Pied Piping*

In HPSG, pied piping is a matter of the inheritance of nonempty specifications for the features REL or QUE, triggered by the presence of a *wh*-relative or *wh*-interrogative word within a given phrase. First consider the relative clauses in (24) and their interrogative counterparts in (25).

(24) (a) the book [[WHICH/WHAT] inspired them]
(b) the person [[WHOSE mother] died]
(c) the person [[WHOSE mother's dog] died]
(d) the person [[WHOSE mother's dog] we were all fond of]
(e) the person [[to WHOM] they dedicated the building]

(25) (a) I wonder [[WHAT] inspired them]
(b) I wonder [[WHOSE mother] died]
(c) I wonder [[WHOSE mother's dog] died]
(d) I wonder [[WHOSE mother's dog] we were all fond of]
(e) I wonder [[to WHOM] they dedicated the building]

The grammar of *wh*-relative and *wh*-interrogative clauses requires an initial constituent (as indicated in brackets) that contains an appropriate *wh*-word somewhere within.

The basic treatment of pied piping is very simple. The relative and interrogative words are distinguished from other words in that they bear nonempty specifications for the features REL and QUE, respectively. Following P&S-94, REL takes a set of (referential) indices as its value, and QUE takes a set of restricted parameters, as illustrated in (26).

(26) (a) who (relative): (b) what (interrogative):

$$\begin{bmatrix} \text{CAT} & \text{NP} \\ \text{CONT} & [\text{INDEX } \boxed{3}] \\ \text{REL} & \{\boxed{3}\} \\ \text{QUE} & \{\,\} \end{bmatrix} \qquad \begin{bmatrix} \text{CAT} & \text{NP} \\ \text{CONT} & \boxed{1}\ \text{x} \mid \textit{thing}\ (\text{x}) \\ \text{REL} & \{\,\} \\ \text{QUE} & \{(\boxed{1})\} \end{bmatrix}$$

In English, both REL and QUE values are maximally singleton.

---

presented in P&S-94 (chapter 4). The latter analysis could be integrated with the amalgamation analysis by changing disjoint union to be familiar set union (to allow two arguments to share a single SLASH value) and adding the equivalent of Pollard and Sag's 'Subject Condition'.

Influenced by the generalizations about parasitic gaps isolated by Postal (1994) [building on observations made in Cinque (1990)], I am assuming here that parasitic gaps should not be treated in this way, but rather should be treated in terms of two arguments whose SLASH values contain distinct, but coindexed NP elements.

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Nonempty REL and QUE specifications are passed up from the *wh*-words – via the heads that select them – to the phrases that directly dominate them and from these to successively larger constituents such as those bracketed in (24) and (25). At the top level of the relative or interrogative clause, then, the grammar can simply impose the requirement that the nonhead daughter have a nonempty REL or QUE specification (e.g. that it be specified as [REL {*index*}]), and this will be sufficient to guarantee that the nonhead daughter contains an appropriate *wh*-word somewhere within it.

Words will mediate this 'feature passing'. To this end, a word's value for REL is constrained to be the disjoint set union of the REL values of its arguments, as shown in (27).[22]

(27) picture: $\begin{bmatrix} \text{HEAD} & \textit{noun} \\ \text{ARG-ST} & \langle \boxed{1}[\text{REL } \boxed{3}], \boxed{2}[\text{REL } \boxed{4}] \rangle \\ \text{SPR} & \langle \boxed{1} \rangle \\ \text{COMPS} & \langle (\boxed{2}\text{PP}[\textit{of}\ ]) \rangle \\ \text{REL} & \boxed{3} \cup \boxed{4} \end{bmatrix}$

It is this amalgamation that will allow a noun like *picture* (in *whose picture of Kim* or *Kim's picture of whom*) to project upwards the REL specifications of one of its dependents.[23]

The inheritance of REL and QUE is governed by the following constraint on the type *hd-nexus-ph*:

(28) *Wh*-Inheritance Principle (WHIP):

$$\textit{hd-nexus-ph} \Rightarrow \begin{bmatrix} \text{REL} & /\boxed{1} \\ \text{QUE} & /\boxed{2} \\ \text{HEAD-DTR} & \begin{bmatrix} \text{REL} & /\boxed{1} \\ \text{QUE} & /\boxed{2} \end{bmatrix} \end{bmatrix}$$

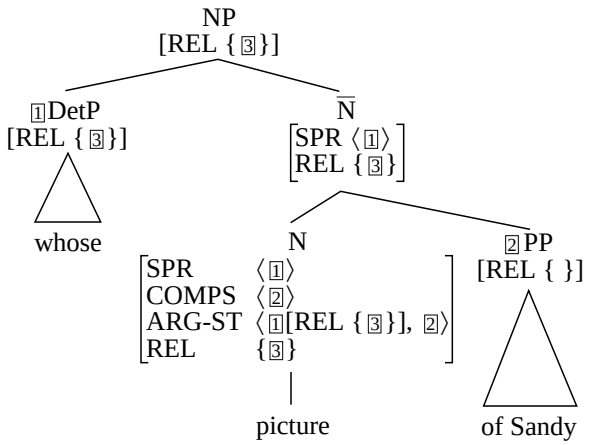
Lexical amalgamation of REL and (28) interact to ensure the feature propagation sketched in (29).

[22] Note that this lexical entry also obeys the constraint requiring that the values of the valence features SUBJ, SPR and COMPS 'add up' to the ARG-ST list, a constraint that holds in general for basic lexemes, though not for words that result from application of certain lexical rules, for example the CELR.

[23] REL values in English (but not universally; see P&S-94 (chapter 5)) are constrained to be at most singleton (this is entailed by the analysis of section 6.) In consequence of this constraint, the use of nonvacuous set union has the effect of allowing only one of the arguments of the noun in (117) to bear a nonempty REL specification, thus blocking examples like *the king [whose reign of whose kingdom]*.... Of course, some varieties of English do allow such examples (Kayne 1983, Sells 1985). For these varieties, a constraint in terms of familiar set union appears to be appropriate.

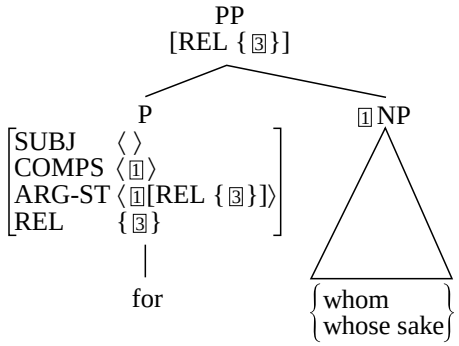
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(29)



Example (30) illustrates a similar constraint interaction.

(30)



We also correctly predict that the *wh*-word can be arbitrarily deep within the nonhead daughter in examples like those in (31).

(31) (a) Give me the phone number of the person [[WHOSE mother's friend's sister's dog's … appearance] had offended the audience].
(b) This is the senator [[to WHOSE mother's friend's sister's … favorite charity] the lobbyist had donated a small fortune].

The nonempty REL value of the possessor phase *whose* is collected by the noun *mother*, and then passed up by the WHIP to the possessor phrase *whose mother's*, where it is collected by the next higher noun, and so forth. This 'head-driven' approach to the inheritance of nonlocal feature specifications simplifies the inventory of features and the statement of the relevant constraints.

Finally, it should be noted that verbs amalgamate the REL values of their arguments in just the same way as nouns. This is particularly important in the analysis of gerunds (see Malouf 1996), which allow pied piping, but

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crucially only when they project a non-clause and hence take a possessive phrase as specifier. This is illustrated by the following contrasts:

(32) (a) My uncle from Iowa, [whose/*whom talking to Sandy yesterday was quite unexpected], ...
(b) My uncle from Iowa, [Sandy*('s) talking to whom yesterday was quite unexpected], ...

5. *Wh*-Relatives

5.1 *General constraints*

All *wh*-relative clauses are instances of the type *wh-rel-cl*, which is a subtype of the type *rel-cl* (see above). From that type, *wh*-relatives inherit constraints requiring them to be [MC –] and [INV –], but in addition, they are subject to the constraint in (33).

(33) $$\textit{wh-rel-cl} \Rightarrow \begin{bmatrix} \text{HEAD} & [\text{MOD NP}_{\boxed{1}}] \\ \text{NON-HD-DTRS} & \langle [\text{REL } \{\boxed{1}\}] \rangle \end{bmatrix}$$

This constraint just says that the non-head daughter of a *wh*-relative must have a REL value containing exactly one index – the same index as the relative clause's MOD value.[24] And because that MOD value is further identified with the nominal phrase that the relative will modify, it follows from the constraint in (33) and the theory of pied piping sketched in the previous section that the *wh*-word occurring in the non-head daughter must be coindexed with the nominal that the relative clause modifies.

