English Filler Gap Constructions*

Ivan A. Sag
Department of Linguistics
Stanford University
Stanford, CA
Email: sag@stanford.edu

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Abstract

This paper delineates and analyzes the syntactic and semantic parameters of variation exhibited by English Filler-Gap constructions. It demonstrates that a detailed, fully explicit account of the observed variation is available within a framework embracing the notion 'grammatical construction.' This account, which explicates similarities and differences among topicalization, interrogatives, relatives, exclamatives, and comparative correlatives in terms of linguistic types and hierarchical constraint inheritance, is articulated in detail within the framework of Sign-Based Construction Grammar, a version of Head-Driven Phrase Structure Grammar (HPSG) integrating key insights from Berkeley Construction Grammar. The results presented here stand as a challenge to any analysis incorporating transformational operations, especially proposals couched within Chomsky's 'Minimalist Program.'

1 Introduction

In the tradition of transformational-generative grammar, the term '(grammatical) construction' has been a theoretical taboo at least since the 1980s. It was then that Chomsky argued that transformations like 'passive' and 'raising', common in earlier versions of transformational grammar, should be eliminated in favor of general conditions on structures that would allow a single operation – 'Move NP' – to do the work of a family of such transformations. In the subsequent evolution of transformational theory, one finds discussion of more general operations, such as 'Move α' or simply 'Move'. This evolution from construction-specific rules to proposals focused on abstract principles from which the idiosyncrasy of individual constructions are supposed to be derived is universally heralded by practitioners of Government-Binding (GB) Theory and the Minimalist Program (MP) as a significant positive step in the evolution of linguistic science.

However, as noted already by McCawley (1988a), the centerpiece of Chomsky's (1986) argument – his discussion of the passive construction – did not touch on crucial issues such as the participial verb morphology, the choice of the preposition *by*, and the role of the verb *be*. As McCawley pointed out, the 'more explanatory' proposals made by Chomsky in fact provided no explanation of the relevant properties of the construction. His analysis of passivization, when complete, would be just as stipulative as, though more abstract than, the construction-based transformational alternative it sought to replace. Obviously unswayed by such criticism, Chomsky (1993: 4) wrote as follows, sowing the seeds of an anticonstructionist bias that remains alive and well even today among practitioners of GB and MP, as well as within related fields that have traditionally relied on generative linguistics for insights and guidance:

> [In a Principles-and-Parameters approach, -IAS] the notion of grammatical construction is eliminated, and with it, the construction-particular rules. Constructions such as verb phrase, relative clause, and passive remain only as taxonomic artifacts, collections of phenomena explained through the interaction of the principles of UG, with the values of the parameters fixed.

But the 'interaction of principles' envisaged by Chomsky and many GB researchers remains elusive. Rhetoric aside, the proposals made within transformational analyses, including GB and MP, are typically poorly justified (even when widely adopted), imprecise (even when presented in seemingly formalized terms), untested for compatibility with other proposals (despite unsubstantiated assertions to that effect), and overly reliant on theory-internal assumptions whose independent motivation remains unclear. In many cases, these proposals are also empirically problematic (once they are made precise enough to test), or else insufficiently predictive of the attested cross-linguistic variation.[1]

Equally problematic is the bifurcation drawn between 'core' phenomena and the 'periphery' of language. The core phenomena are meant to be 'pure instantiations of Universal Grammar', while the periphery consists of 'marked exceptions (irregular verbs, etc.)' (see Chomsky & Lasnik 1993). The move away from constructions has thus led to the study of 'Core Grammar' and to the systematic exclusion of other phenomena. Though the core/periphery distinction is seldom discussed in the MP literature, its pervasive effect on analytic practice is self-evident.

But how are we to know which phenomena belong to the core and which to the periphery? The literature offers no principled criteria for distinguishing the two, despite the obvious danger that without such criteria, the distinction seems both arbitrary and subjective. The bifurcation hence places the field at serious risk of developing a theory of language that is either vacuous or else rife with analyses that are either insufficiently general or otherwise empirically flawed. There is the further danger that grammatical theories developed on the basis of 'core' phenomena may be falsified only by examining data from the periphery – data that falls outside the domain of active inquiry.[2]

In addition, the shift to a focus on an arbitrarily delimited subset of grammatical phenomena (those that relate to the principles of UG, a notion whose ever-fluctuating particulars are seldom made precise,[3]) has led to a loss of both precision and descriptive coverage in the practice of transformational-generative grammar. Indeed, since the precisely articulated transformational analyses of Chomsky 1955, the level of precision and the scope of the descriptive coverage of generative-transformational analyses have been in continual decline. While much linguistic data has been discussed, in the last half century no large-scale, internally consistent transformational grammar has (to my knowledge) been written for any human language.[4] This remarkable fact is a natural consequence of the general perception among practitioners of GB and MP that such large-scale descriptions are irrelevant for theoretical purposes, a view that coincides with the research community's lack of interest in the development of applications (e.g. linguistically precise language engineering technology), which would require that considerable attention be paid to matters of scale and consistency.[5]

Some of these criticisms are not new. A large international research community of 'Construction Grammarians' have articulated many such concerns as a motivation for their focus on the detailed description of phenomena relegated to the grammatical periphery by practitioners of GB and MP. Published works on Construction Grammar (CxG) have tended to be based on case studies (Fillmore *et al.* 1988, Michaelis & Lambrecht 1996, Fillmore 1999, Kay & Fillmore 1999, Michaelis & Ruppenhofer 2001, Kay 2002, Goldberg & Jackendoff 2004) or presented informally (Goldberg 1995, 2006, Croft 2001, Michaelis 2004), and the model has become associated with data-driven or exemplar-based models of language learning, rather than learning models based on UG (see, e.g. Tomasello 2003, 2008). All this has created a general impression within the GB/MP community that CxG is largely obsessed with trivia, theoretically uninteresting and wrong-headed about issues of learning.

It is interesting to put these matters in historical perspective. Once the operations of transformational theory were reduced to nothing but 'Move' and 'Merge' (as in current MP), the focus of grammatical analysis moved to locating specific features that trigger movement and/or agreement within a space of structures. Further, it has been assumed that these features have specific semantic import. The following seminal, turn-of-the-century quotes define the current MP practice quite accurately:

> In fact, a restrictive theory should force a one-to-one relation between position and interpretation . . . each projection has a specific semantic interpretation. (Cinque 1999: 20,132)

> Syntactic movement . . . must be triggered by the satisfaction of certain

> quasi-morphological requirements of heads. . . . [S]uch features have an interpretive import (Wh, Neg, Top, Foc, . . .): they determine the interpretation of the category bearing them and of its immediate constituents . . . (Rizzi 1997: 282)

However, as Borsley (2006; 2007) points out, an analysis that posits an invisible element heading a functional projection with a certain set of properties and a specific interpretation is little different from a construction-based account that associates the same set of properties with the interpretation directly.[6] Thus, a theory of this kind, were it ever to be fleshed out, would become a kind of Construction Grammar. However, current discussion in MP are of minimal scope, are articulated with a remarkable tentativeness (e.g. reminders that MP is 'a program, not a theory' (Chomsky 2000), and frequently offer the vaguest of conclusions, e.g. that a given projection must be 'higher than' or 'at least as high as' some other or that a particular position would be supported if a given argument is 'on the right track' (e.g. Pesetsky 2000:20,157; Hornstein *et al.* 2005:275). Moreover, MP discussions are preoccupied with theoretical speculations that are not grounded in any well worked out analysis; indeed, there are to my knowledge no MP analyses worked out with the precision that is customary in constraint-based linguistics. In short, in the half century that transformational-generative grammar has completely dominated the mainstream of syntactic theory, it has failed to produce a single generative grammar, at least if we assume the standard definition of that term (i.e. Chomsky's) as 'a precisely formulated set of rules whose output is all (and only) the sentences of a language'.

In this paper I demonstrate that there is in fact no inconsistency between the concern for general principles of grammar (even UG in Chomsky's sense), precise grammar formulation, and rich descriptive coverage of the sort envisaged by CxG researchers. While it remains true that the 'standard theory' transformational grammars that Chomsky disparages in the quote cited above fail to provide a basis for expressing generalizations over construction-specific transformations, there are nonetheless other, nontransformational methods for grammatical analysis that allow cross-constructional generalizations to be expressed naturally. These 'object-oriented' techniques, e.g. object typing, type hierarchies, and constraint inheritance, are well known in computer science generally and have played an important role in the development of 'constraint-based' approaches to grammar, most notably Head-Driven Phrase Structure Grammar (HPSG). These techniques are conspicuously absent from the transformational-generative tradition, whose practitioners continue to formulate their theories in terms of 'rewrite rules' (a class that includes movement operations of all sorts).

I will draw on widely utilized object-oriented resources to develop a construction-based theory of English filler-gap (F-G) constructions which define an important subset of English gap-binding structures. My analysis extends to F-G clauses of all kinds, including (but not limited to) interrogatives, relatives, exclamatives, 'topicalizations', and the *the*-clauses that appear within comparative correlative ('*The More the Merrier*') constructions. The account sketched here (and in more detail for interrogative constructions in Ginzburg & Sag 2000 (henceforth G&S 2000)) uses feature structures to model linguistic entities of all kinds. This system classifies feature structures in terms of hierarchically organized linguistic **types**, allowing constraints of varying grain to be stated in a natural fashion. This reflects the fact that the structures of natural language come patterned into classes whose members bear a 'family resemblance' to one another.

The analysis that emerges from this perspective attends to matters of detail that have remained

largely untreated in the last half century of transformational generative research on '*wh*-movement' or '$\overline{\text{A}}$-movement'. It provides a mathematically precise account of both generalization and idiosyncrasy in the F-G construction space. Significantly, it also expands the descriptive and explanatory base of grammatical theory to include both 'core' and 'peripheral' phenomena. As will become apparent, there are grammatical generalizations that cut across this distinction, however it might be drawn. My exposition will be relatively informal, but a formalized summary of the grammar I develop is presented in the appendices.

2 The Diversity of Filler-Gap Clauses

Modern discussions of gap-binding dependencies emphasize the properties they have in common, e.g. the relatively uniform unbounded nature of the dependencies, modulo 'island' effects. These basic patterns are reasonably well-established, though considerable uncertainty remains about the role of processing in explaining island effects.[7]

In addition to the many transformational discussions of the English data, there are also several precisely formulated, constraint-based analyses that have now been developed in a number of frameworks, including Generalized Phrase Structure Grammar (Gazdar *et al.* 1985), Combinatory Categorial Grammar (Steedman 1996, 2000), Lexical-Functional Grammar (Kaplan & Zaenen 1989), Tree-Adjoining Grammar (Kroch 1987, 1989), the 'Simpler Syntax' hypothesis (Culicover & Jackendoff 2005, Ch. 9), and HPSG (Bouma *et al.* 2001; Levine & Hukari 2006). What is systematically left out of such analyses, however, is the fact that individual F-G clauses exhibit considerable variation with respect to a number of syntactic and semantic properties.

2.1 Parameters of Variation

This section outlines the relevant differences among *wh*-interrogative, *wh*-exclamative, topicalized, *wh*-relative, and *the*-clauses.[8] These constructions are illustrated in 1–5:

(1) ***Wh*-Interrogative Clause:**

a. How foolish is he?

b. (I wonder) how foolish he is.

(2) ***Wh*-Exclamative Clause:**

a. What a fool he is!

b. (It's amazing) how odd it is.

(3) **Topicalized Clause:**

The bagels, I like.

(4) ***Wh*-Relative Clause:**

a. (I met the person) who they nominated.

b. (I'm looking for a bank) in which to place my trust

(5) ***The*-Clause:**

a. (The more people I met,) the happier I became.

b. The more people I met, (the happier I became).

All five kinds of clause exhibit a gap-binding dependency between a clause-initial filler phrase and a gap located within the sentential head daughter. However there are several parameters of variation that distinguish these types of clause from one another, including the following:

(6) **Parameters of Variation in F-G Clauses:**

a. Is there a distinguished *wh* element in the filler daughter, and if so, what kind?

b. What are the possible syntactic categories of the filler daughter?

c. What are the possible syntactic categories of the head daughter?

d. Can the head daughter be inverted/finite? Must it be?

e. What are the mother's meaning and syntactic category?

f. Is the clause an island?

g. Must it be an 'independent' clause?

Let us consider these in turn. The five types of F-G clause each impose a distinct condition: the filler daughter of a topicalized clause must contain no distinguished element (*wh*-phrase or *the*-phrase); *wh*-interrogative, *wh*-relative, and *wh*-exclamative clauses each require the filler daughter to contain a distinct type of *wh*-element; and the filler of a *the*-clause must contain the definite degree marker *the*. These requirements are illustrated in 7:

(7) **Distinguished Elements within the Filler Daughter:**

a. [My bagels], she likes. (topicalized clause)

b. [**What** (books)] do they like? (*wh*-interrogative)

c. (the person) [**who**(**se** book)] they like . . . (*wh*-relative)

d. [**What** a play] he wrote! (*wh*-exclamative)

e. [**the more** books] they read . . . (*the*-clause)

When these requirements are not met, we find ungrammatical examples like the following:

(8) **Mismatches of Distinguished Element**

a. *[**Which** bagels]/*[**Who**], she likes. (topicalized clause)

b. *[**What a** book] do they like? (*wh*-interrogative)

c. %the thing [[**what**] they like] . . . (*wh*-relative)

d. *[**Which** bagels]/*[**What**] she likes! (*wh*-exclamative)

e. *[**which** books] they read, the more they learn. (*the*-clause)

The variation in *wh*-forms is in part the residue of historical processes. The ancient Indo-European pattern involved distinct pronominal paradigms for interrogative, relative, and ('proximate' and 'remote') demonstrative forms[9] that have gradually been leveled in the historical evolution of Present-Day English. The modern inventory of forms, usually lumped together by generative syntacticians as '*wh*-words', is shown in Figure 1.[10]

FIGURE 1 ABOUT HERE

The data motivating these fine-grained distinctions include the following:[11]

(9) a. Who did they visit?

b.*Who they visited!

c. The person who they visited . . .

(10) a. Whose book did she read?

b.*Whose book she read!

c. The person whose book she read . . .

(11) a. What did she read?

b.*What she read!

c.%The only book what she read . . .

(12) a. What book did she read?

b.*What book she read!

c.*The only one what book she read . . .

(13) a. What books did she read?

b. What books she read!

c.*The only ones what books she read . . .

(14) a. What fun did they manage to have?

b. What fun they managed to have!

c.*The only thing what fun they managed to have . . .

(15) a.*What a good time did they manage to have?

b. What a good time they managed to have!

c.*The only thing what a good time they managed to have . . .

(16) a. Which did she read?

b.*Which she read!

c. The only book which she read . . .

(17) a. Which book did she read?

b.*Which book she read!

c.*The only one which book she read . . .

(18) a. How did the bird irritate the wolf?

b. How the bird irritated the wolf! [*Peter and the Wolf*]

c.%The way how the bird irritated the wolf . . .

(19) a. How was it?

b.*How it was!

c.*The color how it was . . .

(20) a. How tall did they get?

b. How tall they got!

c.*The extent how tall they got . . .

(21) a. When did they do that?

b.*When they did that!

c. The time when they did that . . .

(22) a. Where did they do that?

b.*Where they did that!

c. The place where they did that . . .

(23) a. Why did they do that?

b.*Why they did that!

c. The reason why they did that . . .

Moreover, there are differences in where the *wh*-word can be positioned within the filler daughter (differences in 'pied piping' environments):

(24) a. Those dignitaries [[**pictures of** *whom*] the newspaper had already published] . . . (*wh*-relative)

b.*I wonder [[**pictures of** *whom*] the newspaper had already published]. (*wh*-interrogative)

c.*[**pictures of** *what* **a liar**] the newspaper published! (*wh*-exclamative)

There is thus no morphological or syntactic unity underlying the concept of an English '*wh*-expression'. Recall also that overt *wh*-expressions are entirely absent from many F-G constructions (*tough*-constructions, topicalization, comparative clauses, comparative correlative constructions, bare relative clauses, etc.), all of which have at some time been forced into the procrustean bed of '*wh*-movement' (with obligatory *wh*-deletion rules called on to reconcile the analysis with the observed facts). But the very notion of '*wh*-movement' is suspect – at best a crude and misleading rubric for the discussion of gap-binding constructions.[12]

The five types of F-G clauses also differ with respect to the constraints they impose on the syntactic category of the filler daughter:[13]

(25) **Syntactic Category of the Filler Daughter:**

a. Topicalization: NP, PP, AP, AdvP, VP[14]/*Wh*-interrogative/*Wh*-exclamative/*The*-clause:

NP, PP, AP, AdvP

b. Finite relative: NP, PP

c. Infinitival relative: PP

A grammar that provides no mechanism for imposing such category restrictions will overgenerate, allowing ungrammatical examples like the following:

(26) **Mismatched Filler Categories:**

a. *the person [[**happy with whom**] Kim is]...

b. *[**visit what a mansion**] they did!

c. *[**the more write books**] she does (, the more people listen).

d. *the people [**who(m)**] to confer with]...

Another parameter of variation concerns the syntactic category of the head daughter:

(27) **Syntactic Category of the Head Daughter:**

a. Topicalization/Interrogative/Relative/Exclamative Clauses: *S*

*Bagels, **that I like**

*who **that we like**. (*wh*-interrogative/relative or exclamative)

b. *The*-Clause: *S* or *CP*

The more **(that) you see**, the more **(that) you like**.

Moreover, there is variation with regard to the position (or requirement) of an auxiliary verb within the head daughter (see the discussion of aux-initial clauses in section 3 below):

(28) **Must/Can the head daughter be an inverted clause?**

a. *Wh*-interrogative: *inverted only in independent clause*.

How tall **is Kim**?/*I wonder how tall **is Kim**.

b. Topicalization, *Wh*-relative/*Wh*-exclamative: *never inverted*.

*Bagels, **do they like _** ?/!

*the one who **did he see**...

*How tall **is Kim _** !/*What a nice person **is Kim talking to _** !

c. Noninitial *The*-clause: *optional inversion*

The more my head has ached, the more **have I/I have indulged in humor**. (See Culicover and Jackendoff 1999: 559.)

And only certain F-G clauses allow infinitival realizations, as summarized in 29:

(29) **Must/Can the head daughter be infinitival?**

a. Topicalization/*Wh*-exclamative/*The*-clause: always finite; never infinitival.

*Bagels, **(for us) to like**.

*It's amazing [what a dunce **(for them) to talk to**].

*The harder **(for them) to come**, the harder **(for them) to fall**.

b. *Wh*-interrogative/relative: infinitival VP head daughter possible.

I know how much time **(*for them) to take**.

The time in which **(*for them) to finish** . . .

In addition, as is well known, the semantics of F-G clauses is not uniform. These are determined as indicated:

(30) **Semantics of the Clause:**

a. Interrogative: *question*

b. Relative: *proposition*

c. Exclamative: *fact*

d. *The*-Clause: *austinean* (see section 5.5)

e. Topicalization: *austinean*

This classification follows G&S 2000, who motivate a Vendlerian semantic analysis[15] that recognizes facts, propositions, questions, and outcomes as distinct types of semantic object.[16]

Finally, it is well known that certain constructions (e.g. topicalization, inverted *wh*-interrogatives) are restricted to main (independent) clauses, while others (e.g. relative clauses, uninverted nonsubject *wh*-interrogatives) appear only in embedded contexts. However, few attempts are made in the generative literature to provide a precise characterization of the restrictions on these F-G-constructions, or an account of why other construction types, e.g. *wh*-exclamatives, subject *wh*-interrogatives, freely appear in both environments:

(31) a. It's amazing [**what a nice guy Kim is**].

b. What a nice guy Kim is!

c. Everyone wondered [**who did it**].

d. Who did it?

As noted in the introduction, transformational discussions have largely overlooked the data sets summarized in this section, focusing instead on proposals of ever increasing metatheoretical abstractness, ever diminishing empirical breadth, and ever declining precision. Surprisingly, these proposals are often accompanied by claims about explanatory progress, e.g. the assessment offered by Chomsky (1993: 435):

> A look at the earliest work from the mid-1950s will show that many phenomena that fell within the rich descriptive apparatus then postulated, often with accounts of no little interest and insight, lack any serious analysis within the much narrower theories motivated by the search for explanatory adequacy and remain among the huge mass of constructions for which no principled explanation exists—again, not an unusual concomitant of progress.

However, as Paul Kay reminds me, while accepting with equanimity a progressive reduction of the range of facts that lie within the domain of a scientific theory may be within the *mainstream* of generative linguistics, it is well outside the mainstream of scientific practice, and should surely be regarded with extreme skepticism, if more comprehensive alternative theories are available.

The distinctions surveyed in this section evidently follow neither from more general cognitive or functional principles, nor from any deep principles of human biology or UG. Yet they are part of adult linguistic competence; hence the existence of these distinctions leads us to the conclusion that a theory of language learning must take on the burden of explaining how the varying grains of delimited generalization are abstracted from linguistic experience. The various construction-specific constraints discussed in this paper must thus be seen as part of any observationally adequate grammar of English and no such grammar has (to my knowledge) ever been developed (let alone provided with a 'principled explanation') within any 'much narrower' theory – not in the transformational literature, not in the GB literature, and certainly not in the MP literature. In the sections that follow, I will demonstrate that if we step outside the narrow theoretical confines of transformational grammar, GB and MP, then it becomes possible to articulate a precise framework that allows grammars expressing the appropriate generalizations governing English F-G constructions, while at the same time providing an analysis of the idiosyncrasies found in the data sets outlined above.

3 Background

Early work in Head-Driven Phrase Structure Grammar (HPSG)[17] adapted multiple inheritance hierarchies, already used in computational work in knowledge representation and object-oriented programming, to express cross-classifying generalizations about words. This same general approach has subsequently been applied in various ways to the grammar of phrases by other linguists. Notable examples of such work are Hudson's (1990, 2000) Word Grammar, the construction-based variety of HPSG developed in Sag 1997 and G&S 2000, and the variety of CxG emanating from Berkeley, beginning in the mid 1980s (see Fillmore *et al.* 1988, Fillmore 1999, Kay & Fillmore 1999, and Goldberg 1995).[18] In all of these traditions, generalizations about constructions are expressed through the interaction of a hierarchical classification of types and the type-based inheritance of grammatical constraints.

In addition, as argued by Johnson & Lappin (1999), there are certain kinds of cross-linguistic generalizations that are difficult to state in a grammar lacking the notion of 'construction'. A solution to this problem can be found in the work of Pollard & Sag (1994) and Ackerman & Webelhuth (1998), who observe that a type-based system of grammar could (but need not) embody the claim that certain types are part of a universal inventory, making strong nativist assumptions along the lines of Chomsky's UG (see also Prince 1996). Alternatively, one may appeal to cognitive, communicative, and other functional considerations to explain why linguistic evolution favors certain types (more precisely, the constraints associated with them), without assuming that these are 'hard-wired' as part of human biology. These are significantly different views of UG, but both are compatible with the view that grammars are based on the notion of construction, explicated in terms of typed feature structures and hierarchically organized type constraints.

