English Filler Gap Constructions*

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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 kind of Head-Driven Phrase Structure Grammar (HPSG). The results presented here stand as a serious challenge to any analysis incorporating transformational operations, especially proposals couched within Chomsky's "Minimalist Program."

1 Introduction

In the tradition of transformational 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

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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*. McCawley pointed out that these properties of the construction followed from nothing under the "more explanatory" proposals made by Chomsky, whose analysis of passivization, when complete, was comparably stipulative to (though obviously more abstract than) the construction-based transformational alternative it sought to replace. Obviously unswayed by such criticism, Chomsky (1993: 4) wrote as follows, sewing 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-particlar 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.

The "interaction of principles" envisaged by Chomsky has proved elusive. Rhetoric aside, the proposals made within transformational analyses, including GB and MP, lack adequate precision and are 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]

Similarly problematic is the bifurcation Chomsky has introduced 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 thus leads to the study of "Core Grammar" and to the systematic exclusion of other phenomena.

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 us at serious risk of developing a theory of language that is either vacuous or else rife with analyses that are insufficiently general or otherwise empirically flawed. There is the further danger that grammatical theories developed on the basis of "core" phenomena may be disconfirmable only by examining data from the periphery – data that are by definition outside the domain of inquiry.[2]

[1]For critical discussion substantiating these claims, see, for example, Ackerman & Webelhuth 1998, Johnson & Lappin 1999, Postal 2004, Seuren 2004, Culicover & Jackendoff 2005, Newmeyer 2004, 2008a,b, 2009, and Evans & Levinson in press.

[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 Kaplan & Bresnan 1982, Fillmore *et al.* 1988, Kay & Fillmore 1999, Jackendoff 1997, Culicover 1999, Culicover & Jackendoff 2005, and Sag & Wasow in press.

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, if ever, made precise[3]) has led to a loss of both precision and descriptive coverage in the practice of transformational-generative grammar. Indeed, since the 1960s,[4] no large-scale, internally consistent transformational grammar has (to my knowledge) been written for any human language. This remarkable fact is a consequence of both a general perception in the field that such large-scale descriptions are irrelevant for theoretical purposes and 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.

Some of these criticisms are not new, of course. 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 led to the largely erroneous belief in the GB/MP community that CXG is obsessed with trivia, theoretically uninteresting and wrong-headed about issues of learning.

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) and a 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, well explored, nontransformational techniques 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). However, these techniques have been systematically ignored by the practitioners of the transformational-generative tradition, who continue to formulate their theories in terms of "rewrite rules" (e.g. movement operations, including the "internal merge" of MP).

I will draw on widely utlilized object-oriented resources to develop a construction-based theory of English filler-gap (FG) constructions. My analysis extends to FG 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 (GS-00)) uses feature structures to model linguistic entities of all kinds. This system, which classifies feature structures in terms of hierarchically organized linguistic **types**, allows constraints of varying grain

[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 had little impact on theoretical developments within the field.

to be stated naturally, reflecting the fact that the structures of natural language come patterned into classes whose members bear a "family resemblance" to one another.

The system that emerges from this perspective attends to matters of detail that have been almost completely ignored in the last half century of transformational generative research on "*wh*-movement." It provides a mathematically precise account of both generalization and idiosyncrasy in the FG 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 pervasive 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 Appendices 1 and 2.

2 The Diversity of FG Constructions

Modern discussions of constructions involving FG 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 accounting for island effects.[5]

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 (GPSG; see Gazdar *et al.* 1985), Combinatory Categorial Grammar (see Steedman 1996, 2000), Lexical-Functional Grammar (LFG; see Kaplan & Zaenen 1989), Tree-Adjoining Grammar (TAG; see Kroch 1987, 1989), the "Simpler Syntax" hypothesis (see Culicover & Jackendoff 2005, Ch. 9), and HPSG (see Bouma *et al.* 2001; Levine & Hukari 2006). What is systematically left out of such analyses, however, is the fact that individual FG constructions 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. These constructions are illustrated in (1)–(5):

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

a. How foolish is he?

b. I wonder **how foolish he is**.

[5]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 (to appear) (see also Sag *et al.* 2007, Hofmeister 2007) argue that subjacency effects, including the alleged inability of FG 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. Everything in this paper is consistent with this conclusion; however, nothing depends on it. This seems to be a highly promising line of inquiry for actually explaining certain island phenomena, rather than treating them as an arbitrary property of grammar.

(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 FG 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 FG 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 is the semantics and/or syntactic category of the mother?
f. What is the semantics and/or syntactic category of the head daughter?
g. Is the clause an island? Must it be an "independent clause"?

Let us consider these in turn. The five types of FG 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, ungrammatical sentences like the following result:

(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[6] that have gradually been leveled in the historical evolution of Present-Day English. The modern inventory of forms, usually lumped together as "*wh*-words", is shown in Figure 1.[7]

FIGURE 1 ABOUT HERE

The data motivating these fine-grained distinctions include the following:[8]

(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!

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[6]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 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.

[7]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*.

[8]I am assuming, following GS-00, 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*.

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. Which did she read?

b.*Which she read!

c. The only book which she read . . .

(16) a. Which book did she read?

b.*Which book she read!

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

(17) a. How did they do that?

b.*How they did that!

c.%The way how they did that . . .

(18) a. How was it?

b.*How it was!

c.*The color how it was . . .

(19) a. How tall did they get?

b. How tall they got!

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

(20) a. When did they do that?

b.*When they did that!

c. The time when they did that . . .

(21) a. Where did they do that?

b.*Where they did that!

c. The place where they did that . . .

(22) 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):

(23) 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 FG constructions (*tough*-constructions, topicalization, comparative clauses, comparative correlative constructions, bare relative clauses, etc.), all of which are forced into the Procrustean bed of "*wh*-movement" (with obligatory deletion of an unheard *wh*-expression) by the assumptions made in Chomsky 1977, which have gone unquestioned in the subsequent GB and MP literature. The very notion of "*wh*-movement" is suspect – it is at best a crude and misleading rubric for the discussion of FG constructions.[9]

The five types of FG clauses also differ with respect to the constraints they impose on the syntactic category of the filler daughter:[10]

[9]Even the familiar assumption that island constraints are uniform across FG constructions is open to question. See, for example, Postal 1998, 2001. If Kluender (1992, 1998) and Hofmeister and Sag (to appear) are right in accounting for subjacency effects in terms of processing factors, then it becomes possible to explain much of the cross-constructional variation in island effects in terms of independently motivated differences in processing difficulty.