There is one further set of constraints that *wh*-relative clauses inherit. These are the general constraints governing all clauses shown in (34):

(34) $$\textit{clause} \Rightarrow \begin{bmatrix} \text{SUBJ} & \text{list}(\textit{PRO}) \\ \text{HEAD} & [\text{MOD } /\textit{none}] \\ \text{REL} & \{\,\} \\ \text{QUE} & \{\,\} \end{bmatrix}$$

The first line in the consequent of (34) requires that the SUBJ value of a clause be a list all of whose members are of type *PRO*. Following in the main Pollard (1989), *PRO* is assumed to be a subtype of *synsem*, distinct from both *canonical* and *gap*, which corresponds to unexpressed subjects in all control constructions. *PRO* has a number of properties that are of relevance. First, *PRO* is here treated as [CASE *acc*] and hence can never appear as the SUBJ value of a finite verb form:

(35) (a) *I want [goes to the store].
(b) *[goes to the store] is bothering them.

[24] Notice that (33) relies crucially on the feature NON-HD-DTRS to provide a unified account of the fact that the *wh*-word must be in the filler or the subject.

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Second, *PRO* has a referential index. Thus no clauses will ever be formed from VPs that normally combine with an expletive subject:

(36) (a) *I want [to be raining]. (cf. I want it to be raining; I want to leave.)
(b) *a yard [in which [to be a party]]. (cf. a yard [in which [to have a party]])
(c) *I wonder [what [to be a clown on the cover of]] (cf. I wonder [what [there is a clown on the cover of]]; I wonder [what [to put a clown on the cover of]])
(d) *Bother you(rself) that Kim left!

Third, *PRO* (more precisely its content) is assumed to be of type *reflexive*. This guarantees that the binding and control assignment behavior of *PRO* interact exactly as discussed in P&S-94 (chapters 6–7) to explain 'Visser's Generalization' (Bresnan 1982) in its full generality. Fourth, since *PRO* is a distinct subtype of *synsem*, and since all signs have a SYNSEM value of type *canonical*, no overt element can ever function as the subject of a head whose SUBJ value contains *PRO*. Finally, the specification [SUBJ list(*PRO*)] interacts with independently motivated constraints ensuring that SUBJ lists are maximally singleton. This entails that all clauses in English are either [SUBJ $\langle\ \rangle$] or else [SUBJ $\langle$*PRO*$\rangle$].[25]

The second constraint in the consequent of (34) states that the default for a clause's MOD value is *none*. Relative clauses are the exception to this, with the type *rel-cl* requiring a [MOD [*noun*]] specification. Finally, the last two lines of (34) specify that all clauses bear empty specifications for the features REL and QUE. In the case of REL, this guarantees that the head-daughter of a clause will be [REL $\{\ \}$], which in turn means that its lexical head has amalgamated no REL specifications, which in turn means that there are no relative words within the dependents of that lexical head.[26] This will suffice, for example, to prevent any of the sentences in (37) from being admitted as, for example, a declarative clause:

(37) (a) *[Kim read which book].
(b) *I think [that who went home].

5.2 *Subject wh-relatives*

The simplest type of *wh*-relative, the *wh-subj-rel-cl*, is a subtype of both *wh-rel-cl* and *fin-hd-subj-ph* and hence inherits constraints from both of these supertypes. Earlier, we saw the constraints that govern phrases of the type

[25] It should be noted that the supposition of *PRO* as a distinguished subtype of *synsem*, while providing adequate means for the workings of binding theory (based on ARG-ST lists) and for the treatment of various other grammatical phenomena that make reference to an ARG-ST subject, posits no invisible constituents, i.e. no subject daughters with empty phonology.

[26] The one exception to this is discussed in the next section.

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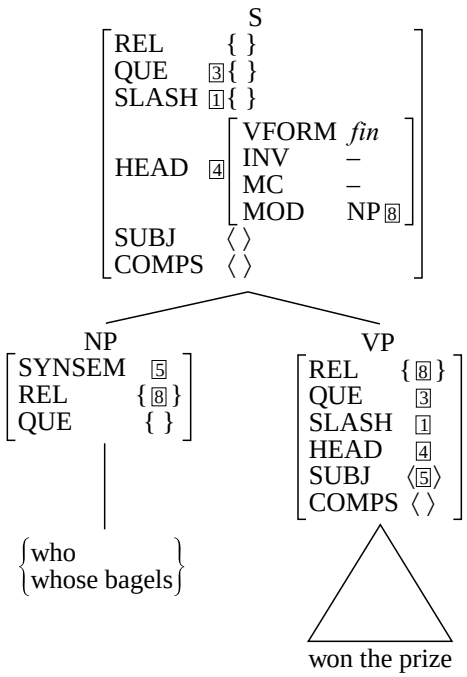
hd-subj-ph, and we have just seen the constraints that govern the type *wh-rel-cl*. This leaves very little that needs to be said specifically about the type *wh-subj-rel-cl*, perhaps just the constraint shown in (38):

(38) $$\textit{wh-subj-rel-cl} \Rightarrow \begin{bmatrix} \text{HD-DTR} & [\text{REL } \boxed{3}] \\ \text{NON-HD-DTRS} & \langle [\text{REL } \boxed{3}] \rangle \end{bmatrix}$$

The effect of this constraint is to prevent the WHIP from interacting with the hard constraint [REL { }] (inherited from (34)) to make the clause's head daughter [REL { }]. This is necessary because precisely in this construction type, the non-head daughter – the subject – has a non-empty REL value that has been amalgamated by the highest verb in the relative clause, which SUBJ-selects that phrase.[27]

The constraints outlined above, interacting with other, independently motivated aspects of HPSG theory and the grammar of English, entail (through a cascade of identities) that subject *wh*-relative clauses obey the numerous constraints whose effect is illustrated in (39).

(39)



Note in particular that every constraint discussed previously is playing some role in this representation, making the combined effect illustrated here a

[27] If, as suggested by Levine & Hukari (1996), this kind of construction involves a subject extraction dependency, then there will be no need to posit a distinct *wh-subj-rel-cl* type or to override the default specification for REL.

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rather intricate theorem.[28] Henceforth, I will omit empty or negative specifications for REL, QUE, INV, AUX, etc. when they are not directly relevant.

Finally, note that since the type *wh-subj-rel-cl* inherits the constraint [VFORM *fin*] from its supertype *fin-hd-subj-ph*, there is no infinitival instance of this kind of relative clause, – no relatives like (40), whose VP is headed by the complementizer *to* (see section 5.3.2).

(40) *A student [who(m) to talk to us] just walked in.

5.3 *Nonsubject Wh-Relatives*

In order to understand other kinds of *wh*-relative clause, we must first examine head-filler phrases in more detail.

5.3.1 *Head-Filler Phrases*

In order to better understand the various kinds of extraction constructions, specifically *wh*-relative clauses and *wh*-questions, it is useful to divide the head-filler phrases into two subvarieties: finite and infinitival. As illustrated in (41) and (42). (As explained more fully below, *to* and *for* are treated as complementizers with the potential to project a relative clause.)

(41)	(a) These bagels, I like.	(declarative)
	(b) the baker [whose bagels I like]	(relative)
	(c) the baker [from whom I bought these bagels]	(relative)
	(d) Whose bagels do you like?	(interrogative)
	(e) From whom did you buy these bagels?	(interrogative)
(42)	(a) the baker [in whom to place your trust]	(relative)
	(b) I wonder [in whom to place my trust].	(interrogative)
	(c) I wonder [who to trust].	(interrogative)

Finite head-filler phrases always require an overt subject, as shown in (43):

(43) (a) *These bagels, likes.
(b) *the baker [[whose bagels] likes].
(c) *the baker [[from whom] bought these bagels].

A parsimonious account of the various properties of these phrases emerges if they are treated in terms of two distinct subtypes of the type *hd-fill-ph*, namely *fin-hd-fill-ph* and *inf-hd-fill-ph*. Let us consider the types having to do with finite head-filler phrases first:

[28] Note that nothing in this analysis rules out extraction from this type of relative clause, as in the following example, of a type noted by Chung & McCloskey (1983):

(i) There were several old rocks songs that she and I were the only two [who knew __].

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(44)

TYPE	CONSTRAINTS	ISA
hd-fill-ph	[SLASH 2] [HD-DTR [HEAD *verbal*] [SLASH {1} ∪ 2]] [NON-HD-DTRS ⟨[LOCAL 1]⟩]	*hd-nexus-ph*
fin-hd-fill-ph	[HD-DTR [HEAD [*verb*] [VFORM *fin*]] [SUBJ ⟨ ⟩]]	*hd-fill-ph*

Here *verbal* is the supertype that covers both verbs and complementizers. Note that the [SUBJ ⟨ ⟩] constraint on the type *fin-hd-fill-ph* in (44) ensures that a finite head filler phrase will always have a sentential head daughter (never a VP head daughter). Because these constraints are stated on the phrasal types in (44) they apply with full generality to declaratives, interrogatives, and relative clauses, predicting the deviance of the examples in (43). The present formulation requires emendation, presumably in the form of further constraints, in order to rule out 'weak island' violations like (45).

(45) *When did you wonder [what you should say __ to Sandy __]?