3.1 Analytic Preliminaries

G&S 2000, whose approach I recast here in streamlined form, provides an account of a number of declarative clauses in terms of a hierarchy of clause types. In the sign-based theory of Construction Grammar I present here (SBCG; see Boas & Sag to appear), **words** and **phrases** are modeled as **signs** (*sign* is a type of feature structure reflecting a grammatically induced correspondence of sound, morphology, syntactic category, meaning, and/or contextual conditions). A sign thus specifies values for the features PHONOLOGY (PHON), FORM, SYNTAX (SYN), SEMANTICS (SEM), and CONTEXT (CNTXT), as shown in 32:

(32)
$$\begin{bmatrix} \textit{sign} & \\ \text{PHON} & \textit{phonological-object} \\ \text{FORM} & \textit{morphological-object} \\ \text{SYN} & \textit{syntactic-object} \\ \text{SEM} & \textit{linguistic-meaning} \\ \text{CNTXT} & \textit{context-object} \end{bmatrix}$$

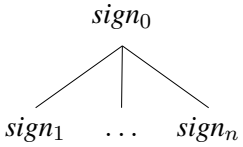
More precisely, a sign is a function that maps each of the features in 32 to an appropriate domain, specified by the grammar signature in terms of a given FS type. Since the domain of functions of type *sign* is the set {PHON, FORM, SYN, SEM, CNTXT}, each particular sign maps each element of this domain to a different, appropriate type of complex value, i.e. another functional feature structure. Those functional feature structures in turn map each feature from their domain to a value drawn from an appropriate set, some of which may be atoms like $+$, $-$, or *accusative*.

A construction, by contrast, is a constraint defining a class of mother-daughter configurations, much as a rule defines a set of local trees in a Context-Free Grammar (CFG).[19] These configurations are modeled as feature structures of a different type: *construct*.[20] A feature structure of this type is a function mapping the feature MOTHER (MTR) to a sign and the feature DAUGHTERS (DTRS) to a list of signs.[21] We may represent such functions in the same format we used in 32, as shown in 33:

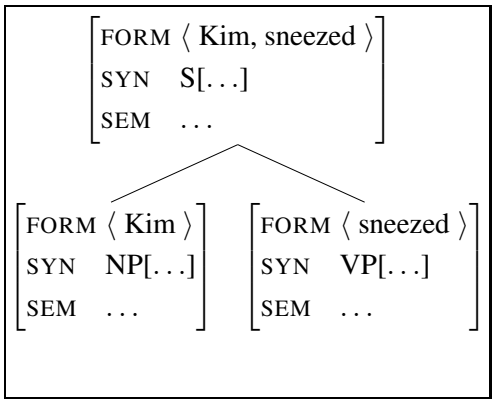
(33)
$$\begin{bmatrix} \textit{construct} & \\ \text{MTR} & \textit{sign}_0 \\ \text{DTRS} & \langle\, \textit{sign}_1, \ldots, \textit{sign}_n \,\rangle \end{bmatrix}$$

A structure like 33 conveys exactly the same information as a local tree like 34a, an instance of which is sketched in 34b:[22]

(34) a.



b.



While feature structures of type *sign* model the conventional sound-meaning correspondences of lexemes, uninflected words, and certain kinds of multiword expressions, constructs define the sound-meaning correspondences that arise when a given sign is 'constructed' from one or more signs by means of a combinatoric construction.

Sign well-formedness in SBCG is defined by the following principle:[23]

(35) **Sign Principle:**

Every sign must be listemically or constructionally licensed, where:

a sign is listemically licensed only if it satisfies some listeme, and
a sign is constructionally licensed only if it is the mother of some construct.

The constructions of the grammar thus interact with the set of listemes to impose constraints on sign well-formedness. Because of the specifics of the English constructicon (the set of listemes together with the inventory of constructions), the signs in 36 are licensed by English grammar and those in 37 are not:

(36) a.
$$\begin{bmatrix} \text{PHON} & \textit{/kIm/} \\ \text{FORM} & \langle\ \text{Kim}\ \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \textit{noun} \\ \text{VAL} & \langle\ \rangle \end{bmatrix} \\ \text{SEM} & \textbf{Kim} \\ \text{CNTXT} & .... \end{bmatrix}$$

b.
$$\begin{bmatrix} \text{PHON} & \textit{/kIm\#snizd/} \\ \text{FORM} & \langle\ \text{Kim, sneezed}\ \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \textit{verb} \\ \text{INV} & - \\ \text{AUX} & - \end{bmatrix} \\ \text{VAL} & \langle\ \rangle \end{bmatrix} \\ \text{SEM} & \textbf{PAST(sneeze)(Kim)} \\ \text{CNTXT} & .... \end{bmatrix}$$

(37) a. *
$$\begin{bmatrix} \text{PHON} & \textit{/kIm/} \\ \text{FORM} & \langle\ \text{Kim}\ \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \textit{prep} \\ \text{VAL} & \langle\ \text{NP}\ \rangle \end{bmatrix} \\ \text{SEM} & \textbf{Kim} \\ \text{CNTXT} & .... \end{bmatrix}$$

b. *
$$\begin{bmatrix} \text{PHON} & \textit{/snizd\#kIm/} \\ \text{FORM} & \langle\ \text{sneezed, Kim}\ \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \textit{verb} \\ \text{INV} & + \\ \text{AUX} & - \end{bmatrix} \\ \text{VAL} & \langle\ \rangle \end{bmatrix} \\ \text{SEM} & \textbf{PAST(sneeze)(Kim)} \\ \text{CNTXT} & .... \end{bmatrix}$$

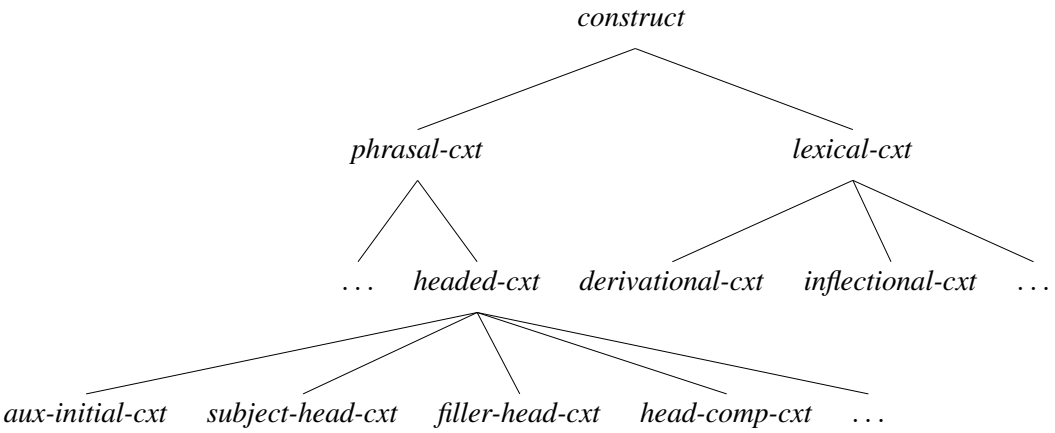
I am assuming that syntactic objects (the values of the feature SYN (SYNTAX)) are feature structures specifying values for CATEGORY (CAT) and VALENCE (VAL), and that categories are feature structure complexes, similar to those used in $\overline{\text{X}}$-Theory. I'm simplifying morphology by describing FORM values in terms of a sequence of orthographic representations; the semantics used here is also simplified in ways I will explain in due course. All of the feature structures in 36–37 conform to the basic structure assumed for feature structures of type *sign*, i.e. they are consistent with the signature of the grammar (see Sag 2011). The problems with the signs in 37 involve incorrect category and valence in 37a and incorrect word order and INV value in 37b.

The 'stand-alone' sentences defined by an SBCG are those well-formed signs whose category includes the specifications appropriate for a finite ([VFORM *fin*]), root ([IC +]), verbal projection.[24] A SBCG thus defines a set of structures, each of which is grounded in lexical signs and which can be represented as a tree, much like the tree structures of a Context-Free Grammar. However, the labels on the nodes of these trees are not atomic category names (NP, S, V, etc.), but rather feature structures of type *sign*, similar to the practice of other frameworks, e.g. Categorial Grammar or Generalized Phrase Structure Grammar. And like CFG rules, SBCG constructions are static constraints that license local structures.

The variable grain of grammatical generalizations is modeled precisely in a type system, where idiosyncratic constraints can be imposed by a construction that defines the properties of a 'maximal' type (one that lacks subtypes), while constraints of full generality or of intermediate grain can be stated in terms of appropriate superordinate types, e.g. *construct*, or any of the

subtypes of *construct* that the grammar recognizes. Some of the types relevant to the English clauses considered here are sketched in 38:[25]

(38)



Each subtype of *construct* in 38 corresponds to a class of constructs that exhibit some grammatically significant set of properties. Each such property set is specified by a combinatoric construction – an implicational (conditional) constraint whose antecedent is the name of that subtype. Phrasal constructs license phrases, according to 35 above; that is, the MTR value of any feature structures of type *phrasal-cxt* must be of type *phrase*. A FS of type *headed-cxt*, specifies a value (a word or phrase) for the feature HD-DTR, in addition to the specification it provides for the features MTR and DTRS. The value of HD-DTR is always identified with one of the members of the DTRS list. The different subtypes of *headed-cxt* provide a more or less traditional taxonomy of local dependency relations between the head-daughter and its sister(s).

An important constraint associated with headed constructs is the Head Feature Principle, which requires the mother's syntactic category to be identical to that of its head daughter. This constraint – in effect, the 'X' of $\overline{\text{X}}$-Theory – is stated succinctly in 39:[26]

(39) **Headed Construction (↑*phrasal-cxt*):**

$$\textit{headed-cxt} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SYN} \ [\text{CAT} \ X \ ]] \\ \text{HD-DTR} & [\text{SYN} \ [\text{CAT} \ X \ ]] \end{bmatrix}$$

The Head Feature Principle is a general constraint with significant consequences for the headed structures of a language. Other constraints, such as the one in 40, specify the defining properties of a particular subset of headed constructs:[27]

(40) **Aux-Initial Construction (↑*headed-cxt*):**

$$\textit{aux-initial-cxt} \Rightarrow \begin{bmatrix} \text{MTR} & \left[\text{SYN} \quad X\,!\left[\text{VAL} \quad \langle\,\rangle\right]\right] \\ \text{DTRS} & \langle\, H\,\rangle \oplus L \\ \text{HD-DTR} & H:\begin{bmatrix} \textit{word} \\ \text{SYN} \quad X:\begin{bmatrix} \text{CAT} & [\text{INV} \quad +] \\ \text{VAL} & L:\textit{nelist} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

This construction requires that in aux-initial clauses, which come in many varieties in English, the head (first) daughter must be a [INV +] word, which (given lexical specifications) guarantees that all such constructs are headed by an 'invertible' finite auxiliary verb. The sisters of the head daughter are identified with the elements of its VAL list and hence correspond to its subject and any other **valents** that it selects. Since the mother's VAL list is empty (i.e. the mother of an aux-initial clause must be [VAL $\langle\,\rangle$]), the constructed clause cannot combine with further valents (i.e. it is 'valence-saturated').

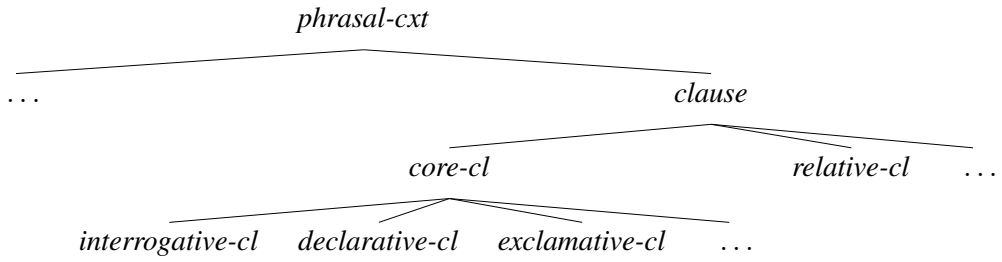
The constraint in 40 predicts the common properties of aux-initial clauses. Almost all finite auxiliary verbs are analyzed in terms of listemes that are unspecified for INV and AUX and hence may head aux-inital constructs.[28] At a finer grain, we find particular varieties of aux-initial clause, each with its own distinctive meaning, as illustrated in Figure 2.[29] These examples clearly instantiate distinct constructions, each involving a language-particular correlation of aux-initial form with a particular meaning, as well as other kinds of idiosyncrasy. But they also exhibit a 'family resemblance', one that is captured by the constraint in 40, taken together with the type hierarchy sketched in the next section.

[FIGURE 2 ABOUT HERE]

3.2 Clausal Constructs

Following Sag 1997 and G&S 2000, I assume that phrasal constructs are also organized in terms of clausal types. That is, there is a subtype of *phrasal-cxt* called *clause* (*cl*), which has various subtypes, including *core-cl* and *relative-cl*. The subtypes of core clause include *declarative-cl*, *interrogative-cl*, and *exclamative-cl*, as shown in 41:

(41)



A given clausal construct is simultaneously classified in the two dimensions of headedness (38) and clausality (41). This cross-classification allows orthogonal generalizations to be

expressed via type constraints, as illustrated in Figure 3 for two kinds of aux-initial construct: *polar-interrogative-clause* (*polar-int-cl*) and *auxinitial-exclamative-clause* (*auxinitial-excl-cl*). The former must simultaneously obey 40 and the constraints that define *interrogative-clause*; the latter must simultaneously obey 40 and the constraints that define *exclamative-clause*. A construct of the former type is shown in Figure 4, using attribute-value matrix (AVM) notation.[30] A similar treatment provides each other kind of aux-initial clause with its own semantics and grammatical restrictions, thus enabling the analysis sketched here to 'scale up' to account for the complete set of English aux-initial constructs.[31]

[FIGURE 3 ABOUT HERE]

[FIGURE 4 ABOUT HERE]

The semantics in Figure 4 requires some explanation. For convenience, I am assuming a 'Montague-style' semantics for clauses and other expressions. For example, a proposition-denoting expression is built up in 'Schönfinkel form', where the verb's semantics combines with one argument at a time – e.g. first the direct object, then the subject. Tense operators are then functional expressions that map **get(the-job)** (the SEM value of the untensed VP *get the job*) to a function from NP denotations to propositions. **past(get(the-job))** can hence apply to the denotation of **Kim** to give the proposition **PAST(get(the-job))(Kim)**, which is true just in case (the intended individual) Kim got the (intended) job at some time in the past.[32] The non-*wh*-question $\lambda\{\ \}$**[PAST(get(the-job))(Kim)]** is formed by λ-abstracting over the empty set to produce a function that maps the empty set (as opposed to a nonempty set of *wh*-parameters) onto the same proposition that *Kim got the job* denotes.

Next, we consider the Subject-Predicate Clause Construction, which defines the most common type of clausal construct in English. Following G&S 2000, I assume that there are a number of similar constructions, including the one that defines 'Mad Magazine' sentences like 42a (see Akmajian (1984) and Lambrecht (1990), among others) and the construction responsible for absolute clauses like the one in 42b (see Stump 1985 and Culicover & Jackendoff 2005):[33]

(42) a. What, {[Me] [worry]}?

b. {[My friends] [in jail]}, I'm in deep trouble.

The Subject-Predicate Construction exists independently of these, licensing simple declarative clauses like 43a, present subjunctive clauses like 43b, and imperative-like clauses with subjects, like 43c:

(43) a. {[Sandy] [leaves me alone]}.

b. I insist that {[Sandy] [leave me alone]}.

c. {[You]/[Everyone] [leave me alone]}!

The semantic distinctions required in particular contexts result from the semantic difference between indicative words (denoting functions to propositions) and subjunctive words (denoting functions to outcomes). Note that subject-predicate clauses are classified in terms of the more general Subject-Head Construction, which ensures that the second of two daughters in a *subject-head-cxt* selects the first via VAL.[34]

Because of the hierararchical organization of construct types posited here, we can formulate the Subject-Predicate Construction in streamlined terms as 44:
The Declarative Clause Construction requires that the mother's semantics be *austinean*.[35] The mother's SEM value in 43 says simply that the semantics of the VP daughter (**Y**, a functor of the appropriate type) applies to the semantics of the subject daughter (**X**), which will produce a semantics of type *proposition* or *outcome*.

The head daughter and mother of any such clause must be specified as [VFORM *fin*], as indicated in 43. In addition, 43 imposes a requirement that the head daughter and mother must be specified as [INV −] and [AUX −]

.[36] These interactions together correctly rule out both non-finite clauses like 44a,b, clauses containing [INV +] lexical heads like 44c, and clauses headed by unfocused auxiliary *do* (like 44d), as well as a host of other examples discussed more fully in G&S 2000 and in Sag to appear:

(44) a.*{[Kim] [to go home].}

b.*{[Pat] [standing on my foot].}

c.*{[I] [aren't coming to the party].}

d.*{[Kim] [dĭd leave].}

A subject-predicate clause thus involves exactly two daughters because all subject-head constructs do: the first is the subject daughter; the second is the head daughter, which selects the first daughter as its only valent. The REL and WH constraints imposed by the Declarative Clause Construction (requiring that both daughters' values for these features be empty) prevent an interrogative, exclamative, or relative *wh*-word (other than an in situ interrogative *wh*-word) from appearing within a declarative clause, as will become clear in the subsequent discussion.

Moreover, a subject-predicate clause cannot be a modifier, i.e. it is specified as [SELECT *none*]. This follows from the more general fact that declarative clauses are a kind of core clause (*core-cl* is a supertype of *declarative-cl*) and core clauses may not serve as modifiers. Core clauses are also required to be finite or infinitival (see Appendix 2). In sum, the hierarchy of types in Figure 5 provides a theory of the various generalizations that subject-predicate clauses obey, with each type corresponding to a generalization that holds over a distinct class of constructs.

[FIGURE 5 ABOUT HERE]

And in virtue of Subject-Predicate Construction, taken together with our theory of feature structures, clauses, constraints, and constraint inheritance, it follows that subject-predicate clauses have the properties sketched in Figure 6, where **PAST**(**snore**)(**Kim**) represents the proposition obtained by applying the indicative verb's semantics (that is: **PAST**(**snore**)) to that of the subject NP.

[FIGURE 6 ABOUT HERE]

Finally, the work done by the Head Feature Principle – ensuring that the feature specifications of the lexical head daughter are 'percolated up' to the clause itself – is fundamental. This is what allows finite clauses to be identified as such locally under subcategorization, or for inverted clauses to be selected by some superordinate construction. For example, the Negative Adverb Preposing Construction (which licenses {[*Never*] [*have I seen such an ugly fish*]}) and the Tag Question Construction (which licenses {[*We won't go,*] [*will we*]}?) both require that the second daughter be specified as [INV +]. In SBCG, constructions cannot make reference to other constructions. This follows directly from the fact that (1) constructions license constructs (which are local, i.e. mother-daughter structures) and (2) constructs are configurations of signs, not constructs.[37,38]

4 The Uniformity of Filler-Gap Constructions

4.1 Generalizations

A large body of research extending back to the 1950s has reached a number of conclusions about the nature of filler-gap dependencies, i.e. dependencies between a gap (the absence of an element – or the presence of an empty element – a '*wh*-trace') and a superordinate syntactic environment where the gap is 'bound'. These generalizations can be stated in theory-independent terms and are reasonably viewed as criteria by which proposed theories of F-G dependencies should be evaluated.

Filler-Gap dependencies are unbounded. There is no longest grammatical sentence instantiating a given F-G-dependency. Various factors interact to make longer sentences harder to process, but these are outside the domain of competence grammar. Thus all of the following instantiations of the *WH*-Relative Clause Construction are grammatically well-formed:

(45) a. (the person) [who I saw __]. . .

b. (the person) [who you think I saw __]. . .

c. (the person) [who (I heard (they claim...)) you said you think I saw __] . . .

Filler-Gap dependencies exhibit island effects. F-G dependencies manifest various island effects involving complex structures that induce unacceptability, and possibly ungrammaticality:

(46) a. (the person) [who you met [students [who saw __]]]. . .

b. (the person) [who you heard [rumors [that [a student saw __]]]]. . .

c. (the person) [who you wondered [whether [I saw __]]]. . .

d. (the person) [who you met [students and __]]. . .

There is an ongoing debate as to whether or not some of these effects can be explained in terms of processing factors, rather than grammar,[39] but it is generally accepted that there are some syntactic environments where grammar must prevent gaps from appearing.

There are both lexical and constructional binding environments. The superordinate environment where gap-binding takes place may be lexical or constructional. That is, there are lexical items like *tough*, *easy*, *hard*, and *ready* which (in one of their valence patterns) must bind a gap within their infinitival complement:

(47) a. Kim is *easy* [(for us) to talk to __].

b. [Getting herself arrested on purpose] is hard [(for us) to imagine Betsy being willing to consider __]. (Postal & Ross 1971)

Some lexical binders in fact appear in a position subordinate to the environment where binding must occur (Chae 1992). These 'subbinding' triggers, properly contained within phrases that are in construction with the gap-containing clause, include *too*, *enough*, and comparatives:

(48) a. Wilt is [[*too* tall] [(for her) to dance with __]].

b. Lee is [[short *enough*] [(for her) to dance with __]].

c. Bo is [[three feet *taller*] [than Mo is __]].

For a treatment of such cases that is compatible with the analysis presented here, see Kay & Sag in press.

A filler can bind multiple gaps. Although a gap is most commonly associated with a single filler (or lexical binder), there are two classes of environment where multiple gaps are associated with a single binder. In coordinate structures, a gap may appear in each conjunct, exhibiting Ross's (1967) 'across-the-board' effect:[40]

(49) a. Who did you say [Sandy liked __ and Lee hated __]?

b.*Who did you say [Sandy liked __ and Lee went to the store]?

c.*Who did you say [Sandy went to the store and Lee liked __]?

Additionally, so called 'parasitic' gaps (**pg**) exhibit an optional one-to-many filler-gap relation:

(50)a. Which CDs did Sandy [file __ [before listening to **pg**]]?

b. ??Which CDs did Sandy [file the papers [before listening to __]]?

(51)a. Which of the books did you think [[Sandy's review of **pg**] [was sufficient to eliminate __ from the reading list of our intro course]]?

b. Which of the books did you think [[Sandy's review of the genre] [was sufficient to eliminate __ from the reading list of our intro course]]?

c. ??Which of the books did you think [[Sandy's review of __] [was sufficiently incompetent to disqualify him from our committee]]?

It is widely assumed (following Cinque 1990 and/or Postal 1998) that the parasitic gaps in these examples are pronominal in nature, and hence merely coindexed with the fillers in examples 50–51, or bound by an 'empty operator'. However, the pronominal status of the parasitic gaps in these examples has been called into question by the detailed critique of Levine & Hukari (2006) (cf. also Levine *et al.* 2001). As Levine and colleagues show at length, the analysis of fillers and gaps must be unified: the multiple gaps in examples like 50a and 51a are directly bound by a single filler, just as a quantifier in predicate logic can bind multiple occurrences of a variable.[41]

Filler-gap dependencies may overlap one another. It is sometimes possible for one F-G-dependency to penetrate another, resulting in a phrase that contains multiple gaps, each with a distinct binder. The phenomenon has perhaps been most discussed in terms of Scandinavian languages (see Engdahl & Ejerhed 1982), however similar examples in English have been observed and discussed to some extent in the literature (e.g. by Fodor (1992)):

(52) a. [Violins this well crafted]$_i$, [that sonata]$_j$ is easy to play __ $_j$ on __ $_i$.

b. [Dignitaries that important]$_i$, I'm never sure [what]$_j$ to talk about __ $_j$ with __ $_i$.