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

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

a. Topicalization/*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:

(25) **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:

(26) **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):

(27) **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**.[11]

And only certain FG clauses allow infinitival realizations, as summarized in (28):

(28) **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** . . .

Finally, as is well known, the semantics of FG clauses is not uniform. These are determined as indicated:

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

a. Interrogative: *question* (propositional function)
b. Relative: *proposition*
c. Exclamative: *fact*
d. *The*-Clause: *austinean* (see section 5.5)
e. Topicalization: *austinean*

This classification follows GS-00, who motivate a Vendlerian semantic analysis (couched in the framework of Situation Semantics) that recognizes facts, propositions, questions, and outcomes as distinct types of semantic object.[12]

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[11] `http://blueraindrop.wordpress.com/2008/01/02/highlighting-from-eccentric-preachersspurg` See Culicover and Jackendoff (1999: 559).

[12] GS follow 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 imperatives and exclamatives may be so embedded, as in examples like (ii) and (iii):

(ii) ??Papers with such immediate relevance for our group's concerns, be sure to file __ !

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

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

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

Hence, I have assume here that a grammar should restrict topicalized clauses so that they express only propositions or outcomes, 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 (iv). Similar remarks apply to the imperative and exclamative examples in (ii) and (iii).

As noted in the introduction, transformational discussions have largely ignored the data sets summarized in this section, instead focusing on proposals of ever increasing metatheoretical abstractness, ever diminishing empirical breadth, and ever declining precision. 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 support a theory of language learning that takes 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, the GB literature, or 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 FG constructions, while at the same time providing the means for an account of the idiosyncrasies found in the data sets outlined above.

3 Background

Early work in Head-Driven Phrase Structure Grammar (HPSG)[13] 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 by Sag (1997) and GS-00, and the variety of CxG developed around Berkeley, beginning in the 1980s (see Fillmore *et al.* 1988, Fillmore 1999, Kay & Fillmore 1999, and Goldberg 1995).[14] In all of these traditions, generalizations about constructions are expressed

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

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

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" (but see Borsley 2006). 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

GS-00, 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 SBCG, **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), SYNTAX (SYN), SEMANTICS (SEM), and CONTEXT (CNTXT), as shown in (30):[15]

(30)
$$\begin{bmatrix} \textit{sign} & \\ \text{PHON} & \textit{phonological-object} \\ \text{FORM} & \textit{morphological-object} \\ \text{SYN} & \textit{syntactic-object} \\ \text{SEM} & \textit{linguistic-meaning} \\ \text{CNTXT} & \textit{context-object} \end{bmatrix}$$

More precisely, a sign is a (polymorphic[16]) function that maps each of the features in (30) to an appropriate value. Since the domain of functions of type *sign* is the set {PHON, FORM, SYN, SEM, CNTXT}, any particular sign maps each element of this domain to a different type of complex value, i.e. another functional feature structure. That function in turn maps features from its appropriate domain to appropriate values, 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 CFG rule defines a set of local trees.[17] These configurations are modeled as feature

[15]A complete list of relevant feature and type abbreviations is provided in Appendices 1 and 3.

[16]A function is polymorphic if it applies to diverse kinds of elements, the nature of the functional value being determined by the type of the input.

[17]Sag (2007b) posits two kinds of construction: combinatory constructions (defining classes of constructs) and lexical class constructions (defining classes of lexemes or words). I will have nothing to say here about lexical class constructions.

structures of a different type: **construct**. 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.[18] We may represent such functions in the same format we used in (30), as shown in (31):

(31)
$$\begin{bmatrix} \textit{construct} & \\ \text{MTR} & \textit{sign}_0 \\ \text{DTRS} & \langle\ \textit{sign}_1, ..., \textit{sign}_n\ \rangle \end{bmatrix}$$

While feature structures of type *sign* model conventional sound-meaning correspondences, different types of feature structures model various kinds of linguistic entities that are relevant to the system of grammar determining which signs are well-formed.

Sign well-formedness in SBCG is given by the following principle:

(32) **Sign Principle:**

Every sign must be lexically or constructionally licensed, where:

a sign is lexically licensed only if it satisfies some entry in the lexicon, and
a sign is constructionally licensed only if it is the mother of some construct.

The constructions of the grammar interact with the lexicon to impose constraints on sign well-formedness. Thus because of the specifics of the English lexicon and its constructional inventory, the signs in (33) are licensed by English grammar and those in (34) are not:

(33) 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.
$$\begin{bmatrix} \text{PHON} & [\textit{kIm\#snizd}] \\ \text{FORM} & \langle\ \text{Kim, sneezed}\ \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \textit{verb} & \\ \text{INV} & - \\ \text{AUX} & - \end{bmatrix} \\ \text{VAL} & \langle\ \rangle \end{bmatrix} \\ \text{SEM} & \textbf{PAST(sneeze)(Kim)} \\ \text{CNTXT} & .... \end{bmatrix}$$

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

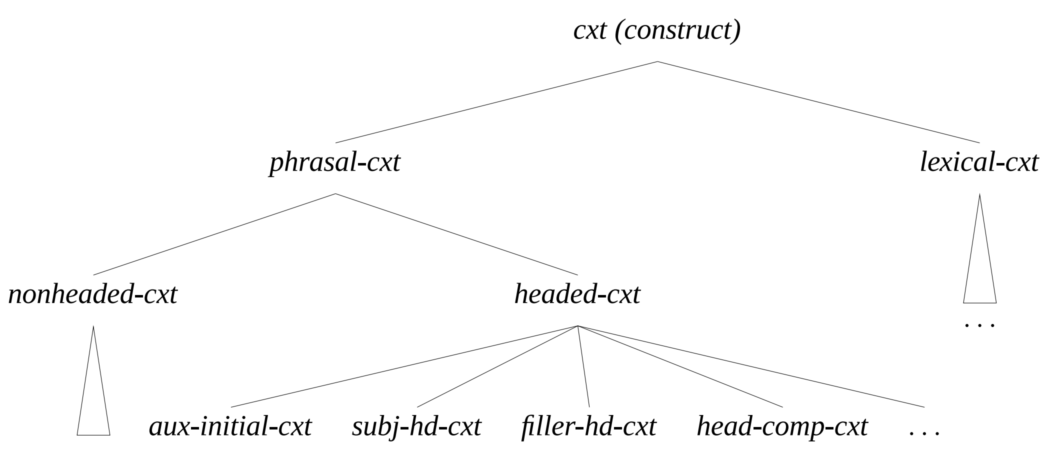
b.
$$*\begin{bmatrix} \text{PHON} & [\textit{snizd\#kIm}] \\ \text{FORM} & \langle\ \text{sneezed, Kim}\ \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \textit{verb} & \\ \text{INV} & + \\ \text{AUX} & - \end{bmatrix} \\ \text{VAL} & \langle\ \rangle \end{bmatrix} \\ \text{SEM}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

[18]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.