With these phrasal types and their associated constraints in place, we may now consider the grammar of finite nonsubject relative clauses like *whose bagels I like* and *from whom I bought these bagels*. These phrases are treated in terms of a single type, *fin-wh-fill-rel-cl*, which inherits from the supertypes *wh-rel-cl* and *fin-hd-fill-ph*. The constraints on this type again have little work to do, though perhaps more than the simplified formulation shown in (46):

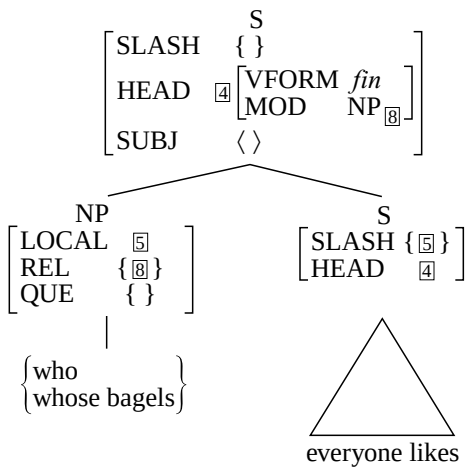
(46) *fin-wh-fill-rel-cl* ⇒ [NON-HD-DTRS ⟨[HEAD *noun* ∨ *prep*]⟩]

The constraint in (46) says only that the filler daughter must be an NP[29] or PP (unlike interrogative or declarative instances of *fin-hd-fill-ph*, where other kinds of filler are permitted). From the independently established constraints already considered, it follows directly that phrases of this type must exhibit the properties shown in (47).

[29] This is meant to include verbal gerunds. See Malouf (1996).

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(47)



That is: (1) the HFP and VALP constrain the values of HEAD, SUBJ and COMPS to be as shown;[30] (2) the binding off of the head daughter's SLASH value is guaranteed by the constraints stated on *hd-fill-ph* (3) the constraint on *clause* and the WHIP interact to ensure the REL and QUE values on the clause and its head daughter are empty; (4) the coindexing of the nonhead daughter's REL value and the clause's MOD value follows from constraints associated with the type *wh-rel-cl*; (5) hence, by the WHIP, there must be a *wh*-relative word somewhere within this nonhead daughter; and (6) the SLIP, interacting with the CELR sketched above, ensures that the head of this relative clause (the S/{NP}) contains (somewhere within it) a verb of reduced valence whose ARG-ST contains an element whose LOCAL value is identified with that of the clause's nonhead daughter (the filler daughter).

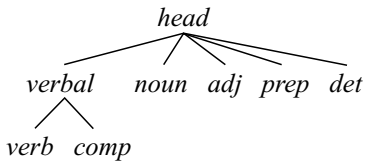
5.3.2 *Infinitival Wh-Relatives*

Let us begin the discussion of infinitival *wh*-relatives with a brief digression into the grammar of complementizers. It is now a commonplace intuition that S and CP should be given a unified (or closely related) syntactic analysis. In terms of the framework developed here, a particularly natural approach to this is to treat S and CP as two subtypes of a common supertype. This can easily be done by treating HEAD values in terms of a part-of-speech (*head*) hierarchy that includes *verbal* as an immediate supertype of *verb* and *comp*, as already mentioned. The resulting hierarchy is the following:

[30] 'S' is intended to include the specifications [SUBJ ⟨ ⟩] and [COMPS ⟨ ⟩].

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(48)



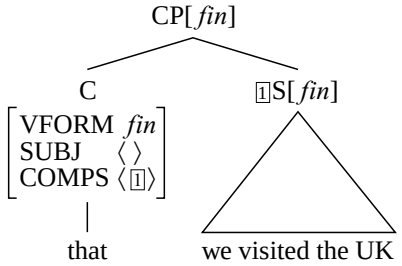
VFORM, AUX and other features used in a variety of PSG analyses of English verbs[31] now become features defined as appropriate for the supertype *verbal*. This provides a basis for assigning common specifications (like [VFORM *fin*] or [AUX +]) to both verbs and complementizers, and hence to the phrases they project.

A single constraint can be stated requiring VFORM sharing between complementizers and their verbal complements. In virtue of this constraint, the lexical entry for the complementizer *that* will be as follows:

(49)
$$\begin{bmatrix} \text{PHON} & \langle \text{that} \rangle \\ \text{HEAD} & \begin{bmatrix} \textit{comp} \\ \text{VFORM} \ \textit{fin} \end{bmatrix} \\ \text{SUBJ} & \langle\,\rangle \\ \text{COMPS} & \langle \text{S}[\textit{fin}] \rangle \end{bmatrix}$$

This word projects the CP in (50) as an instance of the type *hd-comp-ph*:

(50)



And the verbs that have in the past been treated in terms of the transformation of '*That*-Deletion' now can be lexically specified as selecting the following natural class:

(51)
$$\begin{bmatrix} \text{VFORM} & \textit{fin} \\ \text{SUBJ} & \langle\,\rangle \\ \text{CONT} & \textit{proposition} \end{bmatrix}$$

This specification will be consistent only with S[*fin*] or CP[*fin*] complements.

[31] In a tradition beginning with Gazdar et al. (1982). See also Warner (1993) and Kim (1995).

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With respect to the infinitival clauses, we may posit two infinitival C^0s in English: *for* and *to*, whose lexical entries are sketched in (52):

(52) (a) to

$$\begin{bmatrix} \text{HEAD} & \begin{bmatrix} comp \\ \text{VFORM } inf \end{bmatrix} \\ \text{SUBJ} & \langle \boxed{2} \rangle \\ & \text{VP} \\ \text{COMPS} & \left\langle \begin{bmatrix} inf \\ \text{SUBJ } \langle \boxed{2} \rangle \end{bmatrix} \right\rangle \end{bmatrix}$$

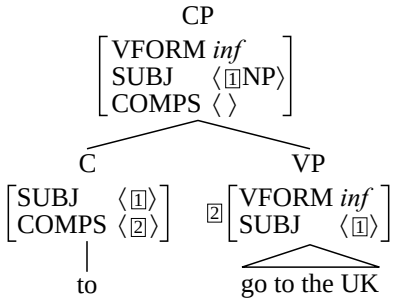
(b) for

$$\begin{bmatrix} \text{HEAD} & \begin{bmatrix} comp \\ \text{VFORM } inf \end{bmatrix} \\ \text{SUBJ} & \langle\ \rangle \\ & \text{CP} \\ \text{COMPS} & \left\langle \boxed{1}\text{NP}, \begin{bmatrix} inf \\ \text{SUBJ } \langle \boxed{1} \rangle \end{bmatrix} \right\rangle \end{bmatrix}$$

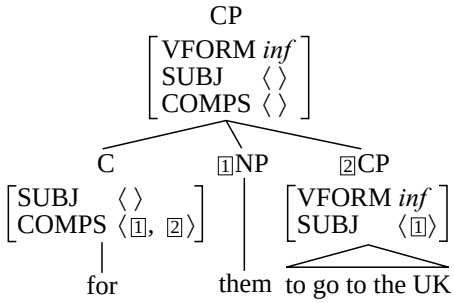
Note that *to*, though a complementizer, is a subject raising element – it identifies its SUBJ value with that of its unsaturated complement.[32]

These elements thus project familiar head-complement phrases of the kind shown in (53) and (54). Note that the complementizer *for* is essentially an object-raising element (being unusual only in having an empty SUBJ value).

(53)



(54)



It is crucial for my analysis that sequences like *Kim to leave* never be allowed to form a head-subject phrase. This can presumably be guaranteed simply by requiring all head-subject phrases to be [HEAD *verb*]. Thus there is no way that a verbal selecting the natural class [*inf*, SUBJ ⟨ ⟩] (e.g. *prefer*, *eager*) will ever allow such a sequence as its complement (**Pat is eager Kim to leave*).

[32] This treatment eliminates the VFORM value *base*, originally introduced by Gazdar et al. (1982), in the process making VPs like *go* and CPs like *to go* a natural class.

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Because complement selection is in large part semantic, infinitival phrases will in general be selected semantically – as phrases that have some kind of message (*proposition*, *question*, *directive*, etc.) as their content. But on this theory (developed further in Ginzburg & Sag ms.), only clauses (and coordinations or modifications of such) have a CONTENT value of type *message*; the content of a verb, a VP, etc. within a clause is of type *property*. So an infinitival CP like (53) may function as a nonclause with a *property*-type content (as it in fact does in (59)) or it may stand independently as a clause with *propositional* content. In the latter case, its unexpressed subject must be of type *PRO*, as guaranteed by the general constraint on clauses discussed earlier. The noncanonical synsem type *PRO* is constrained to have a CONTENT value of type *reflexive*, as noted earlier, and a side effect of this is that *PRO* always has a referential index. Hence if we assume that a 'stand alone' CP must convey a *message* (rather than a *property*) and hence must be clausal (nonclausal CPs and VPs always have *property*-type content), then it follows that CPs like those in (55), where the VP[*inf*] complement of *to* selects a nonreferential subject, are ruled out in a principled fashion.

(55) (a) *What did they want? – [To be 5 o'clock]/[To amuse us that Kim was singing].
(b) *What did they want? – [To be someone available].
(c) *It was [to show]/[to amuse us that Kim was singing] that they wanted.
(d) *What they feared most was [to be no one available to help them].

Similarly, control theory (P&S-94, chapter 7) will require that the controlled complement of verbs like *try*, *persuade*, etc. have a PRO subject, and hence a referential index, thus ensuring the ungrammaticality of examples like those in (56).

(56) (a) *We tried to amuse them that Kim was singing.
(b) *They persuaded us to be no one available.