Fundamental questions about multiple F-G dependencies, e.g. whether the nesting constraint they obey is a matter of grammar or processing, remain unresolved.

Filler-gap identity is sometimes only partial. An overt filler is sometimes required not to exhibit all the properties that it would have in the position of the gap. In addition to case mismatches found in examples like 53 ('weak' F-G-dependencies in the sense of Pollard & Sag 1994), there are also instances of category mismatch, e.g. English topicalized clauses, where a CP filler is unexpectedly associated with an NP-type gap (Webelhuth 1992):

(53) I (*nom*) am easy to please __ (*acc*).

(54) a. That Kim is ready, you can rely on __ .

b.*You can rely on that Kim is ready.

Filler-gap dependencies involve connected local dependencies. It is now generally accepted that the unbounded dependency between a binder and its gap(s) should be factored into a cascade of local dependencies. This is because in many of the world's languages the presence of a F-G-dependency has a critical effect on lexical and constructional choice. In Irish, for example, at

least in the simplest pattern discussed by McCloskey, one complementizer (*goN*) appears in non-F-G environments while another (*aL*) appears in the clause containing the gap and in all higher clauses of the F-G dependency path.[42]

These well-documented effects include the following:

(55) a. Irish complementizer selection (McCloskey 1979, 1990)

b. French 'stylistic' inversion (Kayne & Pollock 1978).

c. Spanish stylistic inversion (Torrego 1984)

d. Kikuyu downstep suppression (Clements 1984, Zaenen 1983)

e. Chamorro verb agreement (Chung 1982, 1995)[43]

f. Yiddish inversion (Diesing 1990)

g. Icelandic expletives (Zaenen 1983)

h. Adyghe (West Circassian) '*wh*-agreement' (Caponigro & Polinsky 2008)

These various phenomena strongly suggest that information about the global F-G dependency must be grammatically encoded at intermediate levels along the F-G dependency path. In all such cases, the lowest clause in the dependency path and the intermediate clauses exhibit analogous patterns. Analyses in terms of successive cyclic movement and the inheritance of feature specifications have both been proposed.

4.2 Analysis

Following Gazdar (1981), the analysis of F-G dependencies naturally breaks down into three problems: (1) the binding environment, (2) the F-G dependency path, and (3) the realization of the gap. Following a long tradition, beginning with Gazdar's pioneering work and including Pollard & Sag 1994, G&S 2000, Culicover & Jackendoff 2005, and Levine & Hukari 2006, the presence of a gap (an extraction site) is encoded in terms of a nonempty specification for the feature GAP. (e.g. [GAP ⟨NP⟩]).[44] By contrast, an expression containing no unbound gaps is specified as [GAP ⟨ ⟩].

Here I follow G&S 2000, whose traceless analysis allows a lexical head to appear without a valent (subject, object, or other complement) just in case its GAP list contains an element corresponding to that valent. That is, a word's VAL list is shortened just in case its GAP list is expanded. These GAP lists also include elements that are on the GAP lists of the word's valents, as shown in 56:[45]

(56) a. No Gap
(*Bo likes Lou*):

$$\begin{bmatrix} \text{FORM} & \langle \text{ likes } \rangle \\ \text{SYN} & \begin{bmatrix} \text{VAL} & \left\langle \begin{bmatrix} \text{NP} \\ \text{GAP} \langle\,\rangle \end{bmatrix}, \begin{bmatrix} \text{NP} \\ \text{GAP} \langle\,\rangle \end{bmatrix} \right\rangle \\ \text{GAP} & \langle\,\rangle \end{bmatrix} \\ \text{SEM} & \textbf{like} \end{bmatrix}$$

b. Gap within Object
(*that Bo likes* [*your review of* __]):

$$\begin{bmatrix} \text{FORM} & \langle \text{ likes } \rangle \\ \text{SYN} & \begin{bmatrix} \text{VAL} & \left\langle \begin{bmatrix} \text{NP} \\ \text{GAP} \langle\,\rangle \end{bmatrix}, \begin{bmatrix} \text{NP} \\ \text{GAP} \langle \text{ NP} \rangle \end{bmatrix} \right\rangle \\ \text{GAP} & \langle \text{ NP} \rangle \end{bmatrix} \\ \text{SEM} & \textbf{like} \end{bmatrix}$$

c. Object Gap
(*that Bo likes* __):

$$\begin{bmatrix} \text{FORM} & \langle \text{ likes } \rangle \\ \text{SYN} & \begin{bmatrix} \text{VAL} & \left\langle \begin{bmatrix} \text{NP} \\ [\text{GAP} \langle\,\rangle] \end{bmatrix} \right\rangle \\ \text{GAP} & \left\langle \begin{bmatrix} \text{NP} \\ \text{SEM} \quad \mathbf{Z} \end{bmatrix} \right\rangle \end{bmatrix} \\ \text{SEM} & \textbf{like(Z)} \end{bmatrix}$$

d. Gaps within Subject and Object
(*that* [*proponents of* __] *like* [*my discussion of* __]):

$$\begin{bmatrix} \text{FORM} & \langle \text{ likes } \rangle \\ \text{SYN} & \begin{bmatrix} \text{VAL} & \left\langle \begin{bmatrix} \text{NP} \\ \text{GAP} \langle \boxed{1} \rangle \end{bmatrix}, \begin{bmatrix} \text{NP} \\ \text{GAP} \langle \boxed{1} \rangle \end{bmatrix} \right\rangle \\ \text{GAP} & \langle \boxed{1}\text{NP} \rangle \end{bmatrix} \\ \text{SEM} & \textbf{like} \end{bmatrix}$$

Note that the semantic valence of the verb (the number of arguments its functional denotation combines with) is reduced by one argument in 56c and that the two valent gaps in 56d are merged, giving rise to (so-called) parasitic gaps.

A principle of grammar requires that in non-gap-binding contexts, a head daughter's GAP list must be the same as its mother's GAP list (G&S 2000 generalize the Head Feature Principle for this purpose). Thus, general grammatical principles, all formulated as local constraints, guarantee that GAP specifications are inherited precisely as indicated in the structure shown in Figure 7. Note that the non-empty GAP specifications are distributed throughout the F-G path, making global information about the F-G dependency locally accessible. Thus a lexical head (a verb or complementizer, for example) lexically specified as [GAP $\langle\,\rangle$] would be barred from appearing along a F-G path. Likewise a construction requiring its mother to be [GAP $\langle X \rangle$] would be allowed to appear only within an F-G path.

[FIGURE 7 ABOUT HERE]

As already noted, gap-binding environments in English may be lexical or constructional. Lexical gap-binding is discussed briefly in section 6 below, as are various gap-binding constructions distinct from the F-G clauses which we now examine in more detail. The common properties of the various F-G clauses surveyed earlier are in part expressed in terms of the common construct type *filler-head-construct* (*filler-head-cxt*), whose instances are constrained by the following construction:

(57) **Filler-Head Construction (↑*headed-cxt*):**

$$\textit{filler-head-cxt} \Rightarrow \left[\begin{array}{ll} \text{MTR} & [\text{SYN}\ \ X_1\ !\ [\text{GAP}\ \ L\ ]] \\ \text{DTRS} & \left\langle \left[\begin{array}{ll} \text{SYN} & X_2\ !\ \left[\begin{array}{l}\text{WH}\\ \text{REL}\end{array}\right] \\ \text{STORE} & \Sigma \end{array}\right], H \right\rangle \\ \text{HD-DTR} & H : \left[\text{SYN}\ \ X_1 : \left[\begin{array}{ll} \text{CAT} & \textit{verbal} \\ \text{GAP} & \left\langle \left[\begin{array}{ll}\text{SYN} & X_2\\ \text{STORE} & \Sigma\end{array}\right] \right\rangle \oplus L \end{array}\right]\right] \end{array}\right]$$

Filler-head constructs thus require exactly two daughters: a filler and a head daughter. 57 links the STORE value of the filler (see sec. 5.3) and the filler's SYN value (except values for the features WH and REL) to the corresponding values of the first element of the head daughter's GAP list. This GAP element is in turn identified with the gap within the head daughter, in the manner just described. Any remaining elements on the head daughter's GAP list (members of the list L) must become part of the GAP list of the mother, which allows unbound gaps to be 'passed up' to a higher binder in the case of sentences with overlapping F-G dependencies (e.g. those in 52 above). The syntactic category of the head daughter (and hence that of its mother) is required to be *verbal*, which (following Sag 1997) must resolve to one of its two subtypes, i.e. to *verb* or *complementizer*. Accordingly, the head daughter of a F-G construction must always be a verbal projection (S or VP) or a CP.

An analysis of this kind has numerous advantages over the movement-based alternatives suggested in the transformational literature. First, the framework in which it is couched is stated in terms of purely static, localized constraints, increasing the chances that a competence grammar embodying this analysis can be embedded within a realistic model of language processing, as it must be, if we are to adopt a 'strong' version of the competence/performance hypothesis (as urged by Kaplan & Bresnan (1982)). Because the constraints are static, they are not biased toward one kind of process or another (e.g. comprehension vs. production), and hence can function as one of the modules (along with real-world knowledge and discourse modeling, among others) that are directly consulted by the cognitive mechanisms that achieve remarkably flexible, incremental and highly integrative comprehension and production. The locality of SBCG constructions also serves to structure and delimit the grammatical information that is accessible to such mechanisms, assuming that constructions are directly accessed in real-time sentence processing.[46]

Second, an analysis that is based on constraints relating the filler to the gap, rather than movement of an element from one syntactic position to another, provides the basis for a solution to the dilemma (first raised by Gazdar *et al.* 1982) that transformational theory fails to provide a uniform account of single-gap and multi-gap extraction. This problem has not been solved in the movement-based literature, as far as I am aware.[47] Movement accounts are thus fundamentally challenged by the fact that when multiple elements move, only one filler is realized. That is, there is no unified definition of 'movement' that predicts that we will find a single filler both when a single element is moved from a gap position and (in the case of coordination or parasitic gap

structures) and when multiple fillers are moved from multiple gap positions. The foundations of the transformational analysis of F-G dependencies are seriously flawed.

By contrast, in constraint-based analyses like those available in Categorial Grammar (Steedman 1996, Steedman 2000), LFG (Kaplan & Zaenen 1989), HPSG or SBCG (Chaves & Sag ms.), the across-the-board effect follows from the interaction of the theory of coordination and the theory of F-G dependencies. For example, assuming (1) that F-G dependencies are encoded via nonempty GAP lists and (2) that coordination involves a schematization imposing identity over feature structures that include GAP specifications, it follows that each conjunct in a well-formed coordinate structure has the same value for the feature GAP. When this value is a nonempty list, there will be a corresponding gap in each conjunct, as in familiar examples like 58 (Ross 1967):

(58) Bagels, I think [[Kim likes __] and [Sandy hates __]].

Note further that by removing GAP specifications from the structures identified under coordination would readily allow the particular constraint-based analysis presented here to be adapted to the alternative, discourse-based approach to across-the-board effects discussed in note 40.

A third advantage of the analysis presented here is that information about the F-G dependency is locally encoded along the extraction path, as shown in Figure 7. As has often been pointed out (Zaenen 1983, Hukari & Levine 1995, Bouma *et al.* 2001, Culicover & Jackendoff 2005, Levine & Hukari 2006), constraint-based accounts of extraction provide a straightforward treatment of phenomena sensitive to extraction paths and do so without the introduction of otherwise unmotivated entities like intermediate traces and their well-known attendant problems (e.g. the prospect of incorrectly stranding a preposition in the middle of a F-G dependency).

A fourth benefit of the constraint-based analysis of F-G constructions is that the relevant constraints need not specify total identity between filler and gap. As emphasized by Bresnan (2001), this provides the basis for an account of category discrepancies of the sort noted in 54 above. Movement-based accounts, by contrast, leave us wondering why movement of a CP leaves an NP trace.[48]

Finally, the constraint-based analysis of F-G constructions presented here makes no appeal to phonetically unrealized elements in the position of the gap. Though the existence of *wh*-traces continues to be taken for granted in textbook after textbook on transformational grammar (including MP, e.g. Radford 2004: 191-192 and Carnie 2007: 324), the fact remains that there is no independent motivation for the existence of *wh*-traces, not from '*wanna*-contraction' (see Postal & Pullum 1982, Sag & Fodor 1994 and Pullum 1997), not from auxiliary contraction (see Pullum & Zwicky 1997) not from 'floated' quantifiers (see Sag & Fodor 1994, Sag 2000), not from strong crossover phenomena (see Postal 2004), and not from weak crossover phenomena (see Dalrymple *et al.* 2008). In addition, from a traceless account of F-G constructions it also follows (from the basic fact that coordination applies to constituents and a traceless analysis has no phonetically empty constituents) that examples like 59 are ill-formed:

(59) a.*Who did you compare __ and __ ?

b.*Who did you compare __ and a picture of __ ?

These examples comply with Ross's across-the-board convention, but their deviance remains unexplained in the transformational literature, as noted in Sag 2000.

5 The Filler-Gap Clause Family

Constructional gap-binding comes about via constructions that define the various subtypes of *filler-head-cxt*. We will now examine these constructions in turn.

5.1 Topicalized Clauses

The simplest filler-head construction is the Topicalization Construction formulated in 60:

(60) **Topicalization Construction (↑*filler-head-cxt*):**

$$\textit{top-cl} \Rightarrow \left[\begin{array}{ll} \text{MTR} & \left[\text{SEM} \quad \lambda\mathbf{X}[\mathbf{Y}](\mathbf{Z})\right] \\ \text{DTRS} & \left\langle \left[\begin{array}{ll} \text{SYN} & \left[\begin{array}{ll} \text{CAT} & \textit{nonverbal} \\ \text{WH} & \{\,\} \\ \text{REL} & \{\,\} \end{array}\right] \\ \text{SEM} & \mathbf{Z} \end{array}\right], \left[\begin{array}{ll} \text{SYN} & \left[\begin{array}{ll} \text{CAT} & \left[\begin{array}{ll} \textit{verb} & \\ \text{IC} & + \\ \text{INV} & - \\ \text{VFORM} & \textit{fin} \end{array}\right] \\ \text{VAL} & \langle\,\rangle \\ \text{GAP} & \left\langle \left[\text{SEM} \quad \mathbf{X}\right] \right\rangle \end{array}\right] \\ \text{SEM} & \mathbf{Y} : \textit{austinean} \end{array}\right] \right\rangle \end{array}\right]$$

The specification [IC +] (passed up to the mother by the Head Feature Principle) ensures that all clauses licensed by this construction are independent clauses. This correctly permits topicalized clauses to function as root clauses and also allows them to appear in embedded environments where main clause phenomena (those specified as [IC +]) are allowed:

(61) a. They argued convincingly that {[problems like this,] [we would never be able to solve __]}.

b. Nothing made things clearer than the fact that {[the people from her district,] [no one had issued an invitation to __]}.

The construction in 60 further requires that the head daughter be an S (a valence-saturated phrase of category *verb*, rather than *complementizer*). Similarly, the [INV −] restriction excludes head daughters that are aux-initial (see note 16). The semantics of a topicalized clause is obtained by abstracting over the variable associated with the gap (the SEM value of the element on the head

daughter's GAP list) to build the functional expression λ**X[Y]**, which then takes **Z**, the semantics of the filler daughter, as its argument.

Notice that certain properties of topicalized clauses are not mentioned in 60 because they follow from more general considerations. For example, the second daughter in 60 must be the head daughter, because this is guaranteed by the Filler-Head Construction (57), which all topicalized clauses must also satisfy. In addition, the fact that the head daughter must contain exactly one gap dependency follows from the interaction of the [GAP $\langle\ \rangle$] constraint in 60 with the constraint on GAP values in 57. A topicalized clause thus simultaneously satisfies many constructional constraints, some very specific, some very general, and some of intermediate grain.

Figure 8 illustrates a topicalized construct whose head daughter is the mother of the incomplete derivation tree in Figure 7 above. This analysis provides a simple propositional semantics for topicalized clauses, as indicated.[49] Finally, 60 requires that both daughters in a topicalized clause must be [WH { }] and [REL { }]. This constraint, taken together with the theory of pied piping (e.g. that of G&S 2000 or the alternative suggested by Van Eynde 2004), ensures that the filler daughter contains no interrogative, exclamative, or relative *wh*-word, as desired.

[FIGURE 8 ABOUT HERE]

In the absence of further constraints, the filler daughter in a topicalized construct may be of any nonverbal category:

(62) a. {[Bagels,] [I like _]} (NP)

b. {[Onto the table,] [they managed to throw seven books _]} (PP)

c. {[Happy,] [I'm not _]} (AP)

d. {[Carefully,] [she rotated the timing device _]} (AdvP)

In all likelihood, there are further syntactic restrictions on topicalized fillers, and some of the examples in 62 may instantiate distinct constructions. But the present approach can be modified in minor ways to accommodate the full range of non-*wh* fronting constructions in English.

Note further that 60 requires the head daughter to be finite, correctly ruling out examples like 63:

(63) *Bagels, ((for) Kim) to like.

However, the head daughter in a topicalized construct may be subjunctive (as in the case of subject-predicate clauses), or even imperative:

(64) a. We suggest that {[proposals of this kind,] [she not **take** advantage of _]}

b. {[Proposals of this kind,] [nobody **be** taken in by _]}

c. {[Proposals of this kind,] [**don't** be taken in by _]}

This is an interesting difference between topicalized clauses and the other kinds of filler-head constructs considered below. (For more on the semantic treatment of subjunctives and imperatives as outcomes, see G&S 2000, Chs. 2 & 3.)

Note that the head daughter of a topicalized clause must be [VAL $\langle\,\rangle$]. This means that VPs cannot head a topicalized clause, ruling out a 'spurious' second analysis for a subject-head clause like 65:[50]

(65) Proposals of this kind bother me.

In addition, the [GAP $\langle\,\rangle$] requirement on (the mother of) a topicalized clause makes it an extraction island:[51]

(66) *[How many of the visitors]$_i$ did he say that {[bagels,]$_j$ [he would give $\_\_\,_j$ to $\_\_\,_i$]}?

And finally, because the filler daughter is also specified as [GAP $\langle\,\rangle$], no further F-G dependency can penetrate the filler daughter, correctly ruling out examples like 67:

(67) *[How many of the visitors]$_i$ did he say that {[pictures of $\_\_\,_i$,]$_j$ [he would give $\_\_\,_j$ to the newspapaper]}?

Absolute extraction islands can thus be treated in terms of a simple constraint requiring that the mother or a daughter of a certain construction be [GAP $\langle\,\rangle$]. By contrast, 'weak' islands – environments where only certain F-G dependencies are grammatically excluded – are naturally accommodated by placing restrictions on the GAP value of a given type of construct. The restriction [GAP *list*(NP)], for example, ensures that a given phrase's GAP value is either the empty list, or else a nonempty list, all of whose members are of category NP. If this constraint is included in a given construction, then the only F-G dependencies that can permeate the constructs it licenses must involve an NP gap. This method of analysis allows us to deal with the fact that grammaticized island constraints are more construction-specific than standardly assumed (Postal 1998, 2001).

5.2 *Wh*-Exclamatives

As noted earlier, G&S 2000 introduce the semantic type *fact* (related to, but distinct from *proposition*) as the content of an exclamative clause. This provides an account, as G&S argue, of the possibility of exclamative complements of factive verbs and the impossibility of using exclamatives assertorically. In addition, the fact-based analysis of exclamatives, which is not reviewed here, provides an analysis of a number of semantic obervations involving entailment and argument validity in dialogues with copular sentences.

Exclamative *wh*-words are lexically specified with a nonempty value for the feature WH. In fact the distinctive exclamative WH-value, shown in 68 contains an exclamative quantifier, abbreviated as '**what!**$_x$':[52,53]

(68)
$$\begin{bmatrix} \text{FORM} & \langle\ \text{whata}\ \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \textit{det} \\ \text{SELECT} \quad \text{CNP}[\text{SEM}\ \mathbf{V}] \end{bmatrix} \\ \text{WH} & \{\mathbf{what!}_x(\mathbf{V})\} \\ \text{REL} & \{\ \} \end{bmatrix} \\ \text{SEM} & x^* \end{bmatrix}$$

The truth conditions for **what!** quantification are to be defined in terms of a contextually variable property of 'unusualness'. This is meant to capture the intuition of G&S 2000's 'there is an unusual x' quantification as well as the ideas of Michaelis and Lambrecht (1996), who appeal to a notion of 'higher on a scale than expected'. The WH specification shown in 68 is passed up to the filler daughter of a *wh*-exclamative construct, where it is 'retrieved' and integrated into the clausal exclamative semantics, as shown in 69:[54]

(69) ***Wh*-Exclamative Construction (↑*filler-head-cxt* & ↑*exclamative-cl*):**

$$\textit{wh-excl-cl} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SEM} \quad \textit{fact}(\mathbf{Q}[\lambda\mathbf{X}[\mathbf{Y}](\mathbf{Z})])\ ] \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \textit{nonverbal} \\ \text{WH} & \{\mathbf{Q}\} \end{bmatrix} \\ \text{SEM} & \mathbf{Z} \end{bmatrix}, \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{INV} & - \\ \text{VFORM} & \textit{fin} \end{bmatrix} \\ \text{VAL} & \langle\ \rangle \\ \text{GAP} & \langle\ [\text{SEM}\ \mathbf{X}]\ \rangle \end{bmatrix} \\ \text{SEM} & \mathbf{Y} \end{bmatrix} \right\rangle \end{bmatrix}$$

The meaning assigned in here is a fact derived by applying G&S 2000's *fact* predicate to the proposition constructed by applying the exclamative operator **Q** to the proposition obtained by applying the predicate λ**X[Y]** to the filler daughter's semantics **Z**. The construction in 69 interacts with the constraints on filler-head constructs introduced in 57 above to license constructs like the one shown in Figure 9.

[FIGURE 9 ABOUT HERE]

The WH specification in Figure 9 is inherited in accordance with general constraints similar to those governing GAP specifications.[55] As a result, the filler daughter in 69 must include a non-empty specification for WH precisely because it contains an exclamative *wh*-expression. The reduced semantics for the clause illustrated in Figure 9 can be loosely paraphrased as 'The play that I saw was really unusual!'.

The constraints in 69 allow for exclamatives to appear as both independent and non-independent clauses (the IC value is unconstrained), but the head daughter must always be both uninverted and finite. The following observations are thus correctly predicted:

(70) a. It's amazing {[what a nice person] [Sandy is __ /*is Sandy __]}.

b. {[What a nice person] [Sandy is __ /*is Sandy __]}!

c.*It's amazing {[what a nice person] [(for) Sandy to be __]}.

In addition, the [VAL $\langle\ \rangle$] condition on the head daughter in 69 predicts that subject exclamative clauses, like subject topicalizations, are impossible, as they are for many speakers:[56]

(71) a. %It's amazing {[what a nice person] [just walked in]}.

b. %{[What a nice person] [is talking to Sandy]}

Because facts are constructed from propositions and nothing else (see G&S 2000, Ch. 3), the only phrases that can serve as the head daughter of a *wh*-exclamative clause are those whose SEM value is of type *proposition*. This provides a principled semantic explanation for the deviance of examples like the following, where the head daughter's semantics fails to satisfy this condition:

(72) a.*{[What a nice person] [be sure to visit __]}!

b.*It's amazing {[what a nice person] [they be considering __]}.

c.*{[What a nice person] [will you visit __]}!/?

d.*{[What a nice person] [am I fond of __]}!