The sentences defined by an SBCG are those well-formed signs whose category includes the specifications appropriate for a finite, root, verbal projection.[19] An SBCG thus defines a set of derivations each of which can be represented as a tree, much like the derivations of a Context-Free Grammar. However, the labels on the nodes of these trees are not monadic category names (NP, S, V, etc.), but rather feature structures of type *sign*, much as they are in other frameworks, e.g. GPSG or Categorial Grammar. And like CFG rules, SBCG constructions are static constraints that can be directly utilized by either the human parser or its sentence production counterpart. This "process neutrality," not a property of transformational grammars, is arguably an important design property for grammars to have, if our goal is a strong version of the competence hypothesis, which considers the role devices of competence grammar play in a precisely formulated model of language processing (See Kaplan & Bresnan 1982, Sag & Wasow in press).

As already noted, natural language generalizations typically manifest themselves along varying analytic grains. This fact is modeled precisely in a type system, where idiosyncratic constraints can be imposed by an individual construction itself, 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 (35):[20]

(35)



Each subtype of *construct* in (35) is used to define the domain of some grammatical property or constraint. That is, each of these subtypes is the antecedent of some construction. (Recall that a construction is an implicational (conditional) constraint defining the properties of a given type.) Phrasal constructs (as opposed to lexical constructs) license phrases; that is, the MTR value of any feature structures of type *phrasal-cxt* (*phr-cxt*) must be of type *phrase*. The type *headed-construct* (*hd-cxt*) distinguishes headed constructs from other phrasal constructs. This is done in terms of the feature HD-DTR, whose value (a sign) is identified with a particular member of the DTRS list.

[19]Fragments and various other apparent exceptions to this characterization of the sentences defined by a grammar are analyzed as finite clauses by GS-00, a position for which there is interesting independent evidence, as shown by Arnold & Borsley (2008).

[20]Type abbreviations are listed in Appendix 1.

The different subtypes of headed-construct 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 (HFP), which requires the mother's syntactic category to match that of its head daughter. This constraint, which is the "X" of "$\overline{\text{X}}$ Theory", is stated succinctly in (36):[21]

(36) **Head Feature Principle:**

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

The HFP is a general constraint with far-reaching consequences for the headed structures of a language. Other constraints, such as the one in (37), specify the defining properties of a particular class of constructs:

(37) **Aux-Initial Construction:**

$$\textit{ai-cxt} \Rightarrow \begin{bmatrix} \textit{hd-cxt} & \\ \text{MTR} & [\text{SYN} \;\; [\text{VAL} \;\; \langle\,\rangle\;]] \\ \text{DTRS} & \langle\, \text{X}_0, \text{X}_1, \ldots \text{X}_n \,\rangle \\ \text{HD-DTR} & \text{X}_0 : \begin{bmatrix} \textit{word} & \\ \text{SYN} & \begin{bmatrix} \text{CAT} & [\text{INV} \;\; +] \\ \text{VAL} & \langle\, \text{X}_1,...,\text{X}_n \,\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

In aux-initial clauses, which come in many varieties in English, the head daughter must be an "invertible" word, i.e. a finite, auxiliary verb whose lexical entry is compatible with (can be resolved to) [INV $+$]. The sisters of the head daughter are identified with the elements of its VALENCE (VAL) list. 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 can select no further valents (i.e. it is valence-"saturated").

The constraint in (37) predicts the common properties of aux-initial clauses. At an even finer grain, we find particular varieties of aux-initial clause, each with its own distinctive meaning, as illustrated in Figure 2.[22]

[FIGURE 2 ABOUT HERE]

These examples clearly instantiate distinct constructions, each involving a language-particular correlation of aux-initial form with a particular semantic function, as well as other kinds of idiosyncrasy. Equally clearly, these clauses together constitute a family, in that they exhibit a "family resemblance" that is captured by the constraint in (37).

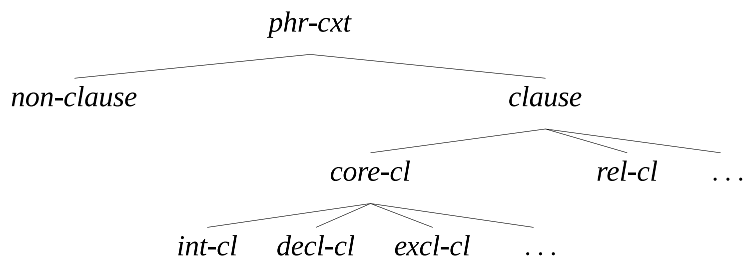
[21] Variables such as X, X_1, and Y range over feature structures in the constructions and other constraints that are formulated here. Σ-variables and L-variables range over sets and lists of feature structures, respectively. A colon indicates that the immediately following constraint must be satisfied by all values of the immediately preceding variable, i.e. it introduces a restriction on a variable.

[22] See Culicover 1971, Fillmore 1999, Newmeyer 1998: 46–49, and GS-00.

3.2 Clausal Constructs

Following GS-00, I assume that phrasal constructs are also organized in terms of clausal types. That is, there is a parallel classification of phrasal constructs into *clause* and *non-clause*, with clauses being further subdivided into *core-clause* (*core-cl*) and various other types, e.g. *relative-clause* (*rel-cl*). The subtypes of core clause include *declarative-clause* (*decl-cl*), *interrogative-cl* (*int-cl*) and *exclamative-clause* (*excl-cl*), as shown in (38):

(38)



A given clause is thus simultaneously classified in the two dimensions of headedness [(35)] and clausality [(38)]. This cross-classification allows cross-cutting generalizations to be expressed via orthogonal constraints, as illustrated in Figure 3 for two kinds of aux-initial construct: *polar-interrogative-clause* (*pol-int-cl*) and *aux-initial-exclamative-clause* (*ai-excl-cl*). The former must simultaneously obey (37) and the constraints that define *interrogative-clause*; the latter must simultaneously obey (37) and the constraints that define *exclamative-clause*. A construct of the former type is shown in Figure 4, using attribute-value matrix (AVM) notation.[23] 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.[24]

[FIGURE 3 ABOUT HERE]

[FIGURE 4 ABOUT HERE]

Next, we consider the Subject-Predicate Construction (SPC), which defines the most common type of headed construct in English. Following GS-00, I assume that there are a number of similar constructions, including the one that defines "Mad Magazine" sentences like (39a) and the construction responsible for absolute clauses like the one in (39b):[25]

[23]I assume that a question is a propositional abstract, i.e. a function from sets of entities to propositions. 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 usually assumed within HPSG. An introduction to the tools employed here can be found in Sag *et al.* 2003.