The structure for *for*/*to*-phrases in (54) differs from familiar $\bar{S}$ or CP structures.[33] However, there do not appear to be convincing arguments against this flat structure. The existence of the possibility of coordination as in (57a) cannot be taken as evidence that the NP + CP[*to*] sequence forms a constituent, because of the parallel possibility of nonconstituent coordination like (57b) (under the sensible assumption that the NP + PP sequence after *give* does not form a constituent).

[33] The structure in (54) would, however, simplify aspects of widely accepted formulations of binding theory, as noted by Reinhart (1983: 24).

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(57) (a) I prefer for [Sandy] [to do the washing] and [Kim] [to do the drying].
(b) Kim gave [a book] [to Sandy] and [a record] [to Dana].

Similarly examples like those in (58a), if indeed they are taken as grammatical, have an acceptability status (at best) like that of (58b).

(58) (a) ?Leslie meant for, but nobody else meant for, [Sandy] [to do the washing].
(b) Joan offered, and Mary actually gave, [a gold Cadillac] [to Billy Schwartz]. (Abbott 1976: 640)

That is, nonconstituent sequences like those presumed in (54) can appear in Right Node Raising constructions, as argued by Abbott. Structures like (54) are thus in fact quite unobjectionable. And the analysis just sketched in terms of these structures has the further benefit that it makes assignment of *accusative* case to the NP after *for* a case of ordinary object case assignment.[34]

In addition, the assumption that the structure of *for*/*to*-clauses differs fundamentally from that of finite clauses introduced by *that*, or other elements like *if*, provides an immediate account of the contrasts in (59), noted by Emonds (1976: 196).

(59) (a) Mary asked me if, in St. Louis, John could rent a house cheap.
(b) He doesn't intend that, in these circumstances, we be rehired.
(c) *Mary arranged for, in St. Louis, John to rent a house cheap.
(d) *He doesn't intend for, in these circumstances, us to be rehired.

Adverbials that should be able to introduce a sentential constituent cannot introduce the putative sentential constituent that follows *for*. On the present analysis, there is a clause for the adverbial to modify only in the case of *that*-clauses like (59a,b), not in the case of *for*/*to*-clauses like (59c,d). These last two cases are deviant because two complements appear right-shifted over an adverb, as in, say, **persuaded in St. Louis John to rent a house cheap*.

Finally, it should be noted that when CPs headed by *to* appear in raising environments, nothing requires their unexpressed subject to be of type *PRO*. This is because raising constructions are analyzed in terms of nonclausal CPs.[35] Thus the CP[*inf*] that is selected by the C^0 *for* (just like the CP selected by *believe* – *believe there [to be no solution to that problem]*), will have a

[34] The analysis of P&S-94 (chapter 3) fails to guarantee this, because the NP in question is not on the COMPS list of any element that could uniformly assign it *accusative* case. For a different solution to this problem, see Grover (1995).

[35] I assume that raising elements select CPs whose CONTENT value is of type *property* (not *proposition*). Thus, though CPs must be clausal in order to have a propositional semantics on this theory, the selection for clausal complement (by control verbs) versus nonclausal complement (by raising verbs) is fundamentically semantic in nature.

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SUBJ value whose index is not required to be referential by the general constraint on the type *clause*. This correctly allows for expletives as objects in *for-to* clauses and in other raising constructions:

(60) (a) It would be unusual [for [it] [to snow here]].
(b) It would be unwise [for [there] [to be no fire exit]].
(c) I [believe [there] [to be no way out]].
(d) [There] [seems [to be no way out]].
(e) [It] [seems [to be raining]].

Let us now return to the analysis of infinitival relatives. First, note that infinitival head-filler clauses, whether interrogative or relative, never allow an overt subject:

(61) (a) *the baker [[in whom] (for) you to place your trust].
(b) *I wonder [[in whom] (for) them to place their trust].
(c) *I wonder [[who(m)] (for) us to trust].

We express this generalization in terms of the type *inf-hd-fill-ph*, a separate subtype of *hd-fill-ph* that is constrained as indicated in (62).[36]

(62)

TYPE	CONSTRAINTS	ISA
inf-hd-fill-ph	HEAD [*comp*, VFORM *inf*] HD-DTR [SUBJ ⟨X⟩]	*hd-fill-ph*

Since all instances of this type of phrase are clauses, it follows without further stipulation that the unexpressed subject of this type of phrase will always be of type *PRO*. This correctly guarantees that no overt subject can be realized, that is, that examples like those in (61) are systematically ruled out.

Turning now to infinitival *wh*-relatives, these have only one significant property that distinguishes them from other *inf-hd-fill-phrases*. The filler daughter must be a PP, as illustrated in (63).

(63) (a) the baker [in whom to place your trust] (relative)
(b) I wonder [in whom to place my trust] (interrogative)
(c) I wonder [who(m) to place my trust in] (interrogative)
(d) *the baker [who(m) to place your trust in] (relative)

This appears to be simply an idiosyncracy of English infinitival *wh*-relatives, one which we accommodate in terms of the new type *inf-wh-fill-rel-cl* – a

[36] Note that if the constraints on the type *fin-hd-filler-ph* were revised so as to allow the head daughter to be of type CP, then we would admit phrases like *[which book [that you liked __]]*. Thus the present analysis lends itself to minor variations that can predict the behavior of well-known *wh*-clause patterns in other Germanic languages, such as Bavarian or Swedish.

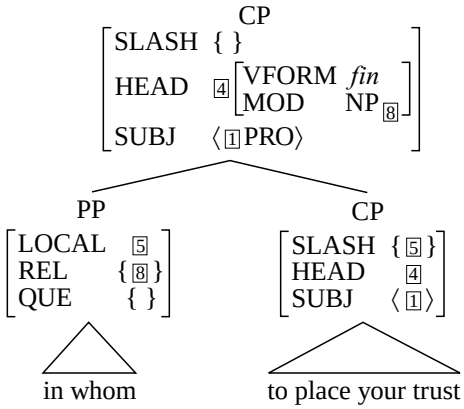
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subtype of both *wh-rel-cl* and *inf-hd-fill-ph*. Associated with this type is the following constraint:

(64) *inf-wh-fill-rel-cl* ⇒ [NON-HD-DTRS ⟨PP⟩]

This type of relative clause, very similar to its finite counterpart, is illustrated in (65).

(65)



An interaction of constraints similar to that found in the case of finite *wh*-relatives guarantees that the values of HEAD, REL, QUE, SLASH and so forth are just as shown in (65). The further constraint that the nonhead daughter must be a PP is also in effect here.

5.4 *That-relatives*

Nothing has been said thus far about *that* relatives:

(66) (a) the people [that voted in the election]…
(b) a book [that Sandy thought we had read]…
(c) each argument [that Sandy thought was unconvincing]…

It is generally thought that the *that* that occurs in these examples is the same complementizer that appears in examples like (67).

(67) I thought [that you were sick].

This view is not without its difficulties, however. For example, it must confront the well-known fact that *that*-relatives like (66a) involve what would appear to be a *that*-trace configuration of a kind that is not in general permitted:

(68) *the people [that I thought [that __ voted in the election]]…

An alternative perspective on relative *that* is defended at length by Hudson (1990) (see also Gazdar 1981 and Van Der Auwera 1985), who presents

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evidence that relative *that* is in fact a pronoun. Under the assumptions of the present analysis, we can in fact treat relative *that* as a *wh*-relative word that is similar in most respects to relative *who* (though the latter differs in that it is in general restricted to animate antecedents).

As Hudson (1990: 396) points out (see also P&S-94, chapter 4), this view is supported by the fact that *that*-relatives, unlike 'bar' relatives (to be discussed in the next section) freely coordinate with *wh*-relatives:

(69) (a) *Every essay she's written and that/which I've read is on that pile.
(b) Every essay which she's written and that I've read is on that pile.
(c) Every essay that she's written and which I've read is on that pile.

Other evidence for the (pro)nominal status of *that* comes from dialect variation, for example, the existence of varieties (cited by Hudson) where relative *that* allows a possessive form, as in (70):

(70) The pencil [that's lead is broken]…

In fact, the only real obstacle facing a treatment of relative *that* as a pronominal, rather than as a complementizer, is the fact that it disallows pied piping:

(71) (a) *The city [in that they were living]…
(b) *The person [with what we were talking]…

Notice, however, that relative *who* has exactly the same property in many varieties of English:

(72) (a) *The people [in who we placed our trust]…
(b) *The person [with who we were talking]…

In such varieties, the only possible pied-piped relative pronouns are *whose*, *which* and *whom*:

(73) (a) The company [in which we placed our trust]…
(b) The people [in whose house we stayed]…
(c) The person [with whom we were talking]…

The constraints on this variation have to do either with case assignments, registered restrictions, or both. In any case, the behavior of relative *that* and relative *who* appear to be identical. Thus there appears to be nothing that prevents us from treating relative *that* as a *wh*-pronoun.[37] This means that

[37] The only remaining difference between relative *who* and relative *that*, it seems, is that the latter may never be used appositively:

(i) *Jones, [that we were talking to last night], always watches football games alone.

For further discussion questioning even this difference, see Hudson (1990: 396).