And the [GAP $\langle\ \rangle$] condition correctly guarantees (in the absence of a processing-based explanation) that *wh*-exclamatives, like topicalized clauses, are islands for purposes of F-G constructions:

(73) *This is [the person]$_i$ that it's amazing {[what a nice present]$_j$ [they gave __ $_j$ to __ $_i$]}.

Similarly, the filler daughter in a *wh*-exclamative construct must be [REL $\{\ \}$] due to a general constraint on exclamative clauses. Hence no relative word can appear within the filler:

(74) *This is the person that it's amazing {[what a nice picture of **whom**] [she painted]}.

Finally, it appears that the filler daughter in a *wh*-exclamative construct may be an NP, AP, AdvP, or (gradable) PP, but not a VP:

(75) a. {[What an interesting person] [Kim wrote about __]}! (NP)

b. {[How happy] [Kim is __]}! (AP)

c. {[How quickly] [they forget __]}! (AdvP)

d. {[How under the weather] [she appears to be __]}! (PP)

e.*{[Go to what a fine store] [he would __]}! (VP)

f.*{[Go to the store how often] [he would __]}! (VP)

The restriction [CAT *nonverbal*] imposed on the filler daughter in 69 is the first approximation to an analysis of the data in 75.

5.3 *Wh*-Interrogatives

Interrogative *wh*-words, like exclamative *wh*-words, bear non-empty specifications for the feature WH. But unlike exclamative *wh*-words, the WH-value of an interrogative *wh*-word can be the empty set or it can be a singleton set containing a parameter (rather than a quantifier). This optionality is indicated by the parentheses in 76:[57]

(76)
$$\begin{bmatrix} \text{FORM} & \langle\ \text{who}\ \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \textit{noun} \\ \text{SELECT} \quad \textit{none} \end{bmatrix} \\ \text{WH} & \{([x, \textbf{person}])\} \\ \text{REL} & \{\ \} \end{bmatrix} \\ \text{SEM} & x^* \end{bmatrix}$$

The interrogative *wh*-word illustrated here also differs from the exclamative *wh*-word in 68 above in that it is a pronoun, rather than a determiner. But the essence of the analysis is the same: the WH-value of the *wh*-word is 'passed up' (modulo constraints on pied-piping) to the filler daughter of a *wh*-interrogative clause.

G&S 2000 (Ch. 6) draw a distinction between subject and nonsubject *wh*-interrogatives. Instances of the former type occur in both matrix and embedded environments, as shown in 77:

(77) a. {[What] [fell]?}

b. I wonder {[what] [fell]}.

The Subject *Wh*-Interrogative Construction (see Appendix 2) thus involves a very local dependency – the *wh*-expression is a subject daughter, not a filler. As noted earlier, questions are treated as propositional abstracts (functions from sets to propositions). *Wh*-questions are thus individuated in terms of a non-empty set of 'parameters' and an open proposition.[58] Accordingly, the SEM value of both 77a and the embedded clause in 77b is written as in 78, where the abstracted parameter set is singleton:

(78) $\lambda\{\pi_x\}[\textbf{Past}(\textbf{fall})(x^*)]$

Here we will confine our discussion to nonsubject *wh*-interrogatives, as these provide the most interesting comparison with other F-G constructions. The Nonsubject *Wh*-Interrogative Construction places the following conditions on the constructs that it licenses:

(79) **Nonsubject *Wh*-Interrogative Construction (↑*filler-head-cxt* & ↑*interrogative-cl*):**

$$\textit{ns-wh-int-cl} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SEM} \ \lambda\{\pi,\ldots\}[\lambda\mathbf{X}[\mathbf{Y}](\mathbf{Z})]] \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \textit{nonverbal} \\ \text{WH} & \{\pi\} \end{bmatrix} \\ \text{SEM} & \mathbf{Z} \end{bmatrix}, \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{INV} & X \\ \text{IC} & X \end{bmatrix} \\ \text{VAL} & \langle\,\rangle \\ \text{GAP} & \langle[\text{SEM} \ \mathbf{X}],\ldots\rangle \end{bmatrix} \\ \text{SEM} & \mathbf{Y} \end{bmatrix} \right\rangle \end{bmatrix}$$

This construction licenses filler-head structures like those we have just seen, except that the WH value of the filler contains a parameter (π), rather than a quantifier (**Q**).[59] 79 interacts with our earlier constraints governing headed constructs and filler-head constructs in a now familiar way, licensing constructs like the one shown in Figure 10.

[FIGURE 10 ABOUT HERE]

The constraint interaction is quite subtle here – the Interrogative Construction plays an important role:[60]

(80) **Interrogative Construction (↑*core-cl*):**

$$\textit{int-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SEM} & \lambda\Sigma_1[\textit{proposition}] \\ \text{STORE} & \Sigma_2 \ \dot{-} \ \Sigma_1 \end{bmatrix} \\ \text{DTRS} & \textit{list}([\text{REL} \ \{\,\}]) \\ \text{HD-DTR} & [\text{STORE} \ \Sigma_2] \end{bmatrix}$$

First, note that the daughters' REL values are here required to be empty. This prevents unbound relative *wh*-words from appearing anywhere within an interrogative clause, correctly predicting that relative *wh*-words do not appear in situ. Second, according to 79, the parameter π in the filler daughter's WH value must be included in the set of parameters that is abstracted over to form the mother's semantics. And because of 80, this parameter must also be contained in $\Sigma_0 - \Sigma_1$, i.e. it must be included in the head daughter's STORE value, but absent from the mother's. That is (thinking in terms of a 'bottom-up' derivation), π and possibly some other parameters are retrieved from the head daughter's STORE value and the remaining parameters are passed up, becoming the mother's STORE value. This is a general property of interrogative clauses in both the analysis presented here and that of G&S 2000, where the inheritance of stored parameters must proceed as shown in Figure 11.

[FIGURE 11 ABOUT HERE]

Since other parameters may be retrieved from the head daughter's STORE value, we obtain a proper account of the multiple readings of multiple *wh*-interrogative sentences like 81a, discussed by C. L. Baker (1970) and many others since:[61]

(81) Who remembers where we bought what?

a. Who remembers the answer to the question 'Where did we buy what'?
$\lambda\{\pi_z\}[z$ **remembers** $\lambda\{\pi_x, \pi_y\}[$**we bought** x **at** $y]]$

b. For which pairs z, x, does z remember where we bought x?
$\lambda\{\pi_z, \pi_x\}[z$ **remembers** $\lambda\{\pi_y\}[$**we bought** x **at** $y]]$

Let us now consider the interaction of the various constraints included within the Nonsubject *Wh*-Interrogative Construction in 79. First, the head daughter's SEM value must be a proposition, as nothing else is can form the body of a question (a propositional abstract). This provides a semantic account of the impossibility of *wh*-interrogatives formed from imperatives, exclamatives, other interrogatives, and subjunctives:

(82) a.*{[Who] [(everybody/you) visit __]}!/?

b.*I wonder {[who] [what a nice book you gave __ to __]}.

c.*I wonder {[when] [what to read __ __]}?

d.*I wonder {[what] [you be upset about __]}.

Second, in constructs defined by 79, the mother and the head daughter must include matching specifications for the features IC and INV. This ensures (for nonsubject *wh*-interrogatives) that an aux-initial head daughter is possible just in case the construct is an independent clause:

(83) a. {[Who] [will you visit __]}?

b.*{[Who] [you will visit __]}?

c. They don't know {[who] [you will visit __]}.

d.*They don't know {[who] [will you visit __]}.

In (standard varieties of) English, this effect is restricted to *wh*-interrogatives; in other Germanic languages it applies more broadly, defining the properties of independent clauses in general. What is analyzed in transformational frameworks in terms of head movement, and its interaction with a considerable number of attendant theory-internal assumptions seldom made fully explicit, is here the consequence of a simple identity constraint.

Third, the mother of a construct licensed by 79 need not be finite (it may also be infinitival). However (given that head-subject clauses must be finite,[62] as we have seen), when a valence-saturated, infinitival clause is built, there must be an unexpressed subject – an instance of what Fillmore (1986a) calls *free null instantiation* (*fni*). In such clauses the subject is a covert sign, which receives a free indefinite or contextually anchored interpretation, and hence provides an account of the so-called '*arb*' interpretation of examples like 84:

(84) It was unclear {[which museum] [to visit _]}.

And since infinitive *to* is a nonfinite verbal element (Pullum 1982) specified as [INV −] and [IC −], infinitival interrogatives appear only in embedded environments.

Fourth, the range of filler constituents in *wh*-interrogatives parallels that of *wh*-exclamatives – NP, PP, AP, and AdvP fillers are all possible:[63]

(85) a. {[Who] [did you see _]}?

b. {[To whom] [did you send the letter _]}?

c. {[How happy] [are they _]}?

d. {[How quickly] [do you think you can do that _]}?

VP fillers are correctly excluded by the [CAT *nonverbal*] condition in 79:[64]

(86) *{[Go to which store] [would they not _]}?

Finally, observe that the grammar sketched here does not treat *wh*-interrogative clauses as extraction islands. That is, the constraints formulated in 79 allow for extractions like the following:

(87)a. He's [the kind of relative]$_i$ that I never know {[what sort of present]$_j$ [to give _ $_j$ to _ $_i$]}.

b. ?He's [the kind of relative]$_i$ that I never know {[what sort of present]$_j$ [I should give _ $_j$ to _ $_i$]}.

c. *He's [the kind of relative]$_i$ that I don't know {[what sort of present]$_j$ [they gave _ $_j$ to _ $_i$]}.

Here, as elsewhere, the finite verb with specific time reference renders the example in 87c unacceptable,[65] with cases like 87b being intermediate. Graded data like these can be better explained in terms of processing complexity, rather than via grammatical constraints, along the lines suggested by Kluender (1992, 1998) and Hofmeister and Sag (2010).[66]

5.4 *Wh*-Relatives

Relative *wh*-words are distinguished (following Pollard and Sag 1994) in terms of non-empty specifications for the feature REL, as shown in 88:[67]

(88)
$$\begin{bmatrix} \text{FORM} & \langle\ \text{who}\ \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \textit{noun} \\ \text{SELECT} \quad \textit{none} \end{bmatrix} \\ \text{WH} & \{\ \} \\ \text{REL} & \{[x, \textit{person}]\} \end{bmatrix} \\ \text{SEM} & x^* \end{bmatrix}$$

The parameter's restriction represents a presupposition that values of x must satisfy. The presence of a *wh*-relative word like the one described in 88 triggers the inheritance of a nonempty REL specification up through the filler daughter of a *wh*-relative clause, in the same way (modulo differences in pied-piping) that WH specifications are inherited in *wh*-exclamative and *wh*-interrogative clauses.

The *Wh*-Relative Construction interacts with the general Relative Construction, as indicated in 89–90:

(89) ***Wh*-Relative Construction (↑*filler-head-cxt* & ↑*relative-cl*):**

$$\textit{wh-rel-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \left[\text{SEM} \quad \lambda P \lambda x[\lambda \mathbf{Z}[\mathbf{X}](\mathbf{Y}) \,\&\, P(x)]\ \right] \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & [\text{REL} \ \{[x, \mathbf{R}]\}] \\ \text{SEM} & \mathbf{Y} \end{bmatrix}, \begin{bmatrix} \text{SYN} & [\text{GAP} \ \langle [\text{SEM}\ \mathbf{Z}\ ], ...\rangle] \\ \text{SEM} & \mathbf{X} \end{bmatrix} \right\rangle \end{bmatrix}$$

(90) **Relative Construction (↑*clause*):**

$$\textit{relative-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{INV} & - \\ \text{IC} & - \\ \text{SELECT} & \text{CNP} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{DTRS} & \textit{list}([\text{SYN}\ \ [\text{WH}\ \ \{\ \}]]) \end{bmatrix}$$

According to 89, *wh*-relative clauses receive a standard modifying semantics constructed by abstracting over the index (x) of the parameter in the filler daughter's REL set. *Wh*-relatives also conform to the more general properties of relative clauses shown in 90, and hence they must not be independent clauses, must not be aux-initial, and must be specified so as to modify a common noun phrase (CNP). The daughters must in addition have an empty WH value.

Following Sag 1997, a distinction is drawn between finite *wh*-relative clauses and their infinitival counterparts. This distinction corresponds to two subtypes of *wh-rel-cl*. The Finite *Wh*-Relative Construction imposes the minimal further requirements that the constructs it licenses be finite and include a filler daughter whose syntactic category is *nominal* – an intermediate category type that must resolve to either *noun* or *prep*:

(91) **Finite *Wh*-Relative Construction (↑*wh-rel-cl*):**

$$\textit{fin-wh-rel-cl} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SYN } [\text{CAT } [\text{VFORM } \textit{fin}]]] \\ \text{DTRS} & \langle\, [\text{SYN } [\text{CAT } \textit{nominal}]], \ldots \,\rangle \end{bmatrix}$$

Thus only NP and PP fillers are allowed in constructs licensed by this construction, as noted in 25 above.

The Head Feature Principle ensures that the head daughter of a *fin-wh-rel-cl* construct is also finite and the semantic rule in 89, which specifies a conjunction of propositions (rather than outcomes) within the body of the λ-expression, ensures that the head daughter will be indicative, as well. Here too, we obtain a natural semantic account of why many kinds of phrases cannot head a relative clause, including the following, where the head daughter's clause-type/meaning-type is as indicated:

(92) a.*[the people] {[who] [am I sick of __]}... (*exclamative/fact)

b.*[the people] {[who] [did they visit __]}... (*interrogative/question)

c.*the books {[which] [he have read __ by tomorrow]}... (*subjunctive/outcome)

Through interaction with the superordinate constructions just sketched, the Finite *Wh*-Relative Clause Construction licenses constructs like the one shown in Figure 12. In addition, since no VAL value is specified for the head daughter in 91 or any of its supertypes, nothing rules out *wh*-relatives like 93, where the indicated head daughter is a finite VP:[68]

(93) [the woman] {[whose friend] [__ likes Kim]}...

[FIGURE 12 ABOUT HERE]

Relative clauses combine with a nominal expression, a CNP, to form a larger CNP in accordance with the nominal-modifier construction. This gives rise to head-functor constructs like the one sketched in Figure 13, where the head daughter's SELECT value is identified with the nominal head daughter, as indicated by the tag 1. This construction can apply recursively, giving rise to 'stacked' relative clauses of the sort shown in 94:

(94) a. [[My uncle who lives in Oregon] whose friend Kim likes] . . ..

b. [[Any person whose work Kim likes] who you failed to invite to the party] . . ..

[FIGURE 13 ABOUT HERE]

As noted in section 2.1, finite and infinitival *wh*-relatives have distinct properties. An infinitival *wh*-relative requires that the filler daughter be a PP:

(95) a. people {[with whom] [to confer __]}... (PP)

b.*people {[who(m)] [to confer with __]}... (NP)

c.*the degree {[how happy] [to remain __]}... (AP)

d.*the degree {[how happily] [to agree __]}... (AdvP)

e.*the people {[talk to whom] [to dare to __]}... (VP)

These contrasts suggest a separate construction for infinitival *wh*-relatives, which can be formulated as in 96:[69]

(96) **Infinitival *Wh*-Relative Construction (↑*wh-rel-cl*):**

$$\textit{inf-wh-rel-cl} \Rightarrow \left[\text{DTRS} \left\langle [\text{SYN} \ [\text{CAT} \ \textit{prep}]] , \left[\text{SYN} \begin{bmatrix}\text{CAT} & [\text{VFORM} \ \textit{inf}]\\ \text{VAL} & \langle\,\rangle\end{bmatrix}\right]\right\rangle\right]$$

As noted in section 5.3 above, infinitival clauses, though VAL-saturated, have an unexpressed subject analyzed via free null instantiation, whose interpretation is either indefinite or else determinate (in context). This correctly predicts contrasts like 97a,b, while freely allowing examples like 98, where the context fixes the reference of the unexpressed subject of the relative clause:

(97) a. The person {[in whom] [to place your trust]} is our president.

b.*The person {[in whom] [for you to place your trust]} is our president.

(98) Rather, there, it seems a more reasonable hypothesis that Freud chose another, more obvious Jewish personage {[with whom] [to identify himself]}, ... [Blatt, D.S. (1988). *The Development of the Hero: Sigmund Freud and the Reformation of the Jewish Tradition*.]

5.5 *The*-Clauses

The grammar of the comparative correlative construction (also known as the 'More-the-Merrier' or the 'Comparative Conditional') has been discussed by numerous researchers over the last few decades.[70] Here, I follow Borsley (2004) and Abeillé and Borsley (2006) in viewing sentences like 99a in terms of a paratactic construction related to those instantiated in 99b–c:[71]

(99) a. {[The more you read,] [the more you understand].}

b. {[If you read,] [(then) you'll understand].}

c. {[As you read,] [(so) you'll understand].}

These are related to an historically well attested Indo-European pattern, traditionally referred to as the 'relative-correlative' construction. Borsley proposes a syntactic feature that identifies the component clauses that participate in such parataxes. I will follow him in this, positing a feature CORRELATIVE (CREL) whose values are *the*, *if*, *as*, *then*, *so*, ... and *none*. The analysis of comparative correlatives proceeds in terms of a construction whose basics are sketched in 100:[72]

(100) **Comparative Correlative Construction (↑*headed-cxt* & ↑*clause*):**

$$\textit{comp-corr-cl} \Rightarrow \left[\begin{array}{ll} \text{MTR} & \left[\begin{array}{lll} \text{SYN} & Z\,! & \left[\begin{array}{ll}\text{REL} & \{\,\}\\ \text{CREL} & \textit{none}\end{array}\right]\\ \text{SEM} & \ldots & \\ \text{STORE} & \{\,\} & \end{array}\right]\\ \text{DTRS} & \left\langle \left[\begin{array}{lll} \text{SYN} & & \left[\begin{array}{ll}\text{CREL} & \textit{the}\\ \text{VAL} & \langle\,\rangle\\ \text{REL} & \ldots\end{array}\right]\\ \text{SEM} & \mathbf{X} & \\ \text{STORE} & \{\mathbf{Z}\} & \end{array}\right],\ H\!: \left[\begin{array}{lll} \text{SYN} & Z\!: & \left[\begin{array}{ll}\text{CREL} & \textit{the}\\ \text{VAL} & \langle\,\rangle\\ \text{REL} & \ldots\end{array}\right]\\ \text{SEM} & \mathbf{Y} & \\ \text{STORE} & \{\mathbf{W}\} & \end{array}\right] \right\rangle\\ \text{HD-DTR} & H & \end{array}\right]$$

100 may appear a bit cryptic, since it does not include the semantics of the mother, the REL values of the daughters, or a specification of the STORE values of the daughters, all of which play a key role in my analysis of correlatives. I will try to explain the intuitions behind each of these components of the analysis, leaving the precise formulation to Appendix 2.

I base my semantic treatment on that of Brasoveanu (2008), who builds on previous semantic work on correlatives, e.g. that of Dayal (1996) and Beck (1997). Brasoveanu argues that the semantic essence of this construction is a relation of correpondence that is predicated of the differences (differentials) evoked from the two *the*-clauses. On this view, the meaning of a relative-correlative clause proceeds as sketched in 101:

(101) a. The more books you read, the smarter you get.

b. As the number of books you read increases, your degree of smartness increases. That is, there's a systematic (monotonic) relation (call it $\mathbf{R}_{mon}$) between two differentials:

1. the difference between the number of books you've read on a given occasion and the number you read on a previous[73] occasion, and
2. the difference between your degree of smartness on the later occasion and your degree of smartness on the earlier one.

As Brasoveanu points out, the relation expressed by correlatives varies cross-linguistically. In Romanian, for example, the relevant relation is simple identity. As a result, though a sentence like 102 is true in English, its Romanian analog is false:

(102) The greater a natural number is, the greater its square is.

A detailed analysis of comparative correlatives is beyond the scope of this paper, but the beginnings of such an analysis are easy enough to sketch. Degree expressions in comparative constructions, e.g. *much* or *three feet* in an example like 103, specify a differential:

(103) Kim is *three feet/much* taller than Sandy is

That is, they tell us what the difference is between Kim's height and Sandy's height (where the latter is assumed to be less than the former). Since *the* fills the role of a such a degree expression syntactically (hence the ungrammaticality of 104), it is natural to treat it semantically in terms of differentials, as well.

(104) *The much/3 feet taller one is, the more confident one becomes.

The meaning of the comparative-correlative construction thus crucially involves the proposition that there is a monotonic relation between two differentials, and the grammar must provide a way of making it possible to express this meaning compositionally. In the present framework, this means that relevant pieces of the semantics must be passed up so as to be accessed by the Comparative-Correlative Clause Construction in 100. That is, given the strong localist assumptions made here about the nature of grammatical constructions, the relevant information must be part of the mother of each *the*-clause that serves as the daughter of a comparative correlative clause. The role of the STORE and REL specifications is to transmit this information upward, and to do so in the context of a general theory of what information is potentially accessed in grammatical constructions.

Restricting attention to NP fillers, let us assume that the listeme associated with comparative *the* includes the following information:

(105)
$$\begin{bmatrix} \textsc{form} & \langle \text{ the } \rangle \\ \textsc{syn} & \begin{bmatrix} \textsc{cat} & \begin{bmatrix} \textit{det} \\ \textsc{select} \quad \underset{[\textsc{sem}\ Q]}{\text{CNP}} \end{bmatrix} \\ \textsc{wh} & \{\ \} \\ \textsc{rel} & \{[x], [t_1], [t_2]\} \end{bmatrix} \\ \textsc{sem} & x^* \\ \textsc{store} & \left\{ \lambda P \lambda \delta [t_1 \leq t_2 \ \&\ 0 \leq \delta \ \&\ \delta = (\textsc{max}\{x : [\text{at } t_2][P(x)\ \&\ Q(x)]\} \right. \\ & \left. \qquad\qquad - \textsc{max}\{x : [\text{at } t_1][P(x)\ \&\ Q(x)]\})] \right\} \end{bmatrix}$$

The element in STORE here is a functional expression which, given a set of objects, outputs a set of differentials. The differentials in question correspond to the differences between certain subsets of that set, those determined by intersection with Q (the CNP's denotation set) at appropriately specified times. So from the set of things Kim has read, this function produces a set of differentials that includes the difference between the number of books Kim read yesterday and the number Kim read the day before, the difference between the number of books Kim read today and the number Kim read yesterday, etc. These must all be nonnegative differentials.

The REL value in 105 contains three parameters (presented here without restrictions), which are used to keep track of an individual variable (x) and two time variables (t_1, t_2), all of which are bound as the construction's meaning is built. The REL and STORE values of phrases containing *the* are inherited in accordance with the general theory of pied piping and quantifier-parameter storage alluded to earlier. Thus, phrases like the following all have REL and STORE values like the ones shown in 105:

(106) *the more*, *the taller*, *the taller a man*, *the more customers*, *the more customers' accounts*,....