[24]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.

[25]On the latter, see Stump 1985; on the former, Akmajian 1984 and Lambrecht 1990, among others.

(39) a. What, **Me worry**?

b. (With) **My friend in jail**, I'm sunk.

According to GS-00, SPC exists independently of these, licensing simple declarative clauses like (40a), "present subjunctive" clauses like (40b), and imperative clauses like (40c):

(40) a. Sandy leaves me alone.

b. I insist that **Sandy leave me alone**.

c. You/Everyone leave me alone!

The semantic differences here follow from the lexical differences between indicative and subjunctive lexical forms. Note that SPC requres that the mother be specified as [VFORM *fin*] and [INV −]. Given the HFP, this means that the VP head daughter will also be so specified, correctly ruling out both non-finite clauses like (41a,b) and clauses containing [INV +] lexical heads like (41c), as well as a host of other examples discussed more fully in GS-00 and in Sag to appear:

(41) a.*Kim to go home.

b.*Pat standing on my foot.

c.*I aren't coming to the party

The Declarative Clause Construction requires that the mother's semantics be *austinean* (a proposition or an outcome). Similarly, the type *subj-hd-cxt* imposes further constraints, i.e. that the mother must be valence-saturated and the head daughter must valence-select the first (subject) daughter. This means that we can simplify the formulation of SPC by assuming that *subject-predicate-clause* (*subj-pred-cl*) is a subtype of both *decl-cl* and *subj-hd-cxt*, as shown in (42)–(44):

(42) **Subject-Predicate Construction: (SPC)**

$$\textit{subj-pred-cl} \Rightarrow \begin{bmatrix} \textit{subj-hd-cxt} \ \& \ \textit{decl-cl} \\ \text{MTR} \begin{bmatrix} \text{SYN} \begin{bmatrix} \text{CAT} \begin{bmatrix} \text{VFORM} & \textit{fin} \\ \text{INV} & - \end{bmatrix} \end{bmatrix} \\ \text{SEM} \quad \mathbf{FR}_{\alpha}(\sigma_1, \sigma_2) \end{bmatrix} \\ \text{DTRS} \quad \langle \, [\text{SEM } \sigma_1 \,] \, , [\text{SEM } \sigma_2 \,] \, \rangle \end{bmatrix}$$

(43) **Subject-Head Construction:**

$$\textit{subj-hd-cxt} \Rightarrow \begin{bmatrix} \textit{hd-cxt} & \\ \text{MTR} & [\text{SYN} \ [\text{VAL} \ \langle \, \rangle \,]] \\ \text{DTRS} & \langle \, X \ , \ H\text{: } [\text{VAL} \ \langle \, X \, \rangle \,] \, \rangle \\ \text{HD-DTR} & H \end{bmatrix}$$

(44) **Declarative Clause Construction:**

$$
\textit{decl-cl} \Rightarrow \begin{bmatrix} \textit{core-cl} & \\ \textsc{mtr} & [\textsc{sem} \;\; \textit{austinean}] \\ \textsc{dtrs} & \textit{list}\left(\begin{bmatrix} \textsc{wh} & \{\,\} \\ \textsc{rel} & \{\,\} \end{bmatrix}\right) \end{bmatrix}
$$

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 prevent an unbound interrogative, exclamative, or relative element from appearing within a declarative clause, as will become clear in the subsequent discussion. Although the type of the mother's semantics follows from the general constraint on declarative clauses, the SPC itself specifies the particular mode of semantic combination, namely the functional realization (of the relevant type) of its daughters' meanings.[26] Moreover, a subject-predicate clause is not a modifier, i.e. it is specified as [SEL *none*]. This follows from the more general fact that declarative clauses are a kind of core clause and core clauses are not modifiers:[27]

(45) **Core Clause Construction:**

$$
\textit{core-cl} \Rightarrow \begin{bmatrix} \textit{clause} & \\ \textsc{mtr} & \begin{bmatrix} \textsc{syn} & \begin{bmatrix} \textsc{cat} & \begin{bmatrix} \textit{verbal} & \\ \textsc{sel} & \textit{none} \\ \textsc{vform} & \textit{fin-or-inf} \end{bmatrix} \end{bmatrix} \\ \textsc{sem} & \textit{message} \end{bmatrix} \end{bmatrix}
$$

In virtue of the SPC, 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 5, where **PAST**(**snore**)(**Kim**) represents the proposition obtained by combining the indicative verb's semantics with that of the subject NP.[28]

[FIGURE 5 ABOUT HERE]

Finally, it should be noted that the Head Feature Principle in (36), in identifying the CAT value of the mother and the head daughter, ensures that the feature specifications of the lexical head

[26]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. See Klein & Sag 1985 for further discussion.

[27]Note that the VFORM constraint on this type is consistent with the more specific constraint imposed by the SPC.

[28]The constructs defined by an SBCG can be displayed either in AVM notation or as a local tree, as illustrated in Figure 5.

daughter are "percolated up" to the clause itself. This information is fundamental – this is what allows finite clauses to be identified as such under subcategorization or inverted clauses to be required 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.[29,30]

4 The Uniformity of FG Constructions

4.1 Generalizations

A vast body of research extending back to the 1950s has established a number of important results 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 FG dependencies should be evaluated.

FGDs are unbounded. There is no longest grammatical sentence instantiating a given FG-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:

(46) 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 __ .] . . .

FGDs exhibit island effects. FG-dependencies manifest various island effects involving complex structures that induce unacceptability, and possibly ungrammaticality:

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

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

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

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

---

[29] 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 2007a, in press.

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

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,[31] but it is generally accepted that there are some syntactic environments where grammar must prevent gaps from appearing.

Lexical and Constructional Binding. 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:

(48) 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 (see, e.g. Chae 1992). These "subbinding" triggers, properly contained within phrases that are in construction with the gap-containing clause, include *too*, *enough*, and comparatives:

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

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

c. Wilt is [[three feet *taller*] [than Bill is __]].