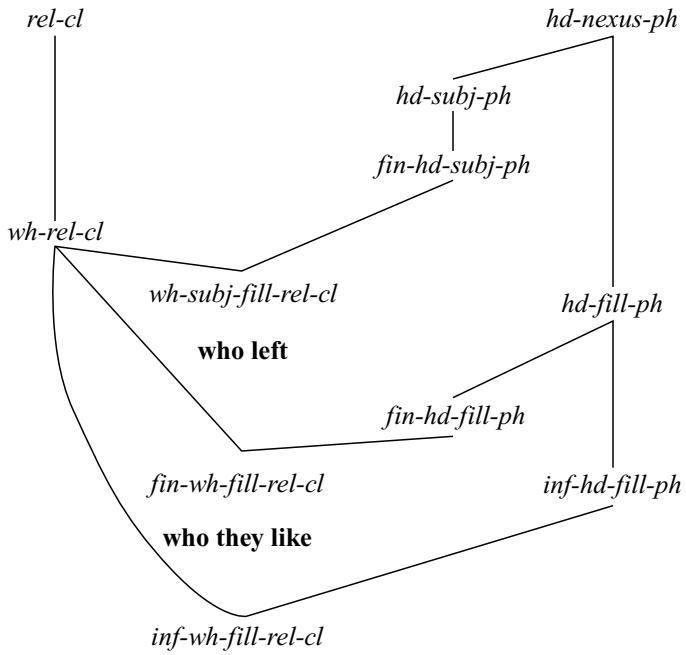
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there is no new type of relative clause required for the treatment of *that*-relatives – they are simply finite *wh*-relative clauses of the kind already discussed.

5.5 *Summary*

This exhausts the inventory of English *wh*-relative constructions (except for free relatives, which we leave unanalyzed). The hierarchy of phrases presented is summarized in (74).

(74)



6. NON-*wh*-RELATIVES

In addition to the clauses already examined, there are a variety of adnominal phrases in English that are usually included under the rubric 'relative clause'. These include the following:

(75) the person …

(a) [we visited __]	('bare' or '*that*-less')
(b) [for us to visit __]	(infinitival)
(c) [to visit __]	(infinitival)

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(d) [hassled by the police yesterday] ('reduced')
(e) [doing the job] ('reduced')

I will briefly discuss each of these types in turn.

6.1 *Bare relatives*

It has been noted (Jacobson 1984, Adger & Flickinger 1992) that bare relatives resist extraposition:

(76) (a) A letter was received [that Jones would be upset by __].
(b) ??A letter was received [Jones would be upset by __].

(77) (a) ??A person arrived yesterday [who we hated __].
(b) ??A person arrived yesterday [we hated __].

However it seems quite likely that the constraints on such extraposition are extragrammatical in nature, as similar examples seem impeccable ((78a) is due to Dick Hudson (p.c., 1996)):

(78) (a) I saw someone yesterday I hadn't seen for years.
(b) Something happened I couldn't really talk about.

Processing difficulty might play a role, as may certain social factors, as these examples do seem restricted to some informal register.

A related issue involves relative clause 'stacking'. Although *wh*-relative clauses can be iterated, as in (79), bare relatives must be the first member of any such iteration (or stack), as shown in (80).

(79) (a) The people [who take this course] [who Dana likes __] usually come from Walker High School.
(b) The only person [that I like __] [whose kids Dana is willing to put up with __] is Pat.
(c) The book [that I like __] [which everyone else in the class hates] was written in 1843.

(80) (a) The only person [I like __] [whose kids Dana is willing to put up with __] is Pat.
(b) *The only person [whose kids Dana is willing to put up with __] [I like __] is Pat.
(c) The book [I like __] [which everyone else in the class hates __] was written in 1843.
(d) *The book [that I like __] [everyone else in the class hates __] was written in 1843.

Jacobson's account of bare relatives seeks to explain this fact in terms of a constraint that disallows extraposition of bare relatives. This is accomplished by denying that there are recursive relative clause structures of

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the kind standardly assumed. For Jacobson, a non-initial relative clause is rather extraposed from the *wh*-phrase in initial position in the highest relative, as shown in (81):

(81) The only person [[whose $___1$ kids]$_2$ Dana is willing to put up with $___2$ [who I like $__$]$_1$] is Pat.

That is, the second relative clause in (81) is actually part of the only relative clause. Multiple stacking is reanalyzed as recursive extraposition, as in (82).

(82) The only person [[whose kids $___1$]$_2$ Dana is willing to put up with $___2$ [[who $___3$] I like $__$ [who Leslie hates $__$]$_3$]$_1$] is Pat.

And hence the fact that bare relatives only appear in initial position in a sequence of relatives follows from the single stipulation that bare relatives cannot be extraposed. In order to allow bare relatives in the initial position of a sequence, Jacobson allows the gap itself to license extraposition, as shown in (83).

(83) The only person [Dana is willing to put up with $___2$ [who I like $__$]$_2$] is Pat.

Once this possibility is provided for, it follows that bare relatives may only appear first in a sequence of relatives, as noted.

However, there are at least three problems facing this 'stacking-as-extraposition' proposal. First, as already noted, the contrasts involving extraposed bare relative vs. other types of relative clauses do not seem to be a matter of grammar, but rather an issue of processing or of informal register. The ban against bare relatives following *wh*-relatives, by contrast, seems to be a firm grammatical constraint.

Second, the reanalysis of stacked relatives via extraposition appears to interact incorrectly with pied piping. Thus extraposition from initial *wh*-phrases in questions is constrained to modify the entire dislocated constituent, not the *wh*-word within it:

(84) [[Which book's]$_i$ author]$_j$ did you meet $__$ [who$_{*i,j}$ you liked $__$]?

(85) [[Which boy's]$_i$ mother]$_j$ did you meet $__$ [who$_{*i,j}$ you liked $__$]?

But in order to reanalyze stacked relatives like (86) via extraposition, this constraint (whatever its status) would have to be violated:

(86) The only person [[whose$_1$ kids]$_2$ Dana is willing to put up with $__$ [[who]$_{1,*2}$ I like $__$]] is Pat.

An alternate approach to bare relatives suggested by Adger & Flickinger (1992) is that they are not modifiers at all, but rather optional nominal complements. This proposal predicts that *that*-less relatives, as complements, are noniterable and must precede adjuncts, including *wh*-relative clauses.

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Perhaps the most serious difficulty facing any such proposal is the fact that bare relatives seem to allow coordination with other kinds of relative clauses, as shown in (87).

(87) (a) (?)The books [I like __] and [that my friends hate __] never seem to sell very well.
(b) (?)The books [I like __] and [which my friends hate __] never seem to sell very well.
(c) (?)The authors [I like __] and [whose books have sold well] are few and far between.
(d) (?)The contributors [I visited __] and [from whom we have received contributions over $5,000] are only Kim, Sandy, and Lee.

The slightly questionable nature of this type of example is observed by Weisler (1980). The problem here is that nominal complements and nominal adjuncts cannot in general be coordinated, as noted by Adger and Flickinger:

(88) *The picture of Anson and under the shelf…

Hence, the examples in (87) provide a certain amount of evidence that bare relatives really are postnominal modifiers, not nominal complements.

Weisler's (1980) analysis of *that*-less relatives contains an insight that helps to make sense of many of the previous observations. He proposes to treat post-nominal S's (his term for bare relatives) as modifying $\bar{N}$ (N′) constituents, while postnominal $\bar{S}$s (his term for other relative clauses, specifically *wh*-relatives) modify N″s, as shown in (89).

(89) (a) $N'' \rightarrow N''\ (\bar{S})$
(b) $N'' \rightarrow N'\ (S)$

Thus bare relatives occur in only one position within a NP – after the $\bar{N}$ that contains the lexical head noun and its complements (if any), but before any other kinds of relative clause.

The N″ recursion in Weisler's analysis is intended to allow stacking of relative clauses analyzable as $\bar{S}$s. Within the present analysis, we may incorporate Weisler's insight in a slightly different form. First (as already indicated in our discussion of *wh*-relatives) we require that the MOD value of a *wh-rel-cl* be a specifier-saturated nominal phrase, that is, an NP, rather than an $\bar{N}$. This receives independent support from the fact that *wh*-relatives may modify even those nominal phrases that have no obvious internal analysis into specifier and $\bar{N}$, as illustrated in (90):

(90) (a) [Who [that you like __]] does Sandy also like?
(b) [Who [whose parents attended the meeting]] is still enrolled in the class?
(c) [All [who lost money in the scam]] are eligible for the program.

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Of course, some further constraint, presumably of a semantic nature, must be added to rule out restrictive relatives like (91a) [cf. (91b)]:

(91) (a) *Pat [who/that I like __] is a genius.
(b) the Pat [who/that I like __] is a genius.

Second, we introduce the sister type *non-wh-rel-cl*, which, as shown in (92), is constrained to modify a nominal element specified as [SPR ⟨DET⟩] and [COMPS ⟨ ⟩] – an N′.