These assumptions allow an account of *the*-clauses that is parallel to the other kinds of filler-head constructs discussed above, i.e. one based on the construction in 107:

(107) ***The*-Clause (↑*filler-head-cxt* & ↑*declarative-cl*):**

$$\textit{the-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & X\,!\begin{bmatrix}\text{CREL} & \textit{the}\\ \text{REL} & \{[x],[t_1],[t_2]\}\end{bmatrix}\\ \text{SEM} & \lambda\mathbf{V}[\mathbf{X}](\mathbf{Y})\\ \text{STORE} & \Sigma \end{bmatrix}\\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & \begin{bmatrix}\text{CAT} & \textit{nonverbal}\\ \text{VAL} & \langle\,\rangle\\ \text{REL} & \{[x],[t_1],[t_2]\}\end{bmatrix}\\ \text{SEM} & \mathbf{Y}\end{bmatrix}, \begin{bmatrix} \text{SYN} & X:\begin{bmatrix}\text{CAT} & [\text{VFORM } \textit{fin}]\\ \text{CREL} & \textit{none}\\ \text{GAP} & \langle[\text{SEM } \mathbf{V}]\rangle\end{bmatrix}\\ \text{SEM} & \mathbf{X}\\ \text{STORE} & \Sigma\end{bmatrix}\right\rangle \end{bmatrix}$$

As before, *nonverbal* is an intermediate-level category type that must resolve to *noun*, *adjective*, *adverb*, or *prep*, requiring the filler daughter within a *the*-clause to be an NP, AP, AdvP, or PP. Since the filler daughter is specified as [REL $\{[x],[t_1],[t_2]\}$], it must contain an occurrence of the degree specifier *the*. Since the functional expression discussed above is part of the filler daughter's STORE set, this element will be identified with the STORE value of the gap and hence percolated up through the *the*-clause, following the same pattern of STORE inheritance that was illustrated in Figure 11 for interrogative parameters. A well-formed construct of type *the-cl* is illustrated in Figure 14, and a comparative correlative construct in Figure 15.

[FIGURE 14 ABOUT HERE]

[FIGURE 15 ABOUT HERE]

6 Residual Matters

6.1 More Filler-Gap Constructions

As noted above, there are other filler gap patterns that have sometimes been discussed in terms of particular transformations:

(108) a. As happy as they appear to be __ ... ['*As*-Fronting']

b. Happy though they might appear to be __ ... ['*Though*-Fronting']

c. Never have I seen such a beautiful tapestry __ . ['Negative Adverb Preposing']

d. Tomorrow, they thought they might go to the beach __ . ['Adverb Preposing']

e. ...and go to the store they did __ . ['VP-Fronting']

f. That Kim is ready, you can rely on __ . [Clause Fronting – see Webelhuth 2011]

Each of these examples could correspond to a construction in a fine grained analysis. However, in the present treatment, 108d is an instance of the Topicalized Clause Construction (see section 5.1), leaving the others to independent treatment.

6.2 Lexical Gap-Binding

Certain lexical signs, for example, one among the various kinds allowed for the adjectives *easy*, *tough*, or *ready*, require an infinitival complement that contains an NP gap (i.e. a complement specified as [VFORM *inf*] and [GAP $\langle \text{NP}_i \rangle$]) where NP_i is coindexed with the adjective's subject. A lexical gap-binder thus has the lexical properties shown in 109 (ignoring the optional *for*-phrase argument):

(109)
$$\begin{bmatrix} \textit{adj-lxm} & \\ \text{FORM} & \langle\ \text{tough}\ \rangle \\ \text{SYN} & \begin{bmatrix} \text{VAL} & \left\langle \text{NP}_i\ , \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & [\text{VFORM } \textit{inf}] \\ \text{GAP} & \langle\ [\text{SYN NP}[\textit{acc}]_i]\ \rangle \oplus L \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{GAP} & L \end{bmatrix} \\ \text{SEM} & \lambda\mathbf{V}\lambda_{\wp}[\textbf{tough}\ ([\mathbf{V}(\wp)])] \end{bmatrix}$$

Lexical signs of this type interact with the feature-based analysis of gaps discussed in section 4.2 above. Note that a word licensed by 109 will in general be specified as [GAP $\langle\ \rangle$], since L in 109 is nonempty only if there is a second gap within the infinitival complement. Because of this, the GAP value of the AP projected by a lexical gap-binder is also generally empty. However, when

tough's infinitival complement contains a second gap (i.e. when L is singleton), the projected AP will have a singleton GAP value, providing an account of multiple filler-gap examples like 52a above.[74]

The gap-binding in *it*-clefts like 110 is also lexical in nature:

(110) It [was [Sandy] [that Kim thought Bo wanted to visit __]].

his is accounted for by positing ⟨NP, XP, S[GAP ⟨XP⟩]⟩ as one of the VAL values allowed by the copula. The copula then functions as the head daughter of a head-complement construct in which two complement daughters are realized.

6.3 Constructional Gap-Binding

English comparatives, free relatives, and constructions where an 'extraposed' clause is associated with *too* or *enough* involve non-clausal structures where a daughter containing an appropriate element combines with an appropriate phrase containing a gap. This is illustrated for free relatives and comparatives in 111:

(111)

a.
$$\begin{bmatrix} \text{FORM} \langle \text{ whoever's, toes, hurt } \rangle \\ \text{SYN} \quad \text{NP}\begin{bmatrix} \text{GAP} \langle\ \rangle \\ \text{WH} \quad \{\ \} \end{bmatrix} \end{bmatrix}$$

$$\begin{bmatrix} \text{FORM} \langle \text{ whoever's, toes } \rangle \\ \text{SYN} \quad \text{NP}\begin{bmatrix} \text{GAP} \langle\ \rangle \\ \text{WH} \quad \{\pi\} \end{bmatrix} \end{bmatrix} \qquad \begin{bmatrix} \text{FORM} \langle \text{ hurt } \rangle \\ \text{SYN} \quad \text{VP}\begin{bmatrix} \text{CAT} \ \textit{verb} \\ \text{GAP} \langle \text{NP} \rangle \end{bmatrix} \end{bmatrix}$$

b.
$$\begin{bmatrix} \text{FORM} \langle \text{ more, food, than, I, ate } \rangle \\ \text{SYN} \quad \text{NP[GAP} \langle\ \rangle\text{]} \end{bmatrix}$$

$$\begin{bmatrix} \text{FORM} \langle \text{ more, food } \rangle \\ \text{SYN} \quad \text{NP[GAP} \langle\ \rangle\text{]} \end{bmatrix} \qquad \begin{bmatrix} \text{FORM} \langle \text{ than, I, ate } \rangle \\ \text{SYN} \quad \text{CP[GAP} \langle \text{NP} \rangle\text{]} \end{bmatrix}$$

Note that the mother in 111a allows a singular interpretation and agreement, as determined by the *wh*-expression, rather than the first daughter, which is not the head (see Pollard and Sag 1994, Ch. 2):

(112) Whoever's toes hurt is/*are in big trouble.

For broadly compatible treatments of some of these phenomena, see Gazdar 1980, 1981, Klein 1981, Jacobson 1995, Müller 1999, Lev 2005a, 2005b, and Kay & Sag in press.

There are various other clausal modifiers where gap-binding takes place. These include bare finite relative clauses like 113, infinitival relatives like 114, and purpose clauses like 115:

(113) a. (the person) **they (said they) liked best _** ...

b. (the person) **that they (said they) liked best _** ...

(114) a. (the thing) **to (tell them you're going to) do _** ...

b. (the person) **_ to do the job**...

(115) a. (They bought it) **to put the computer on _** ...

b.?(They bought it) **to try to put the computer on _** ...

These have two possible analyses in the present framework. On one approach, the modifier clause has its familiar structure (finite S/CP in 113; infinitival clause in 114–115), but is built in terms of a special construction. For example, the *that*-less relative in 113a could be licensed, following Sag (1997), via a construction admitting constructs that are both a relative-clause and a subject-head-construct, as shown in 116a:

(116) a.
$$\begin{bmatrix}\text{FORM} & \langle\ \text{they, liked, best}\ \rangle \\ \text{SYN} & \text{S[GAP}\ \langle\ \rangle\text{]}\end{bmatrix}$$
$$\begin{bmatrix}\text{FORM} & \langle\ \text{they}\ \rangle \\ \text{SYN} & \text{NP}[\textit{nom}]\end{bmatrix} \quad \begin{bmatrix}\text{FORM} & \langle\ \text{liked, best}\ \rangle \\ \text{SYN} & \text{VP[GAP}\ \langle \text{NP}_i \rangle\text{]}\end{bmatrix}$$

b.
$$\begin{bmatrix}\text{FORM} & \langle\ \text{they, liked, best}\ \rangle \\ \text{SYN} & \text{S}\begin{bmatrix}\text{CAT} & \text{[SEL CNP}_i\text{]} \\ \text{GAP} & \langle\ \rangle\end{bmatrix}\end{bmatrix}$$
$$\begin{bmatrix}\text{FORM} & \langle\ \text{they, liked, best}\ \rangle \\ \text{SYN} & \text{S[GAP}\ \langle \text{NP}_i \rangle\text{]}\end{bmatrix}$$

The alternative, shown in 116b, is to introduce a unary (non-branching) construction that builds a modifier from a clause containing a gap. I will not attempt to choose between these two alternatives here.

7 Conclusion

In this paper, I have examined the often subtle grammatical and semantic factors that distinguish the various kinds of filler-gap clauses in English, including topicalized clauses, *wh*-interrogatives, *wh*-exclamatives, *wh*-relatives, and the *the*-clauses that appear within the Comparative Correlative construction. The filler-gap clauses exhibit both commonalities and idiosyncrasies. The observed commonalities are explained in terms of common supertypes whose instances are subject to high-level constraints, while constructional idiosyncrasy is accommodated via constraints that

apply to specific subtypes of these types. A well-formed filler-gap construct must thus satisfy many levels of constraint simultaneously.

I have provided a detailed, internally consistent syntactic and semantic analyses of these clauses in a framework where constructions are taken as basic. A common reaction among practitioners of GB/MPto such an account of a body of linguistic data, i.e. an actual generative grammar, is to dismiss it as insufficiently abstract or as unlearnable. However, as Clark & Lappin (2010) show at length, abstract parameter setting models contribute no solution to the problems of language learning (despite decades of assertions to the contrary). Moreover, as Clark and Lappin argue, it is unclear how a child could acquire such a formal system from the primary linguistic data through (largely) domain general learning procedures. They argue further that this should be taken as grounds for distrusting the formal framework, rather than for assuming a rich set of learning biases and priors, formulated in terms of UG.

By contrast, as Shalom Lappin points out to me, it is not unreasonable to suggest that constructional types of the kind explored here might be efficiently learnable from the primary linguistic data within a weak bias framework of acquisition (as described in Lappin & Shieber 2007 and Clark & Lappin 2010). The primary constructions can be modeled as word and phrasal classes built up through observed distributional congruence and clustering patterns in the linguistic data, and relative to non-linguistic objects and events. These types can be further refined into subtypes by identifying smaller clustering classes (top down), or extended by projecting larger supertypes (bottom up), yielding the bounded lattice structure of the constructional type system. The representation of the class of grammars that a constructional type hierarchy specifies resembles other type systems, such as semantic category systems, physical ontology classifiers, phonological systems, etc. Hence, we allow domain-general learning methods to play a larger role in language learning – a highly desirable result. Moreover, learning could proceed in terms of the Hierearchical Bayesian Models proposed in Kemp *et al.* 2007, according to which properties of individual classes (types) and the properties that determine the distribution of elements across these classes (overhypotheses concerning a supertypes of these classes) can be learned simultaneously from the same data. Thus, grammars of the sort assumed here – constraint-based grammars using linguistic types – can contribute directly to our understanding of language learning.

The analysis of gap-binding presented here extends to the analysis of languages where words and constructions are sensitive to the presence or absence of a gap-binding dependency at intermediate levels along the extraction path.[75] It also provides a uniform account of the general properties of gap-binding dependencies within a given language, as well as a straightforward treatment of the known cross-linguistic generalizations.

We have seen in detail that particular F-G constructions exhibit idiosyncrasies that an adequate grammar must account for if it is to model a native speaker's knowledge of this theoretically critical domain. The constructional variation analyzed here includes:

- whether the head daughter can or must be inverted,
- what constraints are imposed on the grammatical category of the filler daughter,
- the presence of a particular kind of *wh*-word (interrogative, exclamative, or relative) within the filler vs. the absence of any *wh*-word,

- whether the head daughter can be subjectless or not,
- whether the clause can or must be be a main (independent) clause,
- whether the head daughter must be finite or infinitival, and
- the semantic properties of the construction.

We have also seen how the grammar of filler-gap clauses, analyzed in terms of instances of a single abstract type (*filler-head-construct*), is related to other means of gap-binding in English, including lexical gap-binding and binding in non-clausal constructional environments. In addition, we have examined the relation between filler-gap constructs and other headed structures, including various aux-initial, subject-predicate, and head-complement structures that instantiate a small inventory of superordinate construct-types.[76]

The analysis is both model-theoretic[77] and strongly lexicalist. It thus embodies the design properties argued by Kaplan and Bresnan (1982), Jackendoff (1997, 2002), Culicover & Jackendoff (2005)), Sag & Wasow (in press), and Müller (2010) to be most compatible with what modern psycholinguistics tells us that competence grammars should look like. Despite a half century of intense investigation by hundreds of researchers, it is still unknown whether analyses of comparable coverage, precision, and psycholinguistic plausibility can be developed within any framework that employs grammatical transformations, let alone one that seeks to employ a restricted subset of the transformational operations that have been discussed in the literature, e.g. the Minimalist Program articulated by Chomsky (1995) or any of the variants of Minimalism sketched in widely read generative-transformational textbooks. Far from being the epiphenomena disparaged by Chomsky in pronouncements that have been repeated countless times by hundreds of transformational grammarians, the notion of 'grammatical construction' is likely to be the cornerstone of explanatory adequacy in a linguistic theory that enables the development of precise analyses of scale.

Notes

[1]For critical discussion substantiating these claims, see, for example, Johnson & Lappin 1997, 1999, Ackerman & Webelhuth 1998, Lappin et al. 2000a,b, 2001, Postal 2004, Seuren 2004, Newmeyer 2004, 2008a,b, 2009, Culicover & Jackendoff 2005, Pinker & Jackendoff 2005, Evans & Levinson 2009, and Müller 2010.

[2]For further arguments that the core-periphery distinction is both unmotivated and largely inconsistent with more realistic models of language learning and processing, see Fillmore *et al.* 1988, Kay & Fillmore 1999, Jackendoff 1997, Culicover 1999, and Culicover & Jackendoff 2005, Ch. 1.

[3]But see Baker 2002 and the critical response by Newmeyer (2005).

[4]In the 1960s, there were attempts to develop consistent fragments of transformational grammars for English. However, these efforts, e.g. the 'UCLA Grammar' reported in Stockwell *et al.* 1968, had little impact on theoretical developments within the field.

[5]By contrast, many other theoretical frameworks for grammatical analysis have spawned a significant community of researchers developing language engineering projects whose concerns for large-scale consistent grammatical descriptions have reflected back onto the development of grammatical theory. These include Lexical-Functional Grammar, Tree-Adjoining Grammar, Categorial Grammar, Dependency Grammar, Generalized Phrase Structure Grammar, Construction Grammar, and Head-Driven Phrase Structure Grammar. The theory presented here owes a considerable debt to the implementational work within the LinGO and Delphin consortia, whose engineering efforts have proceeded in parallel with the theoretical development of SBCG. See Copestake 2001, Flickinger 2000, and the online resources available at `http://lingo.stanford.edu/` and `http://www.delph-in.net/`.

[6]Borsley (2007) also shows how some of the techniques I discuss below can be used to simplify the lexical organization of functional heads within MP.

[7]For example, Kluender (1992, 1998) presents experimental evidence that certain island phenomena can in fact be explained by independently motivated considerations of processing complexity. Hofmeister & Sag (2010) (see also Sag *et al.* 2007, Hofmeister 2007) argue that subjacency effects, including the alleged inability of gap-binding dependencies to penetrate interrogative and relative clauses, can be better analyzed in terms of the combination of various factors known independently to cause processing difficulty. They thus argue for a 'minimalist' conception of grammar that eliminates any analogue of Chomsky's Subjacency Condition. This seems to be a highly promising line of inquiry with the prospect of achieving an explanation for certain island phenomena in terms of more general cognitive properties, rather than stipulating that they are part of grammar. Everything in this paper is consistent with this conclusion; however, nothing depends on it.

[8]One might include other constructions in this set, e.g. free relative constructions, whose filler daughters also have head-like properties (see Huddleston & Pullum 2002). I return to free relatives briefly in section 6.3.

[9]Compare the Sanskrit lexemes *ka-* 'who (interrogative)', *ya-* 'who (relative)', *ta-* 'he,she,it' (remote demonstrative), and *eta-* 'he, she, it' (proximate demonstrative), each of which exhibits a paradigm allowing three numbers and seven cases (plus vocatives) to be expressed. More closely related languages, e.g. Modern German, have contracted the Indo-European case and number space, but continue to systematically distinguish interrogative forms (used also for exclamatives) from relative and demonstrative forms.

[10]The seventh entry in Figure 1 is restricted to non-elliptical uses of *which*. I regard an interrogative *wh*-phrase like the one in [*Which*] *did you read?* as an elliptical NP containing the determiner *which*.

[11]I am assuming, following G&S 2000, that predicates like *amazing* allow both exclamative and interrogative clause complements. Thus, apparent examples of embedded exclamatives like (i) and (ii) are in fact embedded interrogatives:

(i) It's amazing *what she read*.

(ii) It's amazing *who all she visited*.

[12]Even the familiar assumption that island constraints are uniform across F-G constructions has been seriously challenged. See, for example, Postal 1998, 2001. If Kluender (1992, 1998) and Hofmeister and Sag (2010) are right in accounting for subjacency effects in terms of processing factors, then it may become possible to ground the explanation of such differences in terms of cross-constructional variation in processing difficulty, which would be a welcome result.

[13]It is of course possible that adverb-initial or adjective-initial independent clause involve a construction distinct from topicalization. See section 6 below.

[14]This assumes that so-called 'VP-Fronting' involves a construction distinct from topicalization. See section 6.1 below.

[15]G&S 2000 develop an alternative to the standard theory of questions as sets of answering propositions (Karttunen 1977; Groenendijk & Stokhof 1997), arguing that that notion is insufficiently context-dependent to provide an adequate theory of question meaning (see also Ginzburg 1995a,b). Following Keenan & Hull 1973 and Hull 1975, a question is taken to be a propositional abstract, i.e. a function from sets of entities to propositions. GS present this theory in the framework of Situation Semantics, i.e. the original such framework, developed by Jon Barwise, John Perry, Robin Cooper, Stanley Peters and others. See Barwise & Perry 1983, 1985; Gawron & Peters 1990; Devlin 1991; Cooper & Ginzburg 1996; Seligman & Moss 1997.

[16] G&S followed Radford (1988) in assuming that topicalization allows interrogatives to be embedded in examples like (i):

(i) ?That kind of antisocial behavior, can we really tolerate __ in a civilized society?

They further assumed that exclamatives may be so embedded, as in examples like (ii):

(ii) ??People that stupid, am I fed up with __ !

However, such examples have repeatedly been called into question. Note further that the more acceptable examples like (i) strongly favor a 'negative implicating' interpretation. That is, (i) does not instantiate a general pattern of interrogative embedding. Examples like (iii), where the implicated negative proposition is absent, seem far less acceptable:

(iii)*That visiting student from Denmark, did you like __ ?

Hence, I assume here that a grammar should restrict topicalized clauses so that they express only propositions or outcomes (this includes indicatives, subjunctives, and imperatives), leaving it to the theory of language use to explain why examples like (i), which implicate the assertion of negative propositions, are more acceptable than examples like (iii), which do not. Similar remarks apply to the exclamative example in (ii).

[17]See, for example, Flickinger *et al.* 1985, Flickinger 1987, and Pollard & Sag 1987.

[18]See also Zwicky 1994, Kathol's (1995, 2000) analysis of German clause types, as well as the proposals made in Culicover & Jackendoff 2005.

[19]Sag (2011) distinguishes combinatoric constructions (which define classes of constructs) from lexical class constructions (which define classes of lexemes or words). I will have nothing to say about lexical class constructions here.

[20]My use of the term 'construction' parallels that of Berkeley Construction Grammar, in that constructions are part of a grammatical description, rather than being linguistic objects defined by a grammar. I use 'construct' in a specialized way that is distinct from previous uses of that term in the Construction Grammar literature.

[21]A list of elements can also be treated as a function whose domain is the set {FIRST, REST}, where the value of rest is another (possibly empty) list.

[22]Diagrams indicating a specific feature structure (rather than a feature structure description) are presented within boxes.

[23]The term 'listeme' is first proposed by Di Sciullo & Williams (1987) as a generalization of the notion 'lexical entry'.

[24]Fragments and various other apparent exceptions to this characterization of the sentences defined by a grammar are analyzed as finite clauses, as justified by G&S 2000 and Arnold & Borsley (2008).

[25]Some abbreviations: *cxt* for *construct*, *aux* for *auxiliary*, *cl* for *clause*, and *comp* for *complement*.

[26]'$\Rightarrow$' is an implicational relation: '$T \Rightarrow C$' means that 'all feature structures of type T must satisfy the condition C' (where C is a feature structure description). Variables such as *X* and X_1 range over feature structures in the constructions and other constraints that are formulated here. Σ-variables and *L*-variables range over sets and lists of feature structures, respectively. Finally, I indicate via $\uparrow$ the names of immediately superordinate types, which provide constructional constraints of immediate relevance. This is purely for the reader's convenience, as this information follows from the type hierarchy specified in the grammar signature. See the appendices for further details of the type hierarchy and the relevant constructions.

[27]A colon indicates that the immediately following constraint must be satisfied by all values of the immediately preceding variable, i.e. it introduces a restriction on the possible values of that variable. I use the notation

'[FEAT1 X ! [FEAT2]]' to indicate that the feature FEAT1's value must be identical to the feature structure tagged as X elsewhere in the diagram, except with respect to the value of feature FEAT2. '[FEAT1 X ! [FEAT2 *val*]]' means the same, but further indicates that the value of FEAT2 must be *val*. Hence, the mother's VAL value in 117 must be the empty list, while the head daughter's VAL value is the nonempty list (*nelist*) L, which is identified with the rest of the construct's daughters. The mother's SYN value must in all other respects be identical to that of the head (first) daughter. We thus provide a natural way of expressing linguistically natural constraints requiring that two elements must be identical in all but a few specifiable respects. Note that this is a purely monotonic use of default constraints, akin to the category restriction operation introduced by Gazdar *et al.* (1985). Finally, $\oplus$ denotes the 'append' relation, which splices two lists together into one.

[28]With various exceptions discussed and analyzed in Sag to appear In this system, [AUX +] does not signify a subclass of verbs (as in previous feature-based analyses), but rather a morphosyntactic context that is restricted to auxiliaries; see also note 36.

[29]See Culicover 1971, Fillmore 1999, Newmeyer 1998: 46–49, and G&S 2000, Ch. 2. Note that I am here following Fillmore (1999), who argues that there is no general semantics shared by all aux-initial constructions. This is a controversial point; see Goldberg 2006, 2009, Borsley & Newmeyer 2009, and the references cited there.

[30]Here and throughout, boxed numbers or letters ('tags' in the terminology of Shieber 1986) are used to indicate pieces of a feature structure that are equated by some grammatical constraint. However, the linguistic models assumed here are simply functions, rather than the reentrant graphs that are commonly used within HPSG. For an accessible introduction to the tools employed here, see Sag *et al.* 2003.