One-to-many filler-gap relation. 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 must appear in each conjunct, exhibiting Ross's (1967) "across-the-board" effect:[32]

(50) 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:

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

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

(52)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]]?

---

[31] See Hofmeister & Sag to appear for arguments that processing factors play a larger role than previosuly appreciated.

[32] I am assuming that apparent counterexamples to this pattern, e.g. those in (i), instantiate noncoordinate structures:

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

For discussion, see Postal 1998, Kehler 2002, and the references cited there.

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 Postal 1998) that the parasitic gaps in these examples are pronominal in nature, and hence merely coindexed with the fillers in examples (51)–(52), 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 Hukari show at length, the analysis of fillers and gaps must be unified: the multiple gaps in examples like (51a) and (52a) are bound by a single filler, just as a quantifier in predicate logic can bind multiple occurrences of a variable.[33]

Multiple FGDs. It is sometimes possible for one FG-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)):

(53) 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 FG depencies, e.g. whether the "nesting" constraint they obey is a matter of grammar or processing, remain unresolved.

Partial FG Identity. 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 "weak" FG-dependencies (Pollard & Sag 1994), there are also instances of category mismatch, e.g. English topicalized clauses, which are associated with an NP-type gap (Webelhuth 1992):

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

[33] Once this conclusion is reached, a plausible approach to examples like (51b) and (52c) 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].

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

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

FGDs 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 FG-dependency has a critical effect on lexical and constructional choice. These well-documented effects include the following:

(56) 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)[34]

f. Yiddish inversion (Diesing 1990)

g. Icelandic expletives (Zaenen 1983)

h. Adyghe '*wh*-agreement' (Polinsky 2007)

In Irish, for example, at least in the simplest pattern discussed by McCloskey, one complementizer (*goN*) appears in non-FG environments while another (*aL*) appears in the clause containing the gap and in all higher clauses of the FG dependency path.[35]

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

4.2 Analysis

Following Gazdar (1981), the analysis of FG-dependencies naturally breaks down into three problems: (1) the binding environment, (2) the FG dependency path, and (3) the realization of the gap. Following a long tradition, beginning with Gazdar's seminal work and including Pollard & Sag 1994, GS-00, Culicover & Jackendoff 2005, and Levine & Hukari 2006, the presence of a gap (an "extraction" site) is encoded in terms of a feature specification such as [GAP ⟨NP⟩].[36] By contrast, a gapless expression (more precisely, an expression all of whose gaps are "already bound") is specified as [GAP ⟨ ⟩].

[34] But see Donohue 2003 and the references cited there for a critical assessment of Chung's analysis.

[35] The FG dependency path can be thought of in terms of the connected branches of a syntactic tree stretching from the filler (or other binder) at the top down to the position of the gap.

[36] In the literature, this feature has often been called "SLASH", a reference to Gazdar's original notation for the category of gap-containing expressions.

Here I follow GS-00, 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. The GAP lists of a word's syntactic arguments are "amalgamated" to form that word's GAP list, as shown in (57):

$$(57)\quad \text{a.} \begin{bmatrix} \text{FORM} & \langle \text{likes} \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \textit{verb} \\ \text{VAL} & \left\langle \begin{matrix} \text{NP}_{\mathbf{i}} \\ [\text{GAP } \langle\,\rangle] \end{matrix}, \begin{matrix} \text{NP}_{\mathbf{j}} \\ [\text{GAP } \langle\,\rangle] \end{matrix} \right\rangle \end{bmatrix} \\ \text{GAP} & \langle\,\rangle \\ \text{SEM} & \mathbf{like}(\mathbf{i},\mathbf{j}) \\ & \ldots \end{bmatrix} \quad \text{b.} \begin{bmatrix} \text{FORM} & \langle \text{likes} \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \textit{verb} \\ \text{VAL} & \left\langle \begin{matrix} \text{NP}_{\mathbf{i}} \\ [\text{GAP } \langle\,\rangle] \end{matrix} \right\rangle \end{bmatrix} \\ \text{GAP} & \langle \text{NP}_{\mathbf{j}} \rangle \\ \text{SEM} & \mathbf{like}(\mathbf{i},\mathbf{j}) \\ & \ldots \end{bmatrix}$$

A principle of grammar[37] requires that in general a head daughter's GAP list be the same as its mother's GAP list. Thus, general grammatical principles, all formulated as local constraints, guarantee that GAP specifications are inherited precisely as indicated in the structure shown in Figure 6. Note that the non-empty GAP-specifications are distributed throughout the FG path, making global information about the FG dependency locally accessible. Thus a lexical head (a verb or conmplementizer, for example) lexically specified as [GAP ⟨ ⟩] would be barred from a FG path. Likewise a construction requiring its mother to be [GAP ⟨X⟩] would be allowed to appear only within an FG path.

[FIGURE 6 ABOUT HERE]

As already noted, gap-binding environments may be lexical or constructional. Lexical gap-binding is discussed in section 6 below. In constructional gap-binding, a filler daughter cooccurs with a head daughter that must contain a gap. As already noted, English FG-constructions include topicalization, comparative constructions, comparative correlative constructions, *wh*-relatives, *wh*-interrogatives, *wh*-exclamatives, and various kinds of clefts and preposings not obviously related to any overt *wh*-expression.[38] We will return to these constructions below.

The common properties of the various FG constructions that we have examined are in part expressed in terms of the common construct type *filler-head-construct* (*fill-hd-cxt*). Constructs of this type are subject to the following constraint:

[37] GS propose to generalize the HFP for this purpose.

[38] In addition, certain constructions, such as bare relative clauses, require gap-binding in the absence of an overt filler.

(58) $$\textit{fill-hd-cxt} \Rightarrow \begin{bmatrix} \textit{hd-cxt} & \\ \textsc{mtr} & \begin{bmatrix} \textsc{syn} & [\textsc{val}\ L_1\ ] \\ \textsc{gap} & L_2 \end{bmatrix} \\ \textsc{dtrs} & \left\langle \begin{bmatrix} \textsc{syn} & X \\ \textsc{store} & \Sigma \end{bmatrix},\ H \right\rangle \\ \textsc{hd-dtr} & H : \begin{bmatrix} \textit{phrase} & \\ \textsc{syn} & \begin{bmatrix} \textsc{cat} & \textit{verbal} \\ \textsc{val} & L_1 \end{bmatrix} \\ \textsc{gap} & \left\langle \begin{bmatrix} \textsc{syn} & X \\ \textsc{store} & \Sigma \end{bmatrix} \right\rangle \oplus L_2 \end{bmatrix} \end{bmatrix}$$

Filler-head constructs thus require exactly two daughters: a filler and a head daughter. (58) links the syntactic information and the STORE value of the filler (see sec. 5.3) to those of the first element of the head daughter's GAP list, which will in turn be identified with the gap appearing within the head daughter, as just described. Any remaining elements on the head daughter's GAP list (members of the list L_2) must become part of the GAP list of the mother, thus allowing unbound gaps to be "passed up" to a higher binder in the case of multiple-gap sentences.