(92) $$\textit{non-wh-rel-cl} \Rightarrow \begin{bmatrix} \text{HEAD} & [\text{MOD } \text{N}'_{\boxed{1}}] \\ \text{SLASH} & \{\ \} \\ \text{HD-DTR} & [\text{SLASH } \{\text{NP}_{\boxed{1}}\}] \end{bmatrix}$$

The constraints in (92), which govern finite and nonfinite instances alike (but not reduced relatives), have several effects. First, by requiring the MOD value (and hence the nominal phrase to be modified) to still be 'seeking a determiner', all non-*wh* relatives will combine with the nominal head before the resulting phrase combines with its specifier. Thus, assuming all *wh*-relatives adjoin to NP, it follows that all bare relatives must precede all *wh*-relatives. Second, (92) requires that non-*wh* relatives must 'bind off' the SLASH value of the head daughter, whose only member is an NP coindexed with the phrase's MOD value. This ensures that the gap inside any such clause will be referentially linked to the NP's head noun. Note that this SLASH binding will override the SLIP, which states that by default no SLASH binding should take place. Finally, the various kinds of relative clauses that are instances of this type are then predicted to be unable to modify an NP that has no internal structure.[38] As contrasts like the following show, this prediction is correct.[39]

(93) (a) *[Who [you like __]] does Sandy also like?
(b) *[Who [for Sandy to talk to __]] is still enrolled in the class?
(c) [Who [who/that you like __]] does Sandy also like?

The bare relatives are treated in terms of one subtype of *non-wh-rel-cl*, which also inherits from the type *fin-hd-subj-ph*. The structure of these phrases is sketched in (94).

[38] I assume 'bare plurals' and the like are to be treated via a new type of nonbranching headed phrase, i.e. one which allows an NP to have and N′ head-daughter and which permits no non-head daughters.

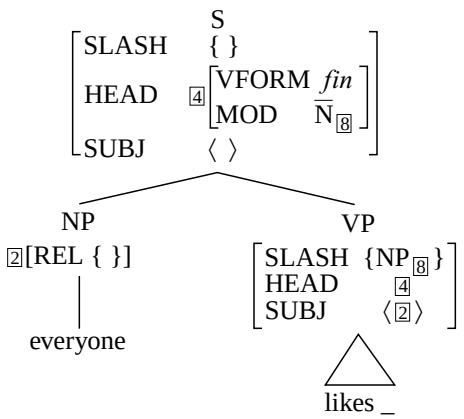
[39] Bare relatives (and simple infinitival relatives discussed in the next section) may, however, modify expressions like *someone*, *everything*, *nothing*:

(i) [Everything you like __] is on the table.
(ii) [Something to talk about __] will pop up sooner or later.

This suggests an analysis of expressions like *someone* as *some one*, etc.

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(94)



Finally, note that the present proposal allows recursion with bare relatives, which appears to be the right result (examples again due to Dick Hudson):

(95) A: The book she recommended that I liked best was X.
B: I disagree. The book she recommended I liked best was Y.

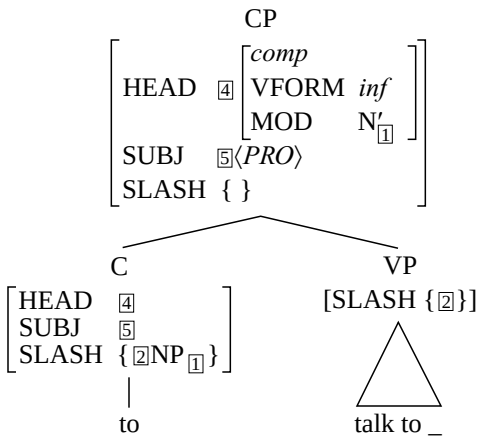
6.2 *Simple infinitival relatives*

Non-*wh* infinitival relative clauses like *to read* __ and *for us to read* __ belong to a distinct subtype of *non-wh-rel-cl* that I will call *simp-inf-rel-cl*. This type, also a subtype of *hd-comp-ph*, is subject to the following constraint:

(96) $\textit{simp-inf-rel-cl} \Rightarrow \left[\text{HEAD} \left[\begin{matrix}\textit{comp} \\ \text{VFORM } \textit{inf}\end{matrix}\right]\right]$

This information, taken together with that inherited from the supertype *non-wh-rel-cl*, ensures that the head daughter must be both infinitival and slashed, as indicated in (97):

(97)



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Relative clauses of this type inherit the constraint that they must modify a specifier-unsaturated phrase. This correctly predicts that infinitival relatives cannot follow a *wh*-relative clause, as illustrated in (98).

(98) (a) The only person [(for us) to visit __] [whose kids Dana is willing to put up with __] is Pat.
(b) *The only person [whose kids Dana is willing to put up with __] [(for us) to visit __] is Pat.
(c) One book [for us to read __] [that Leslie praised __] was *Sense and Sensibility*.
(d) *One book [that Leslie praised __] [for us to read __] was *Sense and Sensibility*.

It also predicts (if nothing further is said) that sequences of simple infinitival relatives should be possible. And some examples of this type do seem to be grammatical:

(99) ?The problems [to solve __] [for you to impress them with __] are the ones in the Times.

Finally, it should be noted that infinitival relatives like (100), which contain only a subject gap, may also be treated as instances of *simp-inf-rel-cl*.

(100) A person [to fix the sink]…

This can be achieved by allowing *PRO* to bear a nonempty SLASH specification (like *gap*; see section 4 above) in phrases of this type (but not elsewhere). If *PRO* is slashed, then the lexical head *to* will amalgamate the SLASH element from its subject argument and hence will satisfy the constraint on this type of phrase requiring that the head daughter be slashed. Notice that this proposal correctly distinguishes (100) from (101).

(101) *A person [for us to fix the sink]…

Nothing within the indicated clause can introduce a nonempty SLASH specification; hence *for* must have an empty SLASH value, in violation of the constraint requiring a slashed head daughter.[40]

[40] Missing from this analysis is an account of the deontic meaning common to many infinitival clauses, for example, infinitival *wh*-relatives, simple infinitival relatives, and infinitival *wh*-interrogatives. A phrase like *the person to talk to*, for example, conveys something of the sense of *the person one should or may talk to*. To express this semantic commonality, an additional clause type might be added, as suggested to me by Carl Pollard. Exploring this modification, however, is beyond the scope of the present study.

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6.3 *Reduced relatives*

The final type of relative clause to be considered is the 'reduced' relative clause. I will treat this as a broad category that includes not only familiar participal phrases, but also a variety of other postnominal modifiers, including all the following:

(102)	(a)	the person [standing on my foot]…	VP[*pres-p*]
	(b)	the prophet [descended from heaven]…	VP[*perf-p*]
	(c)	the bills [passed by the House yesterday]…	VP[*pas*]
	(d)	the people [in Rome]…	PP[+PRD]
	(e)	the people [happy with the proposal]…	AP[+PRD]

For most speakers I have consulted, the distribution of these phrases seems to be as follows: First, reduced relatives may precede or follow *wh*-relatives (including *that*-relatives):

(103) (a) The bills [passed by the House yesterday] [that we objected to __] died in the Senate.
(b) The bills [that we objected to __] [passed by the House last week] died in the Senate.
(c) The only people [who were at Harvard] [being added to our group] are Jones and Abrams.
(d) The only people [being added to our group] [who were at Harvard] are Jones and Abrams.

Moreover, reduced relatives also seem to allow either ordering with respect to both simple infinitival relatives and bare relatives:

(104) (a) A hotel [overlooking/by the river] [to send our relatives to __] should be easy to find.
(b) A hotel [to send our relatives to __] [overlooking/by the river] should be easy to find.
(c) A hotel [overlooking/by the river] [you're satisfied with __] shouldn't be hard to find.
(d) A hotel [you're satisfied with __] [overlooking/by the river] shouldn't be hard to find.

These observations are systematized by positing the type *red*(*uced*)-*rel*(*ative*)-*cl*(*ause*) – a subtype of both *rel-cl* and *hd-comp-ph*. This type is constrained as shown in (105).[41]

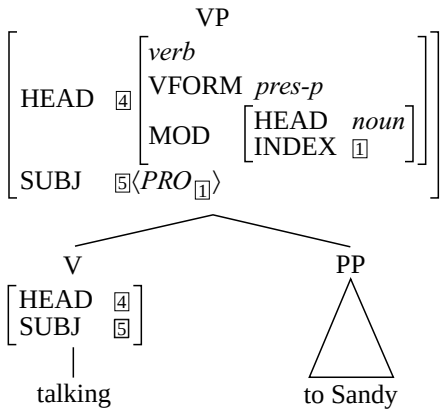
(105) $\textit{red-rel-cl} \Rightarrow \begin{bmatrix} \text{HEAD} & [\text{MOD}\,[\text{INDEX}\,\boxed{1}]] \\ \text{SUBJ} & \langle[\text{INDEX}\,\boxed{1}]\rangle \end{bmatrix}$

[41] Obviously, there is no process of reduction in the present analysis, which involves only static type constraints.

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This type of phrase requires coindexing of its unexpressed subject and its MOD value, as illustrated in (106).