[31]The positive specification for the feature INDEPENDENT-CLAUSE (IC) in Figure 4 ensures that the phrase licensed by this construct cannot function as a subordinate clause, except in those environments where 'main clause phenomena' are permitted. See section 5.1 below.

[32]Throughout, I follow the standard practice of abbreviating '**[Z(Y)](X)**' as '**Z(Y)(X)**'.

[33]The informal representation in 116 is due to Chuck Fillmore. According to this scheme, a daughter is represented simply by enclosing its word sequence in square brackets; a construct is indicated by enclosing its sequence of daughters in curly braces.

[34]More precisely, the second (head) daughter imposes the requirement that its valent syntactically must match the subject daughter except with respect to the features WH and REL (discussed below). See Appendix 2.

[35]This type is discussed at length in G&S 2000. The two kinds of austinean meanings are 'proposition' and 'outcome', where the latter is the basis for the analysis of both imperative and subjunctive clauses.

[36]The latter effect may seem counterintuitive, since auxiliary verbs other than *do* freely occur in this environment, but the restriction is in fact the key to understanding the role of *do* in the English auxiliary system, as argued in Sag to appear.

[37]Again, this is analogous to a Context-Free Grammar, where the daughter of one rule can make reference to the category of the mother that is expanded by some other rule to build the daughter's substructure, but no CFG rule can make reference to another CFG rule. For further discussion, see Sag 2007, in press.

[38]The analysis sketched here presupposes the existence of a number of further constructions, which are included in Appendix 2.

[39]See Hofmeister & Sag 2010 and the references cited there for arguments that processing factors play a larger role than standardly appreciated.

[40]There is controversy about coordinate examples where this effect is absent, e.g. (i):

(i) How many students can we expect our professors to teach __ and still lead a normal life? (Goldsmith 1985)

Examples like this may instantiate noncoordinate structures (see Postal 1998). Alternatively, the across-the-board constraint may involve more semantic or discourse-based factors. For further discussion, see Goldsmith 1985, Lakoff 1986, Kehler 2002, and the references cited there.

[41]Once this conclusion is accepted, a plausible approach to examples like 115b and 116c is that they are grammatical (i.e. licensed by a competence grammar), but unacceptable, e.g. less acceptable on grounds of processing difficulty. This rejection of grammatical 'parasitism' is further supported by the acceptability of examples like the following, where orthogonal factors contributing to processing difficulty are controlled (Some of these examples are from Beatrice Santorini's archive, available at `http://www.ling.upenn.edu/~beatrice/examples/`):

(i) The magazine I spend most of my days **[reading _]**. [advertisement for *The Economist*, attributed to Bill Gates.]

(ii) Reynolds completed Sayers' translation of The Divine Comedy, which Sayers died **[before finishing _]**. [www.touchstonemag.com/archives/article.php?id=13-04-028-f]

(iii) a letter of which [**[every line _]** was an insult]... (Jane Austen)

(iv) These are the Iranian dignitaries that [**[my talking to _]** would have been considered inappropriate].

[42]The F-G dependency path can be thought of in terms of the connected branches of a tree structure stretching from the filler (or other binder) at the top down to the position of the gap.

[43]But see Donohue 2003 and the references cited there for a critical discussion of Chung's data and analysis and Norcliffe 2009 for an important reassessment of the nature of this and related controversies.

[44]In the literature, this feature has often been called 'SLASH', a reference to Gazdar's original notation for the category of gap-containing expressions. In fact, alternative HPSG F-G analyses (e.g. those of Pollard & Sag 1994, Bouma *et al.* 2001, Levine & Hukari 2006, or Chaves submitted) are also compatible with the proposals I make here.

[45]I abbreviate as follows:

$$\underset{[\text{GAP}\ \langle\,\rangle]}{\text{NP}} = \begin{bmatrix} \textit{sign} \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \textit{noun} \\ \text{VAL} & \langle\,\rangle \\ \text{GAP} & \langle\,\rangle \end{bmatrix} \end{bmatrix} \qquad \text{NP}[\ldots] = \begin{bmatrix} \textit{syn-obj} \\ \text{CAT} & \textit{noun} \\ \text{VAL} & \langle\,\rangle \\ \ldots \end{bmatrix}$$

$$\text{S}[\ldots] = \begin{bmatrix} \textit{syn-obj} \\ \text{CAT} & \textit{verb} \\ \text{VAL} & \langle\,\rangle \\ \ldots \end{bmatrix} \qquad \text{NP}[\textit{acc}] = \begin{bmatrix} \textit{syn-obj} \\ \text{CAT} & \begin{bmatrix} \textit{noun} \\ \text{CASE} & \textit{acc} \end{bmatrix} \\ \text{VAL} & \langle\,\rangle \end{bmatrix}$$

[46]For further discussion of these issues, and their consequences for the design of grammar, see Sag & Wasow in press. The analysis presented here is in principle compatible with other declarative, constraint-based theories of grammar that share these design properties, e.g. Lexical-Functional Grammar, Tree-Adjoining Grammar, the Simpler Syntax Hypothesis, and Categorial Grammar (see Müller 2010 for discussion). The sign-based architecture, however, enjoys a special advantage in terms of utilizing competence constraints directly to build partial meanings incrementally.

[47]The difficulties in question are not avoided by accounts based on 'three-dimensional' phrase markers, e.g. those of Goodall 1987 and Moltmann 1992. See Milward 1994, Sag 2000, and the references cited there.

[48]This also raises the larger, unresolved problem of informational discrepancies in movement theories. A-Movement treats locally a-bound traces as [+ANA], though their a-binders are typically [−ANA]. Similarly, if *wh*-traces are to be treated as '*r-expressions*' (Chomsky 1981), then they must again have properties distinct from those of their binders, which are free to vary in referential type. It has never been shown, to my knowledge, how movement-based analyses can be reconciled with discrepancies of this kind in a principled way, since movement otherwise preserves (i.e. induces filler-gap identity for) all other properties, e.g. lexicality, bar-level, and category.

[49]This is true, of course, only if we make the standard assumptions about equivalence of expressions under λ-conversion (β-reduction). Of course, the construction in 60 should impose some kind of 'topic-comment' condition (making the filler daughter's semantics the topic) in the mother's semantics in such a way as to account for the deviance of examples like (i):

(i) *No bagel, I like _ .

However, in the absence of a generally accepted theory of topicality or 'information structure', I will not speculate about the details of such a treatment here. See Prince 1998 for some relevant discussion. Since signs also specify contextual information, they provide a natural home for the kind of contextual constraints that are associated with particular constructions according to Prince, Lambrecht (1994) and many other researchers.

[50]Imperative clauses like the head daughter *don't be taken in by* in 116c are in fact [VAL $\langle\,\rangle$].

[51]Here I am making the cautious assumption that sentences like 117 cannot adequately be explained in terms of processing factors alone. If this caution turns out to be unduly pessimistic (the processing-based account would of

course be preferable, since it is grounded in independently observable, extra-grammatical factors), then the Topicalized Clause Construction can be simplified by removing the [GAP $\langle\,\rangle$] requirement.

[52]'x' is an individual variable, while **V** is a property variable. For convenience, '**what!**$_x$(**V**)' is assumed to be a quantificational operator mapping propositions to propositions. Following standard practice, 'x^*' abbreviates the generalized quantifier generated from the individual assigned to x, i.e. $\lambda P[P(x)]$.

[53]This analysis follows Van Eynde (1998), who builds directly on Allegranza 1998, in replacing the features MOD and SPEC of Pollard & Sag 1994 by the single feature SELECT, which allows the feature SPR to be eliminated, as well. The values of SELECT indicate properties of the phrasal head that are selected by a given modifier or specifier. See also Van Eynde 2006, 2007 and Allegranza 2007. CNP abbreviates a common noun phrase, which may consist of a common noun and appropriate modifiers.

[54]No attempt is made here to accommodate the full range of data discussed by Michaelis and Lambrecht. It is interesting to observe, as pointed out to me by Chris Potts, that the degree-based analysis of exclamatives, apparently first instantiated by the analysis of G&S 2000, has subsequently been advocated by numerous others (e.g. Castroviejo Miró 2006, Mayol 2008, Rett 2008, Abels 2008). Notice that the grammatical analysis proposed here is sufficiently modular that if one chose to replace its semantics with some other, say, that of Zanuttini & Portner (2003) (also closely related to that of G&S 2000), the revision would be quite straightforward.

[55]In particular, these specifications are also 'threaded' through the heads of complex *wh*-phrases, predicting the possibility of a language where the head of such a phrase agrees with the *wh*-element within that phrase. Caponigro and Polinsky (2008) discuss a case of this kind in Adyghe.

[56]A minimally different formulation of 69, one lacking the [VAL $\langle\,\rangle$] specification, would license these examples as well. I have not undertaken the research that would be required in order to ascertain if the individual differences of judgment one finds with respect to these sentences reflects systematic lectal variation.

[57]GS use this distinction to considerable advantage: a [WH $\{\,\}$] *wh*-word must be in situ, while a *wh*-word whose WH value is a nonempty set must be part of the filler daughter in a *wh*-interrogative construct. This follows from their theory of pied piping, taken together with independently motivated requirements of the various gap-binding constructions. The differing WH values also play a critical role in G&S's comprehensive account of in situ interrogatives (including reprise uses), multiple *wh*-interrogatives, and so-called 'aggressively non-D-linked' expressions (*the hell*, *in the world*, etc.). Note also that GS guarantee that exclamative *wh*-words can never appear in situ, because their WH value must be nonempty.

[58]According to G&S 2000, parameters are essentially a pair consisting of an index and a restriction (here assumed to be a property). Parameters are thus quantifier-like in that they bind variables and can take varying scope in a semantic structure, but they are not quantifiers, as they lack quantificational content. I will use π_x to abbreviate a parameter whose index is x.

[59]This WH value is distinct from that of the first sign on the head daughter's GAP list (consistent with the fact that the two are not equated by any grammatical constraint). In fact, the latter WH value is always the empty set, as guaranteed by the interaction of constraints discussed in G&S 2000, ch. 5.

[60]'$\dot{-}$' is a 'contained' set difference operation that removes elements from a set nonvacuously. That is, its result is defined only if the elements to be removed are members of the set in question, i.e. if Σ_1 is a subset of Σ_2 in 117.

[61]Since the parameters associated with appropriate *wh*-expressions are present at each clausal level, it would be straightforward to provide an alternative semantics, say, one based on sets of propositions in the fashion of Groenendijk & Stokhof 1997 or any of the alternatives found in Aloni *et al.* 2006.

[62]That is, there are no declarative clauses like [*Kim to go*]; see **??** above. This precludes *wh*-interrogatives like (i):

(i)*I wonder [who [Sandy to visit __]].

[63]I have not taken a position on the analysis of examples like (i), which may involve bare QPs or a restricted kind of NP, parallel to *a lot (of money)*:

(i) How much does it cost __ ?

[64]Examples like 117 are independently accounted for by the pied piping theory of G&S 2000 and hence may not bear on the question of which constraints the Nonsubject *Wh*-Interrogative Construction should impose on its filler daughter.

[65]See Kluender (1992) and Gibson (1998, 2000) for discussion.

[66]Note that here again, the role of processing in explaining these contrasts could be curtailed in favor of an appropriate constructional constraint.

[67]Interrogative and exclamative *wh*-words are thus a natural class that excludes relative (and correlative) words. The morphology of languages like Modern German supports this classification.

[68]Note, however, that since the SEM value of the relative clause's head daughter must be of type *proposition* (as opposed to a function from NP-meanings to propositions), the only possible VP head daughters here involve subject gaps. Examples like (i) are thus correctly blocked:

(i)*[the woman] {[whose friend] [likes __]}...

[69]I leave unsolved here the semantic problem of how to distinguish 'modal' infinitival uses like (i) from their nonmodal counterparts like (ii):

(i) The person in whom to place your trust... [≈ the person who you should trust...]

(ii) We believed him to be incompetent. [≈ we believed that he was incompetent].

[70]See Ross 1967, Fillmore 1986b, Fillmore *et al.* 1988, McCawley 1988b, Kay & Fillmore 1999, Culicover and Jackendoff 1999, 2005 (Ch. 13), Borsley 2004, den Dikken 2005, Abeillé *et al.* 2006.

[71]Den Dikken (2005) proposes to reconcile the cross-linguistic variation of comparative correlatives with a parameter-based version of UG. For critical discussion of this proposal, see Abeillé & Borsley 2008.

[72]The semantic analysis, discussed only informally in the text, is included in Appendix 2. In a more comprehensive treatment, some of the constraints discussed here would in fact be part of a superordinate construction, so as to express a generalization over a larger class of constructs. For discussion of variant realizations, see Fillmore 1985 and Borsley 2004.

[73]I'm simplifying by talking in terms of 'earlier' and 'later' times. The relevant relation that must hold between the varying occasions (or 'cases') must be more general, in order to allow for sentences like *The more aggressive a lawyer is, the more successful (s)he is*.

[74]Fully compatible proposals for lexical gap-binding are discussed in detail in Pollard & Sag 1994, Bouma *et al.* 2001, and Levine & Hukari 2006.

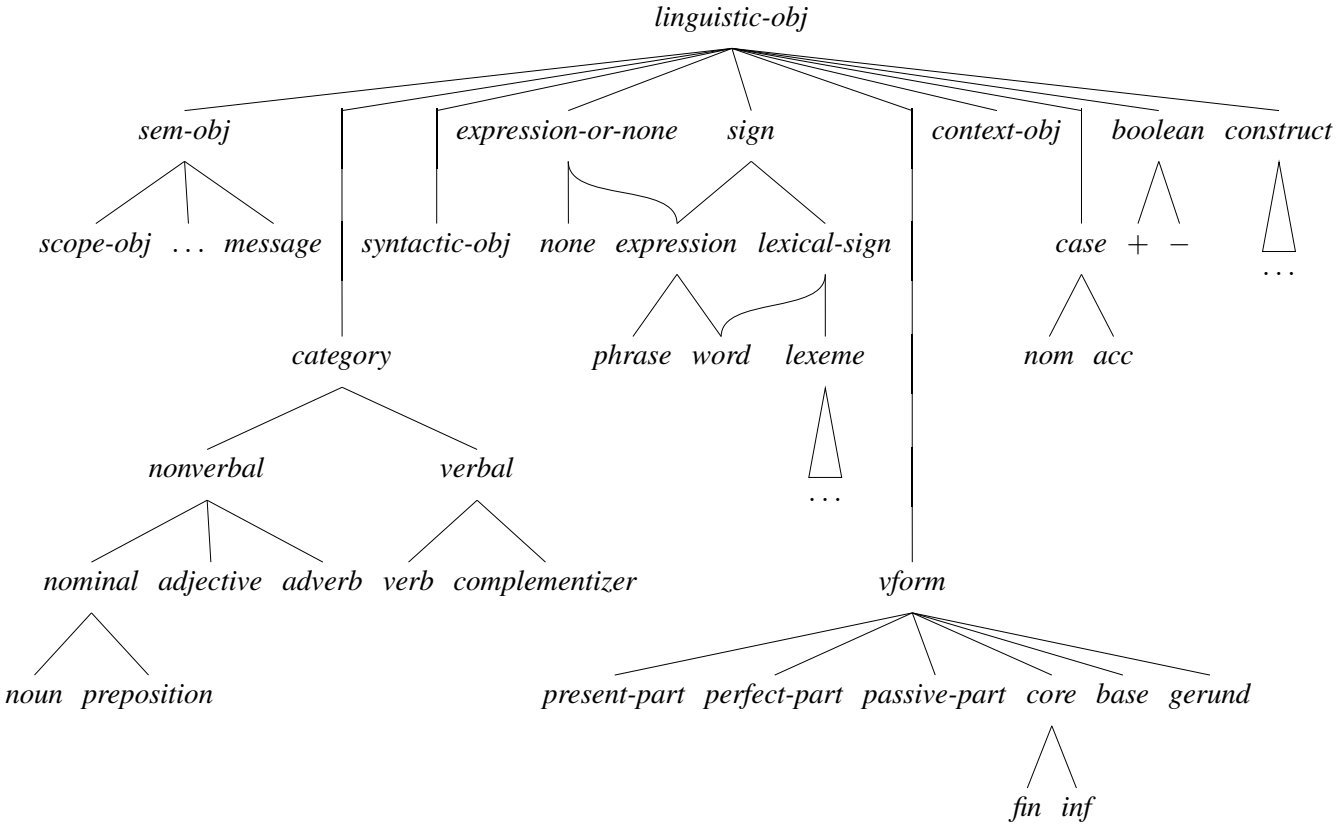
[75]For further discussion of these issues, see Hukari & Levine 1995, Bouma *et al.* 2001, and Levine & Hukari 2006.

[76]The general framework illustrated here has the potential to explain further properties of constructions, as well. As argued by Prince (1996), constructions may involve arbitrary form-function associations: a single function can be associated with many forms and a single syntactic form may be associated with multiple constructions. The former case arises when two distinct constructions require identical SEM value or identical contextual information; the latter when two sister types inherit identical formal constraints, but require distinct meanings (e.g. two of the aux-initial constructions discussed in section 3 above).

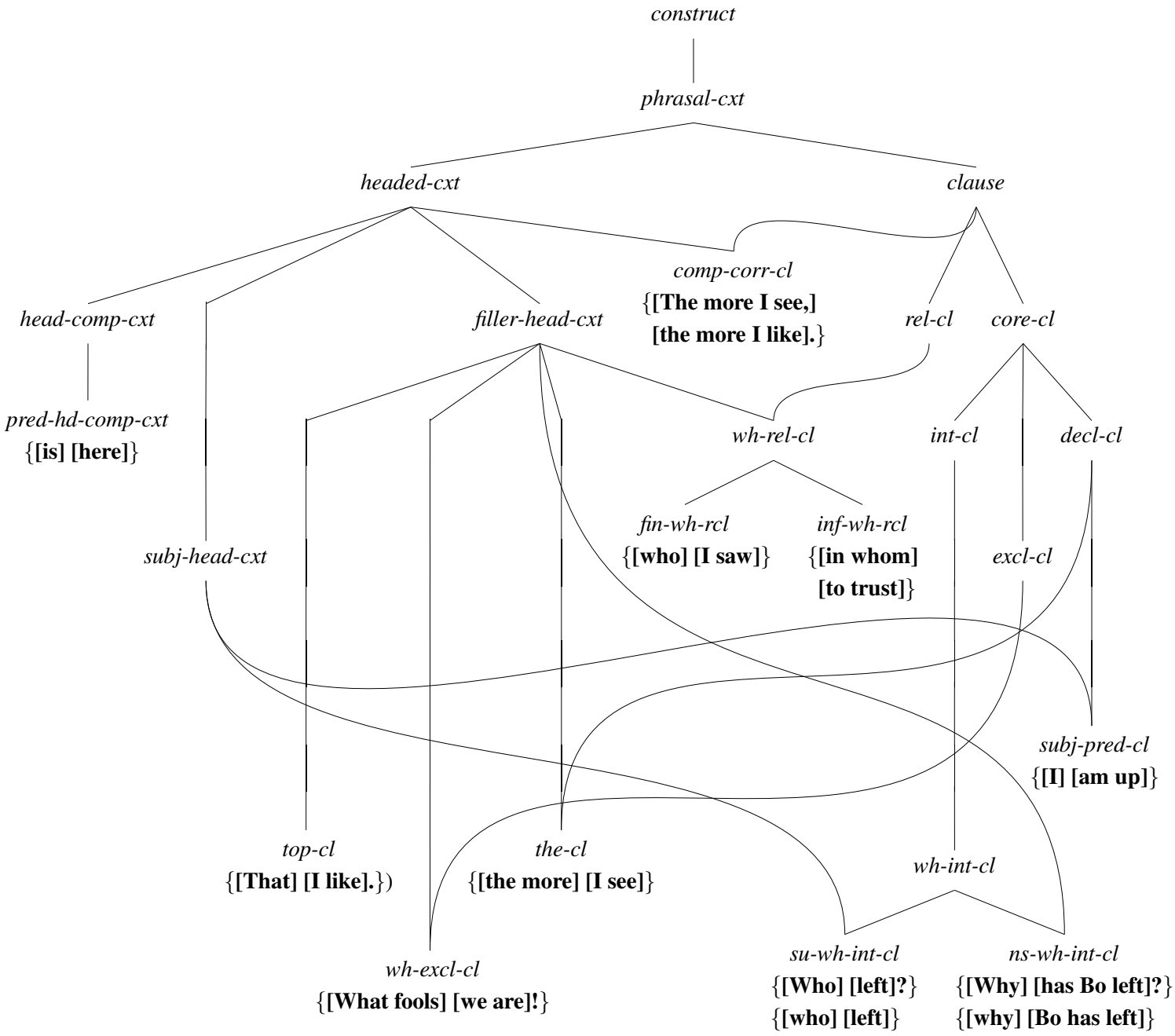
[77]This is intended in the sense of Pullum & Scholz (2001): a grammar is model-theoretic if it is formulated as a set of constraints that grammatical objects must simultaneously satisfy. That is, it involves no operations that destructively modify grammatical objects and the determination of well-formedness involves no appeal to comparison of one grammatical object with other competitors.

Appendix 1: Grammar Signature

The Type Hierarchy:



Some Types of English Linguistic Objects



Some Types of English Phrasal Constructs

Feature Declarations:

$$\textit{sign}: \begin{bmatrix} \text{PHON} & \textit{phonological-object} \\ \text{FORM} & \textit{morphological-object} \\ \text{SYN} & \textit{syntactic-object} \\ \text{SEM} & \textit{semantic-object} \\ \text{CTXT} & \textit{context-object} \\ \text{STORE} & \textit{set}(\textit{scope-object}) \end{bmatrix}$$

lexical-sign: [ARG-ST *list*(*expression*)]

$$\textit{construct}: \begin{bmatrix} \text{MTR} & \textit{sign} \\ \text{DTRS} & \textit{list}(\textit{expression}) \end{bmatrix}$$

headed-construct: [HD-DTR *sign*]

$$\textit{syntactic-object}: \begin{bmatrix} \text{CAT} & \textit{category} \\ \text{VAL} & \textit{list}(\textit{expression}) \\ \text{GAP} & \textit{list}(\textit{expression}) \\ \text{WH} & \textit{set}(\textit{scope-object}) \\ \text{REL} & \textit{set}(\textit{parameter}) \\ \text{CREL} & \textit{the}, \textit{if}, \ldots \textit{none} \end{bmatrix}$$

category: [SELECT *expr-or-none*]

$$\textit{verbal}: \begin{bmatrix} \text{VFORM} & \textit{present-part}, \textit{core}, \ldots \\ \text{IC} & \textit{boolean} \end{bmatrix}$$

$$\textit{verb}: \begin{bmatrix} \text{AUX} & \textit{boolean} \\ \text{INV} & \textit{boolean} \end{bmatrix}$$

noun: [CASE *case*]

Appendix 2: Some Grammatical Constructions of English

Headed Construction (↑*phrasal-cxt*):

$$\textit{headed-cxt} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SYN} \;\; [\text{CAT} \;\; X \;\;]] \\ \text{HD-DTR} & [\text{SYN} \;\; [\text{CAT} \;\; X \;\;]] \end{bmatrix}$$

Head-Complement Construction (↑*headed-cxt*):[1]

$$\textit{head-comp-cxt} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SEM} \;\; \mathbf{FR}(\mathbf{V}_0, \ldots, \mathbf{V}_n) \;] \\ \text{DTRS} & \langle \; H \; \rangle \;\oplus\; \langle [\text{SEM} \; \mathbf{V}_1] \; , \ldots , \; [\text{SEM} \; \mathbf{V}_n] \rangle \\ \text{HD-DTR} & H : \begin{bmatrix} \textit{word} \\ \text{SEM} \;\; \mathbf{V}_0 \end{bmatrix} \end{bmatrix}$$

Predicational Head-Complement Construction (↑*head-comp-cxt*):

$$\textit{pred-hd-comp-cxt} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SYN} \;\; X \; ! \; [\text{VAL} \; \langle Y \rangle]] \\ \text{DTRS} & \langle \; Z \; \rangle \;\oplus L : \textit{nelist} \\ \text{HD-DTR} & Z : \begin{bmatrix} \text{SYN} \;\; X : \begin{bmatrix} \text{CAT} & [\text{XARG} \;\; Y] \\ \text{VAL} & \langle Y \rangle \oplus \; L \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Subject-Head Construction (↑*headed-cxt*):

$$\textit{subject-head-cxt} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SYN} \;\; X_0 \; ! \; [\text{VAL} \;\; \langle \; \rangle \;]] \\ \text{DTRS} & \left\langle X_1 \; ! \begin{bmatrix} \text{WH} \\ \text{REL} \end{bmatrix}, \; H \right\rangle \\ \text{HD-DTR} & H : [\text{SYN} \;\; X_0 : [\text{VAL} \;\; \langle X_1 \rangle]] \end{bmatrix}$$

[1] The functional realization $\mathbf{FR}_\alpha$ of a set of meanings Σ is obtained by applying a unary functor expression in Σ to some other member of Σ and then applying the resulting function to a distinct member of Σ, and so forth, until all remaining members of Σ have become arguments and the resulting function is of type α. This sometimes gives more than one result and is sometimes undefined. When no α is specified, any functional realization is permitted. See Klein & Sag 1985 for further discussion.