The syntactic category of the head daughter is unrestricted in (58). Nonetheless, because English filler-gap constructs are also core clauses, they obey the general constraints on structures of that type. The Core Clause Construction we saw in (45) thus applies to all such constructs, requiring the category of their mother to be *verbal*, which (following Sag 1997) can resolve to either of its two subtypes *verb* and *comp*. Accordingly, the head daughter of a FG construction (barring some further constraint imposed by a more specific 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 within which the analysis is embedded is stated in terms of purely static, localized constraints. This yields competence grammars which can be embedded within realistic models of language processing. Because they 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 directly consulted by cognitive mechanisms that perform incremental comprehension and incremental production. Both the human sentence production mechanism and the comprehension mechanism clearly consult multiple knowledge sources, blending "top-down" and "bottom-up" processing strategies with the integration of contextual, semantic, and nonlinguistic information. That is, we know that human sentence processing is incremental, highly flexible and massively integrative. For further discussion of these issues, and their consequences for the design of grammar, see Sag & Wasow in press. The locality of SBCG constructions thus serves to structure and delimit the grammatical information available, assuming that constructions are directly accessed in real-time sentence processing.

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. Moreover, these difficulties are not avoided by accounts based on “three-dimensional” phrase markers.[39] 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 coordinate (or so-called parasitic gap) structures) and when multiple fillers are moved from multiple gap positions. The foundations of the transformational analysis of FG dependencies are fundamentally 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 2009), the across-the-board effect follows from the interaction of the theory of coordination and the theory of FG dependencies. For example, assuming (1) that FG dependencies are encoded via nonempty GAP lists and (2) that coordination involves a schematization (imposing identity) over feature structures that include specifications for GAP, 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 (59) (Ross 1967):

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

A third advantage of the particular constraint-based analysis developed here is that information about the FG dependency is locally encoded along the extraction path, as shown in Figure 6. As has often been pointed out (Zaenen 1983, Hukari & Levine 1995, Bouma *et al.* 2001, 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.

A fourth benefit of the constraint-based analysis of FG 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 (55) above. Movement-based accounts, by contrast, leave us wondering why movement of a CP leaves an NP trace.[40]

Finally, the constraint-based analysis of FG 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 GB and 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), and not from

[39]For a discussion of the three-dimensional proposals put forth by Goodall (1987) and Moltmann (1992), see Milward 1994, Sag 2000, and the references cited there.

[40]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, since movement preserves (i.e. induces filler-gap identity for) all other properties, e.g. lexicality, bar-level, and category.

weak crossover phenomena (see Dalrymple *et al.* 2001). In addition, from a traceless account of FG constructions it also follows (since only signs can be coordinated), that examples like (60) are ill-formed:

(60) 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.[41]

5 The FG Construction Family

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

5.1 Topicalized Clauses

The simplest filler-head construction is the Topicalized Clause Construction formulated in (61):

(61) **Topicalized Clause Construction:**

$$\textit{top-cl} \Rightarrow \begin{bmatrix} \textit{fill-hd-cxt \& decl-cl} & \\ \text{MTR} & \begin{bmatrix} \text{SYN} & [\text{CAT}\ [\text{IC}\ +]] \\ \text{SEM} & \lambda\mathbf{X[Y](Z)} \\ \text{GAP} & \langle\ \rangle \end{bmatrix} \\ \text{DTRS} & \langle\, [\text{SEM}\ \mathbf{Z}]\ , H \,\rangle \\ \text{HD-DTR} & H: \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{INV} & - \\ \text{VFORM} & \textit{fin} \end{bmatrix} \\ \text{VAL} & \langle\ \rangle \end{bmatrix} \\ \text{SEM} & \mathbf{Y} \\ \text{GAP} & \langle\, [\text{SEM}\ \mathbf{X}\,]\,\rangle \end{bmatrix} \end{bmatrix}$$

The specification [IC +] 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 licensed:

[41] See Sag (2000) for a discussion of the inadequacy of previous analyses of data like (60), in particular the proposals made by Goodall (1987).

(62) a. They argued convincingly that [problems of this sort, 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 (61) 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 auxiliary-initial (see footnote 12). However, certain properties of topicalized clauses need not be stipulated in (61). For example, the fact that the head daughter must contain exactly one gap follows from the interaction of the [GAP $\langle\ \rangle$] constraint in (61) and the constraint on GAP values in the filler-head construction (58). The second daughter in (61) must be the head daughter (as required by the Head-Filler Construction); in addition, the semantics of the clause must be *austinean* (as guaranteed by the Declarative Clause Construction). A topicalized clause thus simultaneously satisfies many constructional constraints, some very specific, some very general, and some of intermediate grain.

Figure 7 illustrates a topicalized clause construct whose head daughter is the mother of the incomplete derivation tree in Figure 6 above. Note that the variable used to construct the λ-abstract in the mother's semantics is the SEM value of the gap (the single element of the head daughter's GAP list). This λ-abstract takes the filler daughter's semantics as its argument, as indicated in Figure 7, thus providing a simple propositional semantics for topicalized clauses.[42] Finally, both daughters in a topicalized clause must be [WH { }] and [REL { }], because this is required by the Declarative Clause Construction and all topicalized clauses are declarative clauses. This constraint, taken together with a theory of pied piping (e.g. that of GS-00 or Van Eynde's (2004)), ensures that the filler daughter contains no interrogative, exclamative, or relative *wh*-word.

[FIGURE 7 ABOUT HERE]

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

(63) 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)

e. Go to the store, he wouldn't __ . (VP)

[42] This is true if we make the standard assumptions about equivalence of expressions under λ-conversion (β-reduction). No doubt the construction in (61) should impose some kind of "topic-comment" condition (making the filler daughter's semantics the topic) in the mother's semantics. However, in the absence of a generally accepted theory of "information structure", I will not speculate about the details of such a treatment. 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.