(106)



The constraints illustrated in (105) should by now be familiar. Note in particular that the unexpressed subject of this phrase, which must be of type PRO because this is a subtype of *clause*, is coindexed with the phrase's MOD value (by the constraint in (105)) and hence is coindexed with the nominal phrase that the relative clause modifies. Because (105) says nothing about the SPR value of the nominal that the reduced relative will modify, it follows that a reduced relative can modify either an N′ or an NP. This in turn predicts precisely the word order variation described above. It also correctly predicts the possibility of multiple reduced relatives, as illustrated in (107):

(107) (a) the people [from Spain] [standing in the hall]…
(b) the people [standing in the hall] [from Spain]…
(c) the books [about cooking] [advertised in the paper]…
(d) the books [advertised in the paper] [about cooking]…

The present proposal treats even nonverbal modifiers (PPs and APs) as reduced relatives. This may seem unintuitive, especially in light of the severe restrictions on what kind of phrase can function as a reduced relative, as illustrated in (108).

(108) (a)	*the person [stands on my foot]…	VP[*fin*]
(b)	*the person [stand on my foot]…	VP[*inf*]
(c)	* the person [as conservative a Republican as Reagan]…	NP[+PRD]

It is quite possible, however, that even these restrictions can be explained without placing any further constraints on the relative clause types. In order to serve as the head of a reduced relative, a phrase must be specified as both [SUBJ ⟨*PRO*⟩] and as [HEAD [MOD [*noun*]]]. This in turn means that the lexical head of such a phrase must also be so specified, making it possible to control what kind of phrase can appear in this construction in terms of

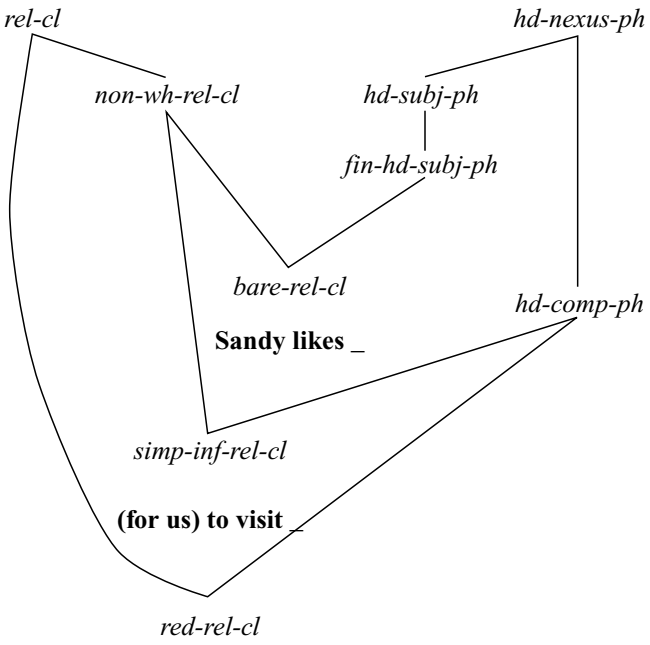
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purely lexical constraints. For instance, it is a general property of [VFORM *inf*] verb forms (e.g. *stand*) and of predicate nouns that they are do not project modifier phrases, and hence they should be lexically specified as [MOD *none*] – this is sufficient to disallow examples like (108b) and (108c). And since finite verb forms require a nominative subject, a requirement inconsistent with our treatment of PRO as [CASE *acc*], nothing further needs to be said to rule out examples like (108a) as well.

6.4 *Summary*

The types of relative clause discussed in this section are summarized in (109):

(109)



7. Head-Adjunct Constructions

The assumption made in P&S-94 is that relative clauses simply function as adjuncts in a head-adjunct structure, roughly (adapting to our earlier revisions) as shown in (110).

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(110)
$$\left[\begin{array}{ll} \textit{hd-adjunct-ph} & \\ \text{PHON} & \langle \text{person, who, dances} \rangle \\ \text{SYNSEM} & \bar{\text{N}}\left[\begin{array}{ll} \text{SPR} & \langle \boxed{2}\,\text{DET} \rangle \\ \text{CONT} & \boxed{3}\left[\begin{array}{l} \text{INDEX } \boxed{5} \\ \text{RESTR } \{\boxed{4}, \textit{dance}(\boxed{5})\} \end{array}\right] \end{array}\right] \\ \text{HD-DTR} & \left[\begin{array}{ll} \text{PHON} & \langle \text{person} \rangle \\ \text{SYNSEM} & \boxed{1}\bar{\text{N}}\left[\begin{array}{ll} \text{SPR} & \langle \boxed{2} \rangle \\ \text{CONT} & \left[\begin{array}{l} \text{INDEX } \boxed{5} \\ \text{RESTR } \{\boxed{4}\textit{person}(\boxed{5})\} \end{array}\right] \end{array}\right] \end{array}\right] \\ \text{NON-HD-DTRS} & \left\langle \left[\begin{array}{ll} \textit{wh-rel-cl} & \\ \text{PHON} & \langle \text{who, dances} \rangle \\ \text{SYNSEM} & \left[\begin{array}{l} \text{HEAD [MOD } \boxed{1}] \\ \text{CONT } \boxed{3} \end{array}\right] \end{array}\right] \right\rangle \end{array}\right]$$

Relative clauses are all projected from empty relativizers. Hence the desired semantic result can be achieved simply: the CONTENT value of the empty relativizer is a restricted index, and the various identities specified in the relativizer's lexical entry ensure that the restriction set (RESTR value) is determined via set union from the proposition[42] determined by material in the relative clause (*dance*(5) in (110)) and the restriction set of the $\bar{\text{N}}$ being modified (the set containing *person*(5) in (110)). With these identities all specified lexically, the semantics of noun-relative clause combinations can be specified simply by identifying the CONTENT value of the phrase (the whole $\bar{\text{N}}$ in (110)) with that of the non-head daughter. This is in essence what P&S propose and is also what is indicated in (110).

However, an issue arises in the present analysis, where each relative clause is headed not by an invisible relativizer, but rather by a verb or complementizer. There is no independent motivation for assigning a finite verb one kind of semantic content (a restricted index) when it appears as the highest verb in a relative clause and a completely different kind of interpretation (a *proposition* or *qfpsoa*) in all other contexts. Intuitively, finite verbs should have propositional content in all their uses, as they do in the analysis developed here.

7.1 *Head-relative phrases*

These observations are naturally accommodated by treating head-relative phrases as a distinct type of construction. This phrase type and its immediate supertype – *head-adjunct-phrase* – are sketched in (111).

[42] More precisely, in terms of the semantics developed by P&S, a *quantifier-free-parameterized-state-of-affairs*, or *qfpsoa*.

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(111)

SORT	CONSTRAINTS	ISA
hd-adj-ph	[HD-DTR [SYNSEM 1] ; NON-HD-DTRS ⟨[HEAD [MOD 1]]⟩]	*hd-ph & non-clause*
hd-rel-ph	[HEAD *noun* ; CONT [INDEX 2 ; RESTR 3 ∪ {4}] ; HD-DTR [INDEX 2 ; RESTR 3] ; NON-HD-DTRS ⟨[CONT 4 *proposition*]⟩]	*hd-adj-ph*

These constraints guarantee that the non-head daughter's MOD specification is identified with the head daughter's SYNSEM value in all head-adjunct phrases, but they no longer require that such phrases take their semantic content from the non-head daughter. The constraints on *hd-rel-ph* require that the CONTENT value be a restricted index whose restriction set is constructed by adding the relative clause's propositional content into the restriction set of the head daughter. With these revisions in place, the relative clause in (110) is replaced by (112):

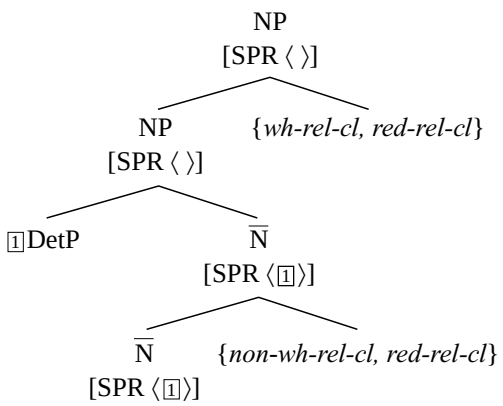
(112)
$$\left[\begin{array}{l} \textit{hd-rel-ph} \\ \text{PHON} \quad \langle \text{person, who, dances} \rangle \\ \text{SYNSEM} \left[\begin{array}{l} \text{HEAD} \ \textit{noun} \\ \text{SPR} \quad \langle \boxed{2}\text{DET} \rangle \\ \text{CONT} \left[\begin{array}{l} \text{INDEX} \ \boxed{5} \\ \text{RESTR} \ \{\boxed{4}, \boxed{3}\textit{dance}(\boxed{5})\} \end{array}\right] \end{array}\right] \\ \text{HD-DTR} \left[\begin{array}{l} \text{PHON} \quad \langle \text{person} \rangle \\ \text{SYNSEM} \ \boxed{1}\overline{\text{N}} \left[\begin{array}{l} \text{SPR} \quad \langle \boxed{2} \rangle \\ \text{CONT} \left[\begin{array}{l} \text{INDEX} \ \boxed{5} \\ \text{RESTR} \ \{\boxed{4}\textit{person}(\boxed{5})\} \end{array}\right] \end{array}\right] \end{array}\right] \\ \text{NON-HD-DTRS} \left\langle \left[\begin{array}{l} \textit{wh-subj-rel-cl} \\ \text{PHON} \quad \langle \text{who, dances} \rangle \\ \text{SYNSEM} \left[\begin{array}{l} \text{HEAD [MOD 1]} \\ \text{CONT} \ \boxed{3} \end{array}\right] \end{array}\right] \right\rangle \end{array}\right]$$

The revised semantic constraint preserves the effect of the P&S-94 analysis, while eliminating the need for multiple semantic analyses of the lexical heads of relative clauses.