Core Clause Construction (↑*clause*):

$$\textit{core-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{SELECT} & \textit{none} \\ \text{VFORM} & \textit{core} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Declarative Construction (↑*core-cl*):

$$\textit{declarative-cl} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SEM} \ \textit{austinean}] \\ \text{DTRS} & \textit{list}\left(\begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{WH} & \{\,\} \\ \text{REL} & \{\,\} \end{bmatrix} \end{bmatrix}\right) \end{bmatrix}$$

Subject-Predicate Construction (↑*subject-head-cxt* & ↑*declarative-cl*):

$$\textit{subj-pred-cl} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SEM} \ \mathbf{Y(X)}] \\ \text{DTRS} & \left\langle [\text{SEM} \ \mathbf{X}] , \begin{bmatrix} \text{SYN} & [\text{CAT} \ [\text{VFORM} \ \textit{fin}]] \\ \text{SEM} & \mathbf{Y} \end{bmatrix} \right\rangle \end{bmatrix}$$

Aux-Initial Construction (↑*headed-cxt*):

$$\textit{aux-initial-cxt} \Rightarrow \begin{bmatrix} \text{MTR} & \left[\text{SYN} \ \ X \ ! \left[\text{VAL} \ \ \langle\,\rangle\right]\right] \\ \text{DTRS} & \langle\, H \,\rangle \oplus L \\ \text{HD-DTR} & H : \begin{bmatrix} \textit{word} \\ \text{SYN} \ \ X : \begin{bmatrix} \text{CAT} & [\text{INV} \ \ +] \\ \text{VAL} & L \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Interrogative Construction (↑*core-cl*):

$$\textit{interrogative-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SEM} & \lambda\Sigma_1[\textit{proposition}] \\ \text{STORE} & \Sigma_2 \doteq \Sigma_1 \end{bmatrix} \\ \text{DTRS} & \textit{list}([\text{SYN} \ [\text{REL} \ \{\,\}]]) \\ \text{HD-DTR} & [\text{STORE} \ \ \Sigma_2 \ ] \end{bmatrix}$$

Exclamative Construction (↑*core-cl*):

$$\textit{exclamative-cl} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SEM } \textit{fact}] \\ \text{DTRS} & \textit{list}([\text{SYN } [\text{REL } \{\ \}]]) \end{bmatrix}$$

Polar Interrogative Construction (↑*aux-initial-cxt* & ↑*interrogative-cl*):

$$\textit{pol-int-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & [\text{CAT } [\text{IC } +] \,] \\ \text{SEM} & \lambda\{\ \}[\mathbf{FR}\,(\mathbf{V}_1,\ldots,\mathbf{V}_n)] \end{bmatrix} \\ \text{DTRS} & \langle [\text{SEM } \mathbf{V}_1] \,, \ldots, [\text{SEM } \mathbf{V}_n] \rangle \end{bmatrix}$$

Inverted Propositional Construction (↑*aux-initial-cxt* & ↑*declarative-cl*):

$$\textit{inv-prop-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & [\text{IC } +\,] \\ \text{GAP} & \textit{nelist} \end{bmatrix} \\ \text{SEM} & \mathbf{FR}_{\textit{proposition}}(\mathbf{V}_1, \ldots, \mathbf{V}_n) \end{bmatrix} \\ \text{DTRS} & \left\langle [\text{SEM } \mathbf{V}_1], \ldots, [\text{SEM } \mathbf{V}_n] \right\rangle \end{bmatrix}$$

Inverted Exclamative Construction (↑*aux-initial-cxt* & ↑*exclamative-cl*):

$$\textit{inv-excl-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & [\text{CAT } [\text{IC } +\ ]] \\ \text{SEM} & \textit{fact}(\mathbf{FR}(\mathbf{V}_1, \ldots, \mathbf{V}_n)) \end{bmatrix} \\ \text{DTRS} & \left\langle [\text{SEM } \mathbf{V}_1], \ldots, [\text{SEM } \mathbf{V}_n] \right\rangle \end{bmatrix}$$

Filler-Head Construction (↑*headed-cxt*):

$$\textit{filler-head-cxt} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SYN}\ \ X_1\ !\ [\text{GAP}\ \ L\ ]] \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & X_2\ ! \begin{bmatrix} \text{WH} \\ \text{REL} \end{bmatrix} \\ \text{STORE} & \Sigma \end{bmatrix}, H \right\rangle \\ \text{HD-DTR} & H : \begin{bmatrix} \text{SYN} & X_1 : \begin{bmatrix} \text{CAT} & \textit{verbal} \\ \text{GAP} & \left\langle \begin{bmatrix} \text{SYN} & X_2 \\ \text{STORE} & \Sigma \end{bmatrix} \right\rangle \oplus L \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Topicalization Construction (↑*filler-head-cxt*):

$$\textit{top-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \left[\text{SEM} \quad \lambda\mathbf{X}[\mathbf{Y}](\mathbf{Z})\right] \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \textit{nonverbal} \\ \text{WH} & \{\ \} \\ \text{REL} & \{\ \} \end{bmatrix} \\ \text{SEM} & \mathbf{Z} \end{bmatrix}, \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \textit{verb} \\ \text{IC} & + \\ \text{INV} & - \\ \text{VFORM} & \textit{fin} \end{bmatrix} \\ \text{VAL} & \langle\ \rangle \\ \text{GAP} & \left\langle \left[\text{SEM} \quad \mathbf{X}\right] \right\rangle \end{bmatrix} \\ \text{SEM} & \mathbf{Y} : \textit{austinean} \end{bmatrix} \right\rangle \end{bmatrix}$$

***Wh*-Exclamative Construction (↑*filler-head-cxt* & ↑*exclamative-cl*):**

$$\textit{wh-excl-cl} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SEM} \quad \textit{fact}(\mathbf{Q}[\lambda\mathbf{X}[\mathbf{Y}](\mathbf{Z})])\ ] \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \textit{nonverbal} \\ \text{WH} & \{\mathbf{Q}\} \end{bmatrix} \\ \text{SEM} & \mathbf{Z} \end{bmatrix}, \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{INV} & - \\ \text{VFORM} & \textit{fin} \end{bmatrix} \\ \text{VAL} & \langle\ \rangle \\ \text{GAP} & \left\langle [\text{SEM} \quad \mathbf{X}] \right\rangle \end{bmatrix} \\ \text{SEM} & \mathbf{Y} \end{bmatrix} \right\rangle \end{bmatrix}$$

Nonsubject *Wh*-Interrogative Construction (↑*filler-head-cxt* & ↑*interrogative-cl*):

$$\textit{ns-wh-int-cl} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SEM} \ \ \lambda\{\pi,\ldots\}[\lambda\mathbf{X}[\mathbf{Y}](\mathbf{Z})]] \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \textit{nonverbal} \\ \text{WH} & \{\pi\} \end{bmatrix} \\ \text{SEM} & \mathbf{Z} \end{bmatrix}, \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{INV} & X \\ \text{IC} & X \end{bmatrix} \\ \text{VAL} & \langle\,\rangle \\ \text{GAP} & \langle [\text{SEM} \ \ \mathbf{X}]\,,\ldots\rangle \end{bmatrix} \\ \text{SEM} & \mathbf{Y} \end{bmatrix} \right\rangle \end{bmatrix}$$

Subject *Wh*-Interrogative Construction (↑*subject-head-cxt* & ↑*interrogative-cl*):

$$\textit{subj-wh-int-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \left[\text{SEM} \ \ \lambda\{\pi,\ldots\}[\lambda\mathbf{X}[\mathbf{Y}](\mathbf{Z})]\right] \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & [\text{WH} \ \ \{\pi\}] \\ \text{SEM} & \mathbf{Z} \end{bmatrix}, \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{GAP} & \langle [\text{SEM} \ \ \mathbf{X}]\,,\ldots\rangle \\ \ldots & \end{bmatrix} \\ \text{SEM} & \mathbf{Y} \end{bmatrix} \right\rangle \end{bmatrix}$$

Relative Construction (↑*clause*):

$$\textit{relative-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{INV} & - \\ \text{IC} & - \\ \text{SELECT} & \text{CNP} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{DTRS} & \textit{list}([\text{SYN} \ \ [\text{WH} \ \ \{\ \}]]) \end{bmatrix}$$

***Wh*-Relative Construction (↑*filler-head-cxt* & ↑*relative-cl*):**

$$\textit{wh-rel-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \left[\text{SEM} \ \ \lambda P\lambda x[\lambda\mathbf{Z}[\mathbf{X}](\mathbf{Y}) \ \&\ P(x)]\right] \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & [\text{REL} \ \ \{[x,\mathbf{R}]\}] \\ \text{SEM} & \mathbf{Y} \end{bmatrix}, \begin{bmatrix} \text{SYN} & [\ \text{GAP} \ \ \langle [\text{SEM} \ \mathbf{Z}\ ],\ldots\rangle] \\ \text{SEM} & \mathbf{X} \end{bmatrix} \right\rangle \end{bmatrix}$$

Finite *Wh*-Relative Construction (↑*wh-rel-cl*):

$$\textit{fin-wh-rel-cl} \Rightarrow \begin{bmatrix} \text{MTR} & [\text{SYN} \ [\text{CAT} \ [\text{VFORM} \ \textit{fin}]]] \\ \text{DTRS} & \langle\ [\text{SYN} \ [\text{CAT} \ \textit{nominal}]], \ldots\rangle \end{bmatrix}$$

Infinitival *Wh*-Relative Construction (↑*wh-rel-cl*):

$$\textit{inf-wh-rel-cl} \Rightarrow \begin{bmatrix} \text{DTRS} & \left\langle [\text{SYN}\ [\text{CAT}\ \textit{prep}]]\ , \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & [\text{VFORM}\ \textit{inf}] \\ \text{VAL} & \langle\,\rangle \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

The-**Clause (**↑*filler-head-cxt* & ↑*declarative-cl*)**:**

$$\textit{the-cl-cxt} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & X\ ! \begin{bmatrix} \text{CREL} & \textit{the} \\ \text{REL} & \{[x],[t_1],[t_2]\} \end{bmatrix} \\ \text{SEM} & \lambda\mathbf{V}[\mathbf{X}](\mathbf{Y}) \\ \text{STORE} & \Sigma \end{bmatrix} \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \textit{nonverbal} \\ \text{VAL} & \langle\,\rangle \\ \text{REL} & \{[x],[t_1],[t_2]\} \end{bmatrix} \\ \text{SEM} & \mathbf{Y} \end{bmatrix}, \begin{bmatrix} \text{SYN} & X : \begin{bmatrix} \text{CAT} & [\text{VFORM}\ \textit{fin}] \\ \text{CREL} & \textit{none} \\ \text{GAP} & \langle [\text{SEM}\ \mathbf{V}] \rangle \end{bmatrix} \\ \text{SEM} & \mathbf{X} \\ \text{STORE} & \Sigma \end{bmatrix} \right\rangle \end{bmatrix}$$

Comparative Correlative Construction (↑*headed-cxt* & ↑*clause*)**:**

$$\textit{comp-corr-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & X\ ! \begin{bmatrix} \text{CREL} & \textit{none} \\ \text{REL} & \{\,\} \end{bmatrix} \\ \text{SEM} & \forall t_1 \forall t_2 \forall \Delta[\mathbf{F}(\lambda x[\mathbf{X}])(\Delta) \Rightarrow \\ & \exists \Delta'[\mathbf{G}(\lambda y[\mathbf{Y}])(\Delta')\ \&\ \mathbf{R}_{mon}(\Delta, \Delta')\ ]] \\ \text{STORE} & \{\,\} \end{bmatrix} \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CREL} & \textit{the} \\ \text{VAL} & \langle\,\rangle \\ \text{REL} & \{[x],[t_1],[t_2]\} \end{bmatrix} \\ \text{SEM} & \mathbf{X} \\ \text{STORE} & \{\mathbf{F}\} \end{bmatrix}, H : \begin{bmatrix} \text{SYN} & X : \begin{bmatrix} \text{CREL} & \textit{the} \\ \text{VAL} & \langle\,\rangle \\ \text{REL} & \{[y],[t_1],[t_2]\} \end{bmatrix} \\ \text{SEM} & \mathbf{Y} \\ \text{STORE} & \{\mathbf{G}\} \end{bmatrix} \right\rangle \\ \text{HD-DTR} & H \end{bmatrix}$$

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WH-Word	Category	Interrogative	Exclamative	Relative	Example
who	NP	+	−	+	*who*
whose	Det	+	−	+	*whose book*
what	NP	+	%	−	*what*
what	Det_{sing}	+	−	−	*what book*
what	Det_{pl}	+	+	−	*what stories*
what	Degree word	+	+	−	*what fun*
what a	Det_{sing}	−	+	−	*what a good time*
which	NP	−	−	+	*which*
which	Det	+	−	%	*which book*
how	AdvP_{manner}	+	+	%	*how*
how	AP	+	−	−	*how*
how	Degree word	+	+	−	*how tall*
when	PP_{time}	+	−	+	*when*
where	PP_{place}	+	−	+	*where*
why	PP_{reason}	+	−	+	*why*

Figure 1: '*Wh*'-Words and their Functions

Exclamatives:	**'Blessings, Curses, . . .':**
Boy, **was I stupid**! Wow, **can she sing**!	May they live forever! May all your teeth fall out!
Conditionals:	**Interrogatives:**
Were they here now, we wouldn't... **Should there be a need**, we could...	Were they involved? We won't go, **will we**?
Declaratives:	
So **can I __** ! Never **would I do such a thing __** .	