In all likelihood, there are further syntactic restrictions on topicalized fillers, and some of the examples in (63) may instantiate constructions distinct from Topicalization. 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 (61) requires the head daughter to be finite, correctly ruling out examples like (64):

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

But like the SPC, the head daughter in a topicalized construct may be subjunctive:

(65) a. We suggest that [[proposals of this kind], she not **take** advantage of __ .]

b. [Proposals of this kind], nobody **be** taken in by __ !

This is an interesting difference between topicalized clauses and the other kinds of filler-head constructions considered below. For more on the semantic treatment of subjunctives as outcomes (the same semantic type as imperatives), see GS-00, Ch. 2.

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 (66):

(66) 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:[43]

(67) *[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 FG dependency can penetrate the filler daughter, correctly ruling out examples like (68):

(68) *[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 a certain construction (or one of its daughters) be [GAP $\langle\,\rangle$]. By contrast, "weak" islands – those out of which some, but not all extractions are grammatically excluded – can be accommodated by placing restrictions on the GAP value within a given type of construct. The restriction [GAP *list*(NP)], for example, ensures that a given phrase's GAP value either be the empty list, or else a list all of whose members are of category NP. If this constraint is included in a given construction, then the only FG-dependencies that can permeate the constructs it defines must involve an NP gap. This method of analysis provides a natural way of accommodating the fact that island constraints (assuming they are part of grammar) are more construction-specific than standardly assumed (see Postal 1998, 2001).

[43] Here I am making the cautious assumption that sentences like (67) 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.

5.2 *Wh*-Exclamatives

As noted earlier, GS-00 introduce the semantic type *fact* (as distinct from *proposition*) as the content of an exclamative clause. This, GS argue, provides an account of the possibility of exclamative complements of factive verbs and the impossibility of using exclamatives assertorically. In addition, the fact-based analysis of exclamatives provides an analysis of a number of further semantic observations involving entailment and argument validity in dialogues with copular sentences, for example the following:

(69) a. Merle is struck by how incredibly well Bo did in the elections.

b. Hence, Merle is struck by the fact that Bo did very well in the elections.

(70) a. Bo told us a fact, which was that Micky did very badly on the exam.

b. Hence, Bo told us just how badly Micky did on the exam.

Exclamative *wh*-words are lexically specified with a nonempty value for the feature WH. In fact the distinctive exclamative WH-value, shown in (71) contains the exclamative quantifier, which I will simply abbreviate as "$\textbf{what!}_x$":[44]

(71)
$$\begin{bmatrix} \text{FORM} & \langle \text{ whata } \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \textit{det} & \\ \text{SELECT} & \text{CNP}[\text{SEM } R] \end{bmatrix} \end{bmatrix} \\ \text{SEM} & x^* \\ \text{WH} & \{\textbf{what!}_x(R)\} \\ \text{REL} & \{\ \} \end{bmatrix}$$

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 GS-00'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 (71) is passed up to the filler daughter of a *wh*-exclamative construction, where it is "retrieved" and integrated into the clausal exclamative semantics, as shown in (72):[45]

[44] Here I follow 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 (SEL), which allows the feature SPR to be eliminated, as well. The values of SEL 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.

[45] I have not attempted to accommodate the full range of data discussed by Michaelis and Lambrecht. Notice that this analysis is sufficiently modular that if one chose to replace the semantics sketched here with some other, say, that of Zanuttini & Portner (2003), the revision would be quite straightforward.

(72) ***Wh*-Exclamative Clause Construction:**

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

This construction interacts with the constraints on filler-head clauses introduced in (58) above to license constructs like the one shown in Figure 8.

[FIGURE 8 ABOUT HERE]

The WH specification in Figure 8 is inherited in accordance with general constraints similar to those governing GAP-specifications.[46] As a result, the filler daughter in (72) includes a non-empty specification for WH precisely because it contains an exclamative *wh*-expression, which is the only way such a specification could arise.[47] The reduced semantics for the clause illustrated in Figure 8 can be loosely paraphrased as “The play that I saw was really unusual!”.

The constraints in (72) allow for exclamatives to appear as 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:

(73) 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 ⟨ ⟩] condition on the head daughter in (72) predicts that subject exclamative clauses, like subject topicalizations, are impossible for many speakers:[48]

(74) a. %It’s amazing [what a nice person just walked in].

b. %What a nice person is talking to Sandy.

[46]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. Polinsky (2007) discusses what appears to be a case of exactly this.

[47]The variable **Q** ranges over generalized quantifiers, rather than parameters of the sort used in the analysis of *wh*-interrogatives described in the next section.

[48]A minimally different formulation of (72), one lacking the [VAL ⟨ ⟩] specification, would license these examples as well.

Because a fact is constructed from a proposition (see GS-00, 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:

(75) 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 FG constructions:

(76) *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:

(77)*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:

(78) a. What an interesting person Kim wrote about __ !

b. How happy Kim is __ !

c. How quickly they forget __ !

d. How under the weather she appears to be __ !

e.*Go to what a fine store he would __ !

f.*Go to the store how often he would __ !

The restriction [CAT *nonvrbl*] imposed on the filler daughter in (72) is the first approximation to an analysis of the data in (78).

5.3 *Wh*-Interrogatives

Interrogative *wh*-words, like exclamative *wh*-words, bear non-empty specifications for the feature WH.[49] Unlike exclamative *wh*-words, the WH-value of an interrogative *wh*-word can be the empty set[50] or it can be a singleton set containing a parameter (rather than a quantifier):

[49] GS allow the WH-value of an interrogative *wh*-expression to be either empty or as shown in (79). They use this distinction to considerable advantage: a [WH $\{\,\}$] *wh*-word must be in situ, while a [WH $\{$*param*$\}$] *wh*-word 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 GS'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.).

[50] This difference is part of GS's explanation for why interrogatives, but not exclamatives, can appear in situ.

(79)

$$\begin{bmatrix} \textsc{form} & \langle \text{ who } \rangle \\ \textsc{syn} & \begin{bmatrix} \textsc{cat} & \begin{bmatrix} \textit{noun} & \\ \textsc{select} & \textit{none} \end{bmatrix} \end{bmatrix} \\ \textsc{sem} & x^{*} \\ \textsc{wh} & \{(\ [x, \textbf{person}(x)]\ )\} \\ \textsc{rel} & \{\ \} \end{bmatrix}$$

The interrogative *wh*-word illustrated here also differs from the exclamative *wh*-word in (71) 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 inherited (again, thinking "bottom-up"), subject to diverse constraints on pied-piping, up to the filler daughter of a *wh*-interrogative clause.