The result of the various constraints just discussed is to restrict the position (and hence the order) of different types of relative clauses in the fashion summarized in (113):

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(113)



This squares well with the array of facts examined in the previous sections.

7.2 *Simple head-adjunct phrases*

The type indicated in (114) completes the picture of head-adjunct phrases.

(114)

TYPE	CONSTRAINTS	ISA
simp-hd-adj-ph	[…]	*hd-adj-ph*

I will not take a position here on the semantic analysis of these phrases. For a promising direction, see Kasper (1995).

There is one final issue to address about the analysis of simple head-adjunct phrases and their interaction with the grammar of relative clauses. When adverbs modify clauses of a particular type, the resulting phrase must be of that same type. This point holds true for the non-relative clauses in (115), as well as for the relative clauses in (116).

(115) (a) [[They left alone] yesterday]… *decl-cl*
(b) I wondered [[who they had visited __] yesterday__]… *inter-cl*
(c) [[Leave town] tomorrow]… *imp-cl*

(116) (a) the person [[who left alone] yesterday]… *wh-subj-rel-cl*
(b) the prophet [[who we visited __] last year]… *wh-fill-rel-cl*
(c) the people [[we saw __] yesterday]… *non-wh-rel-cl*
(d) the bills [[passed by the House] yesterday]… *red-rel-cl*

Related examples that indicate 'transmission' of semantic type through higher levels of structure can be constructed that involve coordination and extraposition constructions:

(117) (a) the person [[[whose mother left] and [whose father stayed]] yesterday]

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(b) the tape recordings [[so many copies of which were distributed] that all exclusive distribution rights had been compromised]…
(c) the people [[[we spied __] and [Dana called out to __]] at the same time]…
(d) the celebrities [[more pictures of whom were taken] than of any prime minister]…

These data thus tell us that the theory of constructions must countenance some way of ensuring that extraposed and modified phrases preserve the semantic type of their head daughter. Similarly, coordinate structures must inherit the semantic type of their conjuncts. Once this is ensured (by whatever means), then all the relative clauses in (117) are correctly accounted for by the present analysis. This follows because the constraint on the type *hd-rel-ph* is not formulated so as to require a non-head daughter of type *rel-cl*. Rather, that non-head daughter can be any phrase that has *propositional* content and bears a [MOD [*noun*]] specification.[43] This formulation thus extends the scope of the analysis to a considerable range of postnominal modifiers.

8. Conclusion

In this paper I have provided a precise grammar of English relative clauses stated in terms of construction types and type constraints. Generalizations about the 'X-bar syntax' (albeit a novel one based on dependency relations and degree of saturation) have been factored into one dimension of analysis, preserving the results of earlier work in HPSG. At the same time, a new, orthogonal informational dimension has been introduced for clausal functions. This constitutes a 'principle-based' move away from 'construction-specific rules' that allows a concise expression of generalizations about particular construction types in terms of constraint inheritance in a multiple inheritance type hierarchy.

The analyses of relatives developed here has in turn led to a number of revisions to the fragment of English grammar sketched in Pollard & Sag (1994), most notably the treatment of features involved in the analysis of unbounded dependency constructions. Extending the proposals of P&S-94 (chapter 9), it has been possible to completely eliminate invisible syntactic constituents (traces, empty complementizers, etc.) from the analysis of English clauses and to express relevant generalizations entirely through the method of hierarchical inheritance of type constraints. The resulting system

[43] It should also be noted that finite and infinitival VPs (*walks*, *walk*, etc.) can never function as postnominal modifiers because their inherent semantics is not propositional. These elements contribute to a proposition only as part of a well-formed clause, i.e. as part of a phrase that is an instance of one of the appropriate clausal types of the language.

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of phrasal types accounts for a wide range of theoretically critical data in this notoriously complex syntactic domain, including extraction dependencies and 'pied piping'.

The results obtained here are of further interest with respect to issues surrounding the innateness and task-specific nature of human linguistic knowledge. As Green (ms.) points out, one can model the acquisition of a type-based system of grammatical constraints like the one presented here in terms of developmental tasks (naming, categorizing by type, analyzing into component parts, detecting systematic correlations, reorganizing type hierarchies, etc.) that have close analogues in other cognitive domains. If it is indeed possible that even phenomena as grammatically complex as English relative clauses can be analysed in terms of a type system like the one presented here, then perhaps less of language has to be thought of as 'hard-wired'. That is, if the program outlined here can be sustained, namely that linguistic knowledge consists of just a system of types and associated constraints, then perhaps much of the nature of grammars can be explained in terms of general cognitive principles, rather than idiosyncratic assumptions about the nature of the human language faculty.

APPENDIX

Phrasal types

TYPE	CONSTRAINTS	ISA
sign	[SYNSEM *canonical*]	
phrase		*sign*
hd-ph	HFP, VALP, ECC	*phrase*
hd-nexus-ph	SLIP, WHIP [CONT 1 / HD-DTR [CONT 1]]	*hd-ph*
hd-fill-ph	[SLASH 2 / HD-DTR [HEAD *verbal* / SLASH {1} ∪ 2] / NON-HD-DTRS ⟨[LOCAL 1]⟩]	*hd-nexus-ph*
fin-hd-fill-ph	[HD-DTR [HEAD [*verb* / VFORM *fin*] / SUBJ ⟨ ⟩]]	*hd-fill-ph*
inf-hd-fill-ph	[HD-DTR [HEAD [*comp* / VFORM *inf*] / SUBJ ⟨X⟩]]	*hd-fill-ph*

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TYPE	CONSTRAINTS	ISA
hd-comp-ph	[COMPS ⟨ ⟩, HD-DTR [COMPS ⟨1, …, n⟩], NON-HD-DTRS ⟨[SS 1], …, [SS n]⟩]	*hd-nexus-ph*
hd-spr-ph	[SPR ⟨ ⟩, HD-DTR [SPR ⟨1⟩], NON-HD-DTRS ⟨[SYNSEM 1]⟩]	*hd-nexus-ph*
hd-subj-ph	[SUBJ ⟨ ⟩, HD-DTR [SUBJ ⟨1⟩, SPR ⟨ ⟩], NON-HD-DTRS ⟨[SYNSEM 1]⟩]	*hd-nexus-ph*
fin-hd-subj-ph	[HEAD [*verb*, VFORM *fin*]]	*hd-subj-ph*
hd-adj-ph	[HD-DTR [SYNSEM 1], NON-HD-DTRS ⟨[HEAD [MOD 1]]⟩]	*hd-ph & non-clause*
simp-hd-adj-ph	[…]	*hd-adj-ph*
hd-rel-ph	[HEAD *noun*, CONT [INDEX 2, RESTR 3 ∪ {4}], HD-DTR [INDEX 2, RESTR 3], NON-HD-DTRS ⟨[CONT 4 *proposition*]⟩]	*hd-adj-ph*

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Clausal type

TYPE	CONSTRAINTS	ISA
non-clause		*phrase*
clause	SUBJ list(*PRO*) HEAD [MOD / *none*] REL { } QUE { }	*phrase*
decl-cl	[CONTENT *propostion*]	*clause*
inter-cl	[CONTENT *question*]	*clause*
imp-cl	[CONTENT *directive*]	*clause*
rel-cl	HEAD [MC – INV – MOD [HEAD *noun*]] CONTENT *propostion*	*clause*

Relative clause types

TYPE	CONSTRAINTS	ISA
wh-rel-cl	HEAD [MOD NP$_{\boxed{2}}$] NON-HD-DTRS ⟨[REL {$\boxed{2}$} QUE { }]⟩	*rel-cl*
wh-subj-rel-cl	HD-DTR [REL $\boxed{3}$] NON-HD-DTRS ⟨[REL $\boxed{3}$]⟩	*wh-rel-cl & fin-hd-subj-ph*
fin-wh-fill-rel-cl	[NON-HD-DTRS ⟨[HEAD *noun* ∨ *prep*]⟩]	*wh-rel-cl & fin-hd-fill-ph*
inf-wh-fill-rel-cl	[NON-HD-DTRS ⟨PP⟩]	*wh-rel-cl & inf-hd-fill-ph*
non-wh-rel-cl	HEAD [MOD N′$_{\boxed{1}}$] SLASH { } HD-DTR [SLASH {NP$_{\boxed{1}}$}]	*rel-cl*
bare-rel-cl		*non-wh-rel-cl & fin-hd-subj-ph*
simp-inf-rel-cl	HEAD [*comp* VFORM *inf*]	*non-wh-rel-cl & hd-comp-ph*
red-rel-cl	HEAD [MOD [INDEX $\boxed{1}$]] SUBJ ⟨[INDEX $\boxed{1}$]⟩	*rel-cl & hd-comp-ph*

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