Figure 2: Some Aux-Initial Constructs

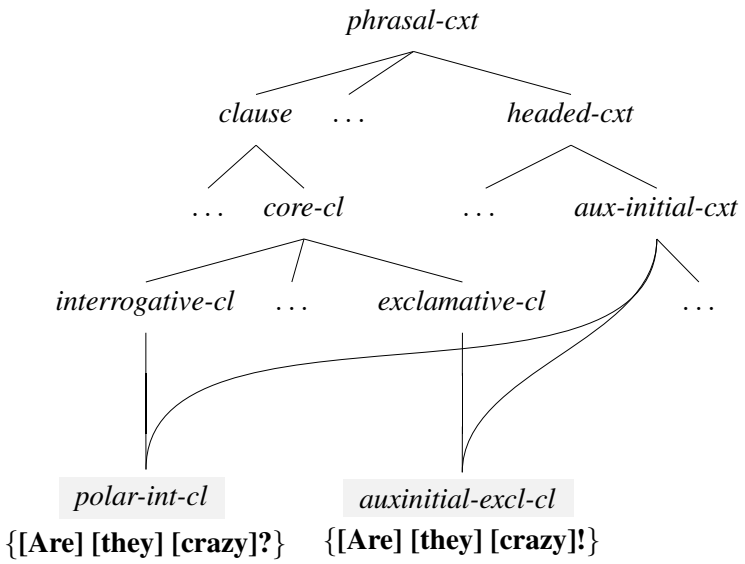

Figure 3: Two Types of Aux-Initial Clause

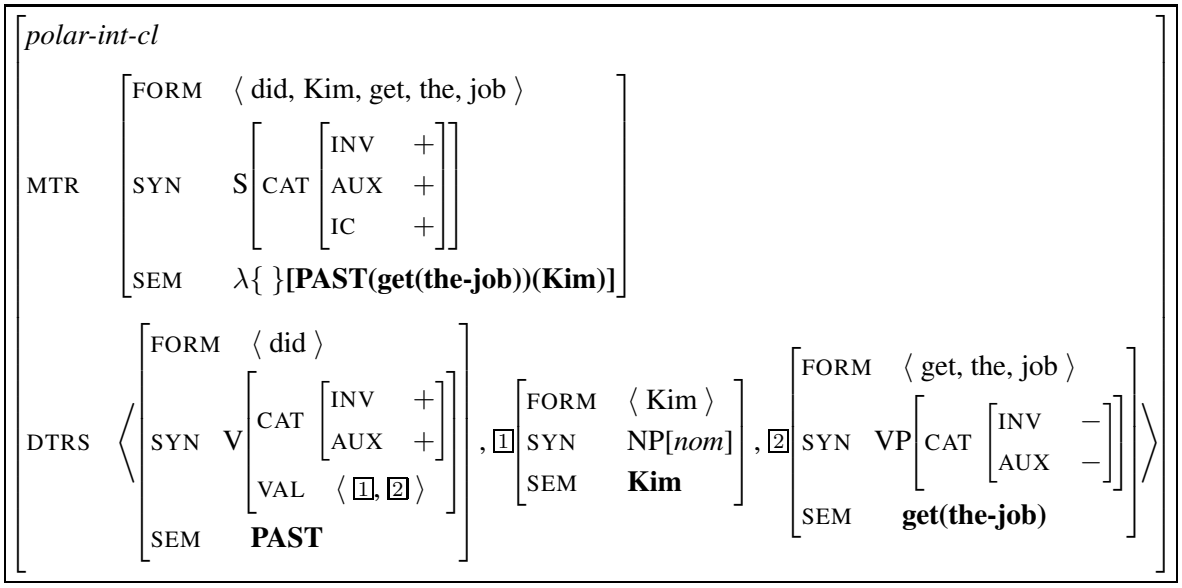

Figure 4: A Construct Licensed by the Polar Interrogative Clause Construction

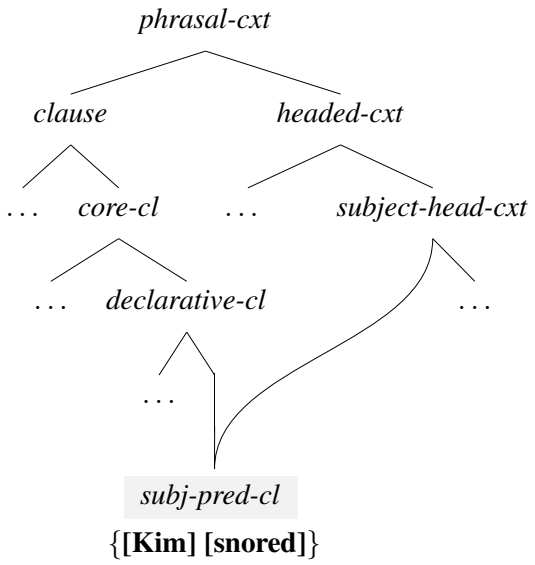

Figure 5: Types Generalizing over Subject Predicate Clauses

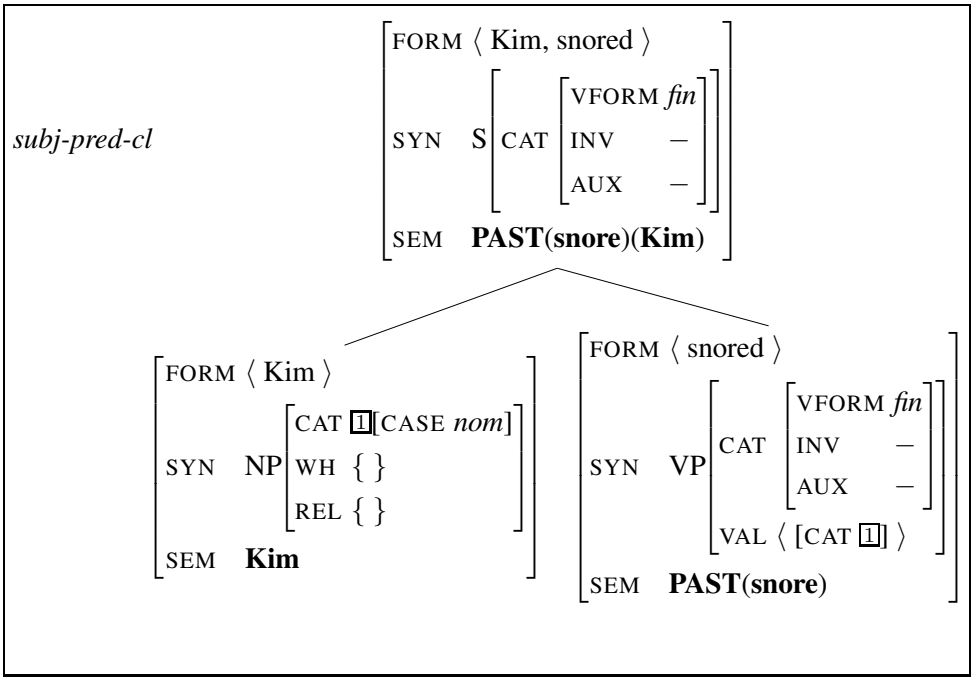

Figure 6: A Construct Licensed by the Subject-Predicate Construction

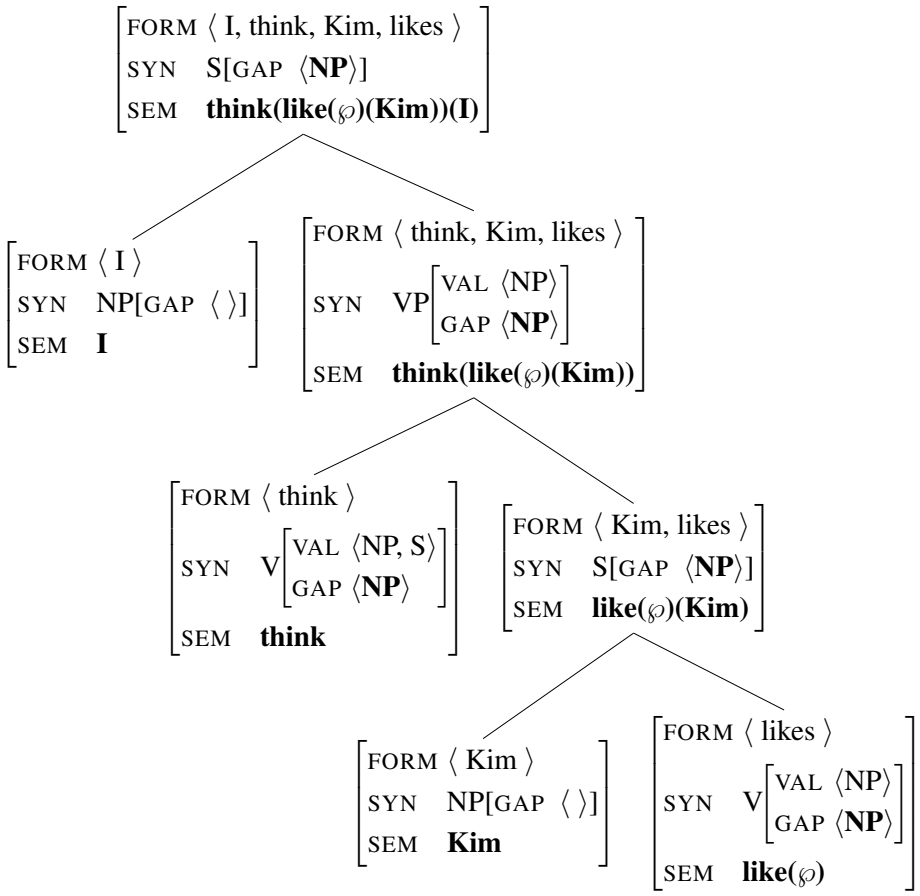

Figure 7: An Incomplete Derivation Showing 'Percolation' of GAP Specifications

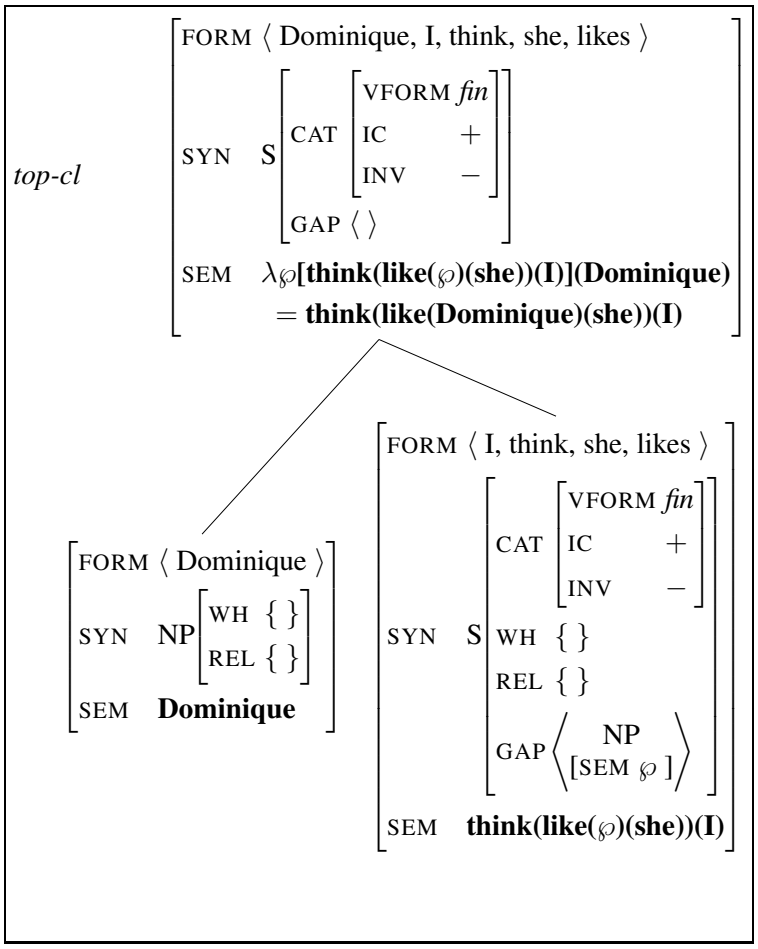

Figure 8: A Construct Licensed by the Topicalization Construction

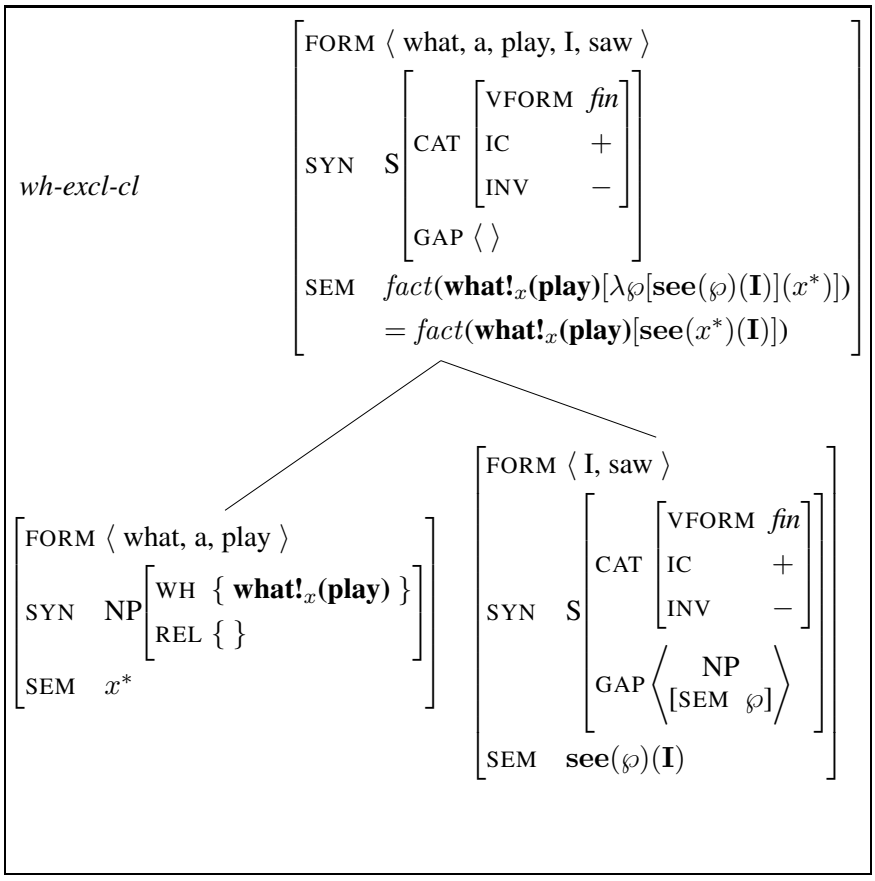

Figure 9: A Construct Licensed by the *Wh*-Exclamative Construction

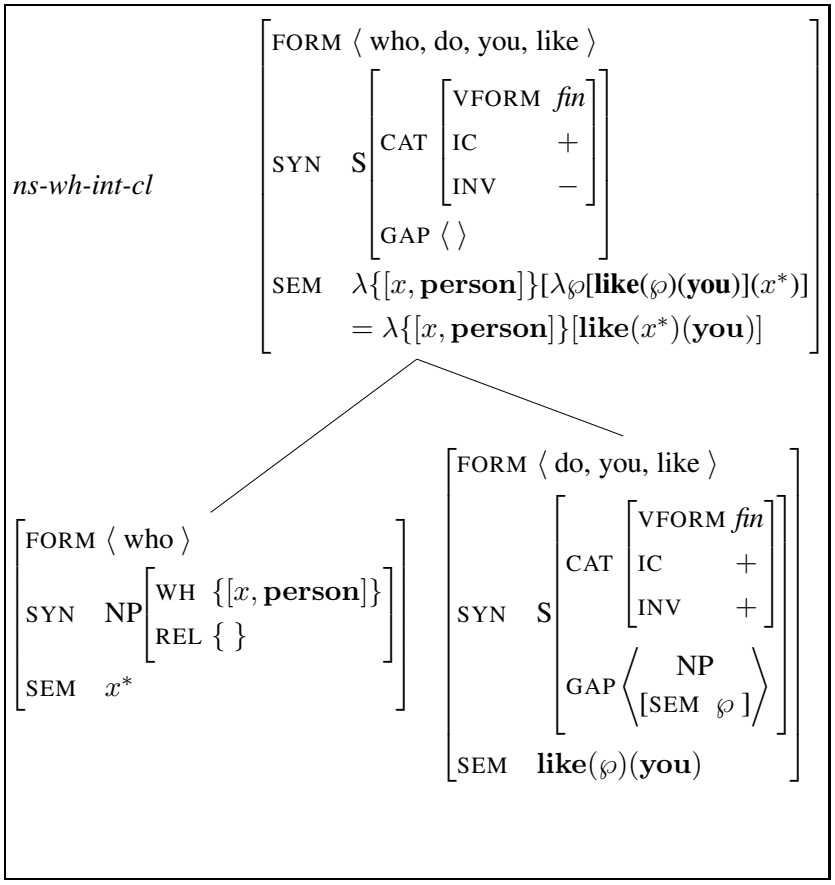

Figure 10: A Construct Licensed by the Nonsubject *Wh*-Interrogative Construction

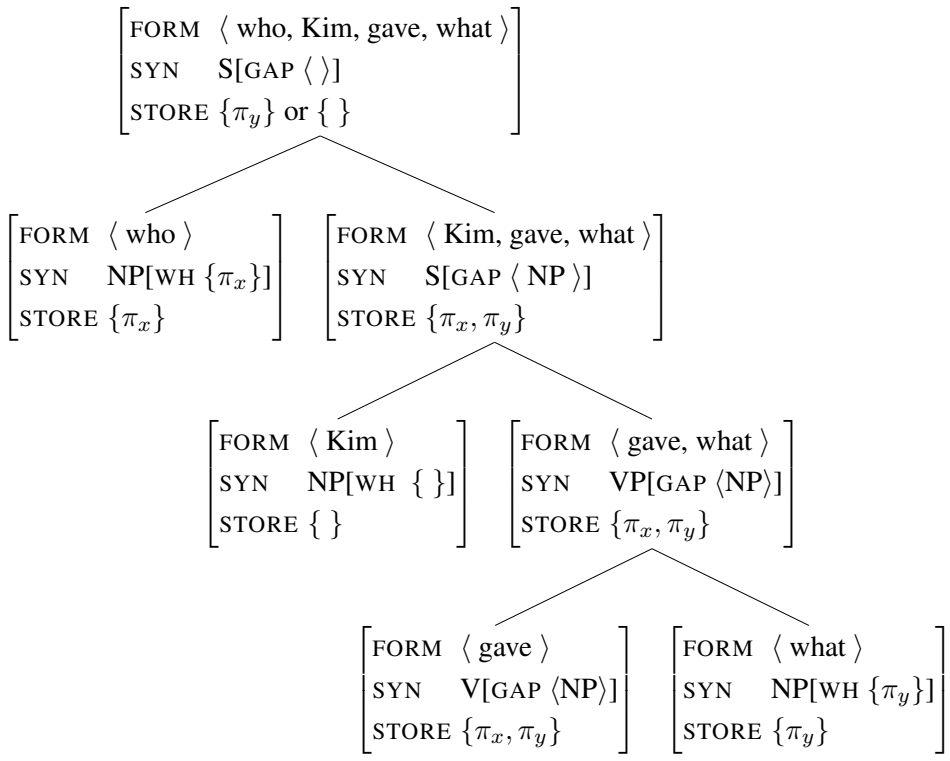

Figure 11: Stored Parameters in a Multiple *Wh*-Interrogative Derivation

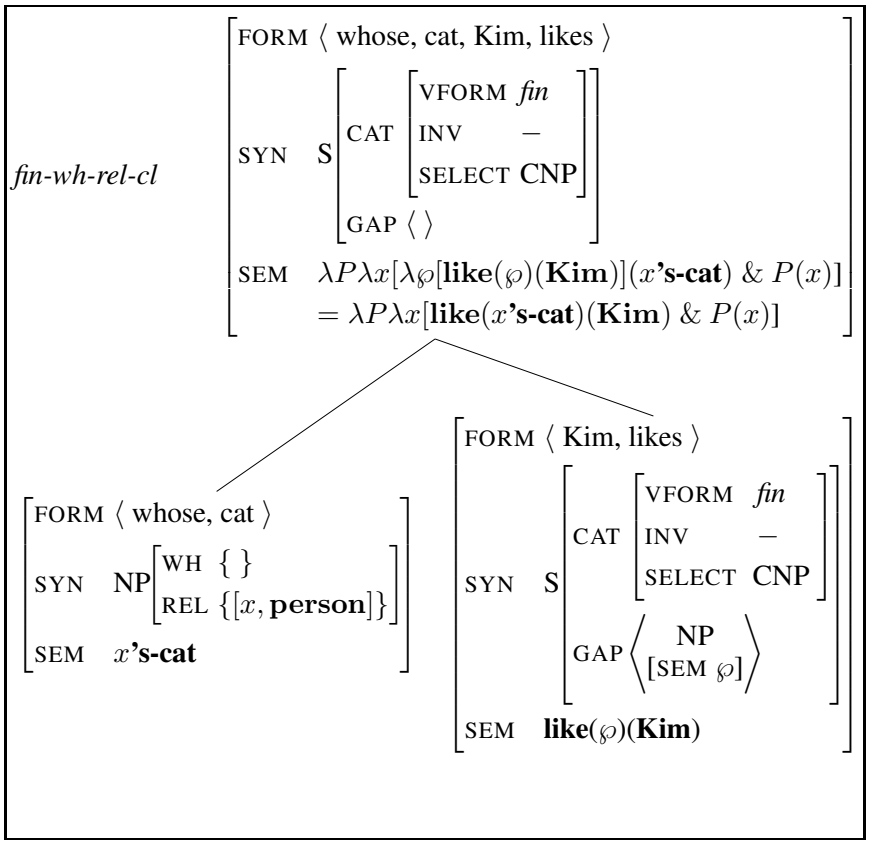

Figure 12: A Construct Licensed by the Finite *Wh*-Relative Clause Construction

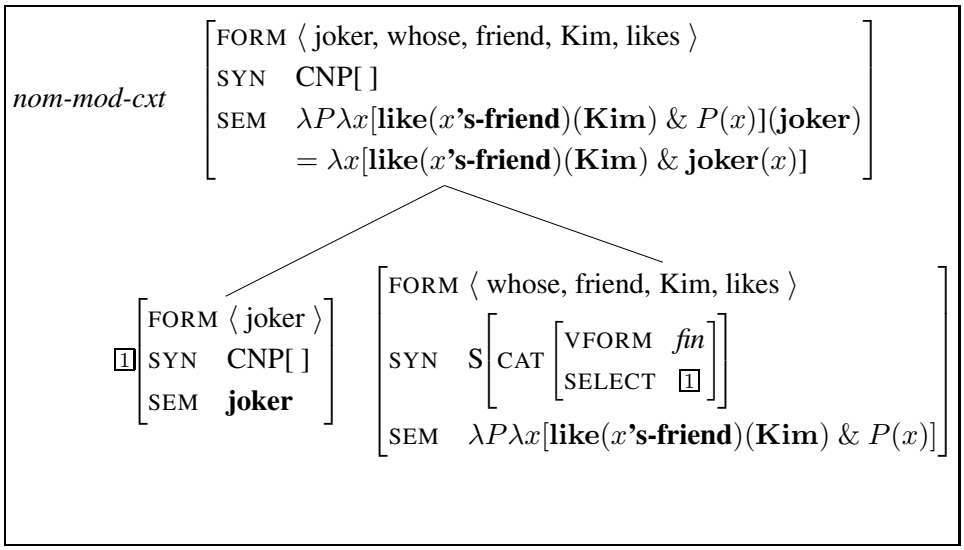

Figure 13: A Nominal-Modifier Construct

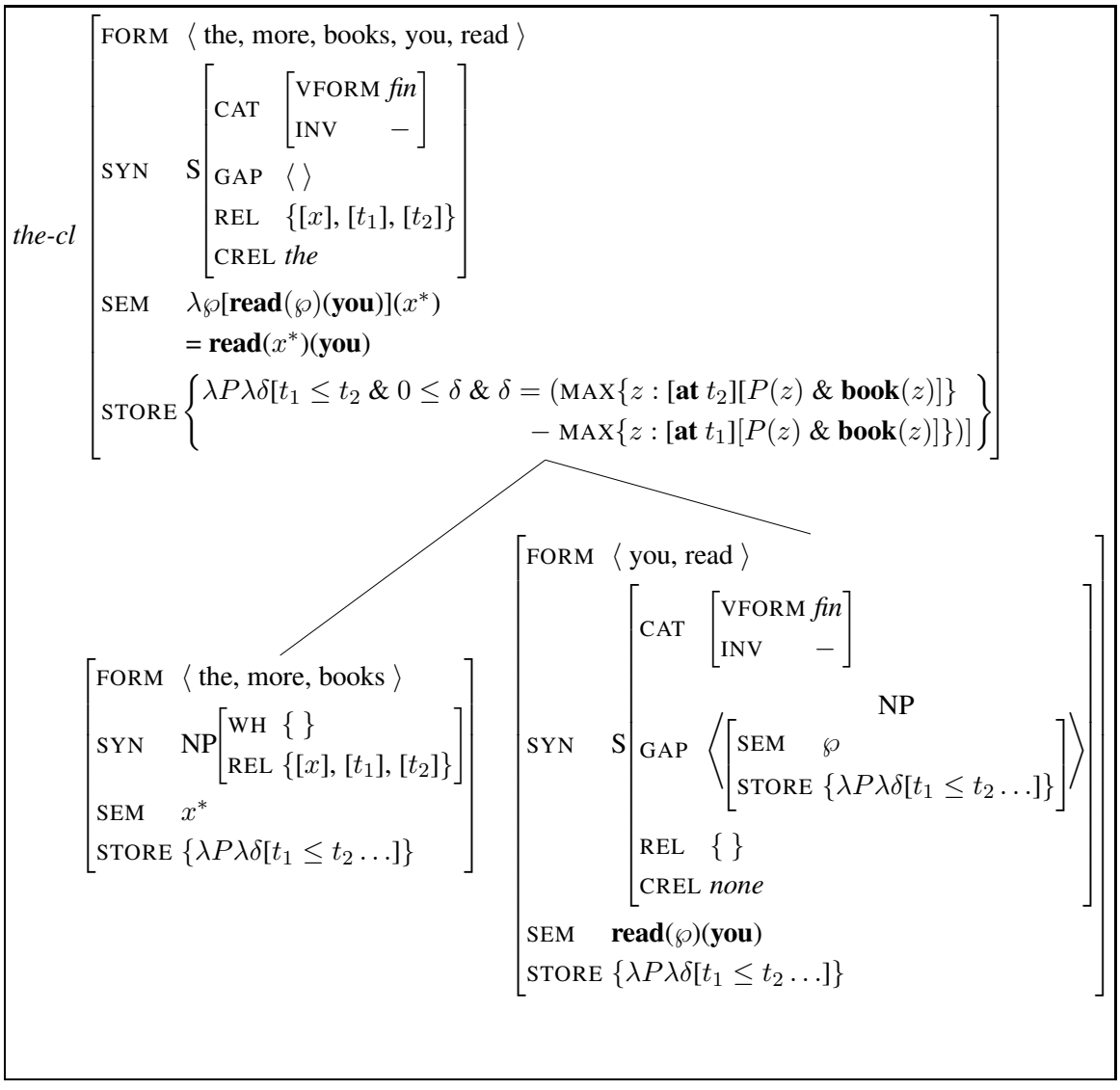

Figure 14: A *The*-Clause

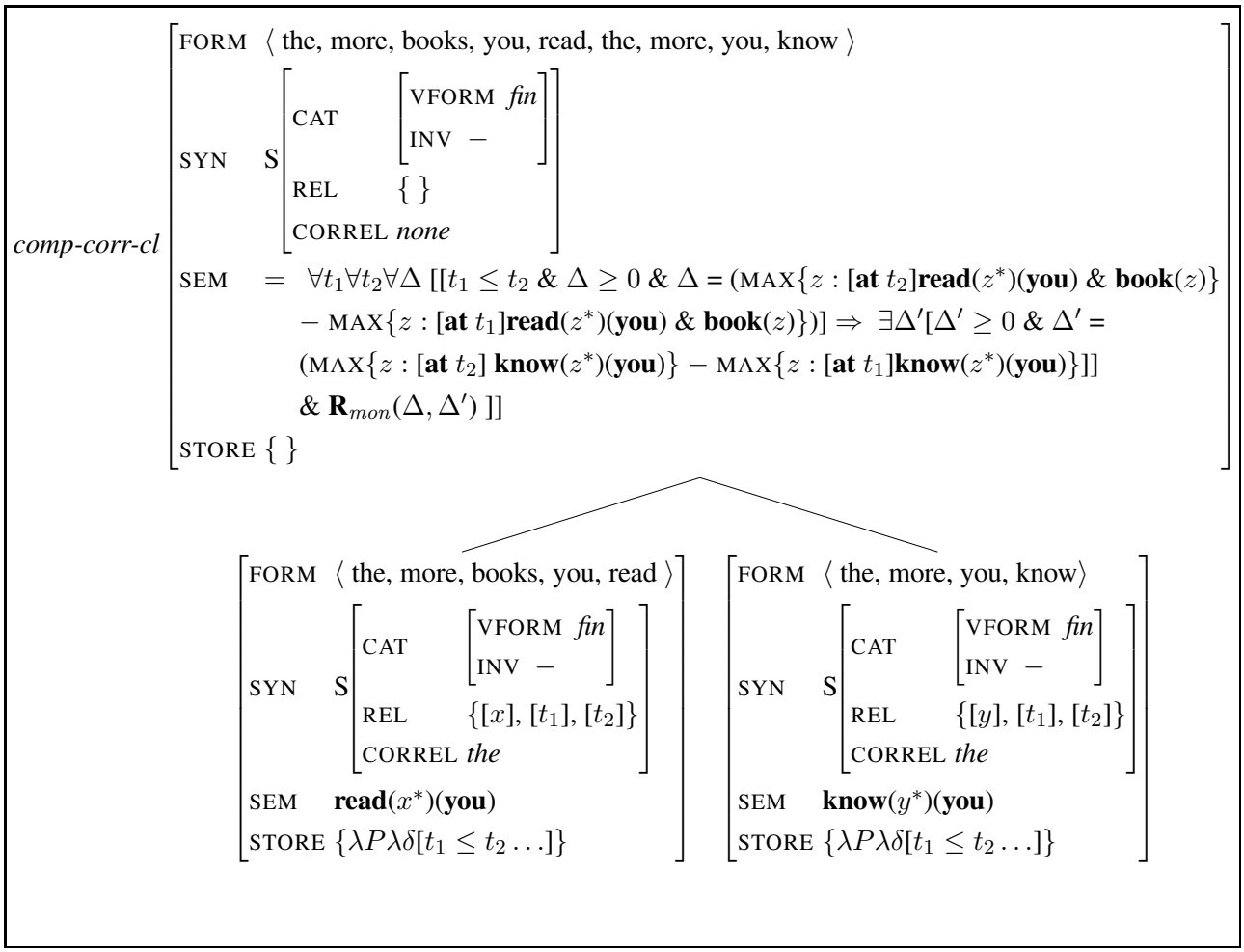

Figure 15: A *Comparative-Correlative* Clause