GS-00 (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 (80):

(80) a. What fell?

b. I wonder [what fell].

The Subject *Wh*-Interrogative Construction (see Appendix 2) thus involves very local extraction – the *wh*-expression is both the filler and the highest subject. The potential semantic difficulties of quantifying into questions are avoided in GS-00 by treating questions as propositional abstracts (functions from sets to propositions). *Wh*-questions are individuated in terms of a non-empty set of "parameters" and an open proposition. Accordingly, the SEM value of both (80a) and the embedded clause in (80b) is written as in (81), where the abstracted parameter set is singleton:

(81) $\lambda\{\pi_x\}[\textbf{fall}(x)]$

Let us first consider the general *Wh*-Interrogative Clause Construction, which licenses filler-head structures like those we have already seen, except that the WH value of the filler contains a parameter (π), rather than a quantifier (**Q**). This parameter must be included in the set of parameters abstracted over in the mother's semantics:

(82) ***Wh*-Interrogative Clause Construction:**

$$\textit{wh-int-cl} \Rightarrow \begin{bmatrix} \textit{int-cl \& fill-hd-cxt} & \\ \textsc{mtr} & \begin{bmatrix} \textsc{sem} & \lambda\{\pi, \ldots\}[\lambda\mathbf{X}[\mathbf{Y}](\mathbf{Z})] \end{bmatrix} \\ \textsc{dtrs} & \left\langle \begin{bmatrix} \textsc{syn} & [\textsc{cat}\ \textit{nonvrbl}] \\ \textsc{sem} & \mathbf{Z} \\ \textsc{wh} & \{\pi\} \end{bmatrix}, \begin{bmatrix} \textsc{sem} & \mathbf{Y} \\ \textsc{gap} & \langle\ [\textsc{sem}\ \ \mathbf{X}\ ]\ \rangle \end{bmatrix} \right\rangle \end{bmatrix}$$

Here we will confine our discussion to nonsubject *wh*-interrogatives, as these provide the most interesting comparison with other FG constructions.

The Nonsubject *Wh*-Interrogative Clause Construction places the following condition on the constructs that it licenses:

(83) **Nonsubject *Wh*-Interrogative Clause Construction:**

$$ns\text{-}wh\text{-}int\text{-}cl \Rightarrow \begin{bmatrix} \textit{wh-int-cl} & \\ \text{MTR} & [\text{VAL}\ \langle\ \rangle] \\ \text{DTRS} & \left\langle \text{X}, \begin{bmatrix}\text{SYN} \begin{bmatrix} \text{CAT} & \begin{bmatrix}\text{INV} & W \\ \text{IC} & W\end{bmatrix} \\ \text{VAL} & \langle\ \rangle \end{bmatrix}\end{bmatrix}\right\rangle \end{bmatrix}$$

(83) interacts with our earlier constraints governing headed constructs and filler-head constructs in a now familiar way, licensing constructs like the one in Figure 9.

[FIGURE 9 ABOUT HERE]

In fact, the constraint interaction is quite subtle here, as the Interrogative Clause Construction plays an important role:[51]

(84) **Interrogative Clause Construction:**

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

According to (83), the variable V in the filler daughter's WH value must be included in the set of variables that is abstracted over to form the mother's semantics. And because of (84), this variable is also part of the head daughter's STORE value, but not the mother's. That is (thinking in terms of a "bottom-up" derivation), V and possibly some other parameters are retrieved from the head daughter's STORE value and the remaining parameters are passed up to constitute the mother's STORE value. This is a general property of interrogative clauses, both here and in GS-00. The inheritance of stored parameters is depicted in Figure 10. The daughters' REL values are here also required to be empty.

[FIGURE 10 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 (85a), discussed by C. L. Baker (1970), and by many others since:[52]

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[51]"$\dot{-}$" is a "contained" set difference operation whose result is undefined if the second set is not a subset of the first.

[52]Again, note the modularity of the proposed analysis. Since the parameters associated with appropriate *wh*-expressions are available 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.

(85) Who remembers where we bought what?

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

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

Let us now consider the interaction of the various constraints included within the Nonsubject *Wh*-Interrogative Construction in (83). First, the head daughter's SEM value must be a proposition, as nothing else is semantically compatible (questions are propositional abstracts). This provides a semantic account of the impossibility of *wh*-interrogatives formed from imperatives, exclamatives, other interrogatives, and subjunctives:

(86) 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 (83), 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:

(87) 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 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, is here the consequence of a simple identity constraint.

Third, the mother of a construct licensed by (83) need not be [VAL $\langle\,\rangle$]; nor need it be finite (though all core clauses are required to be finite or infinitival). However, when the VAL list is nonempty, it must contain a covert element – an instance of what Fillmore (1986a) calls *free null instantiation* (*fni*). Covert signs can only appear on a valence list, never as a daughter of any construction. A *fni* element receives a free indefinite or contextually anchored interpretation, and hence can be used to analyze so-called "*arb*" interpretations of unexpressed elements. Since these elements are accusative in English, this construction never sanctions interrogatives like (80) above, where the finite VP requires a nominative subject. However, an infinitival head daughter like the one in (88) is licensed:

(88) I wondered who [to visit __].

And since infinitive *to* is a nonfinite verbal element specified as [INV −] and [IC −], such clauses must be embedded.[53]

Fourth, the range of filler constituents in *wh*-interrogatives parallels that of topicalization. NP, PP, AP, and AdvP fillers are possible, subject to constraints governing pied-piping:[54]

(89) 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 *nonvrbl*] condition in (83):[55]

(90) *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 (83) allow for extractions like the following:

(91)a. They are [the kind of relative]$_i$ that I never know [[what sort of present]$_j$ to give __$_j$ to __$_i$].

b. ?They are [the kind of relative]$_i$ that I never know [[what sort of present]$_j$ I should give __$_j$ to __$_i$].

c. *?These are [the relatives]$_i$ that I don't know [[what presents]$_j$ they gave __$_j$ to __$_i$].

Here, as elsewhere, the finite verb with specific time reference brings degraded acceptability in (91c),[56] with cases like (91b) 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 (to appear).[57]

---

[53]Note that since there are no declarative clauses like [Kim to go] (because of the finiteness constraint included in the SPC; see (42) above), there are no interrogative clauses like (i):

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

[54]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 __ ?

[55]Examples like (90) are independently accounted for by the pied piping theory of GS-00 and hence may not bear on the question of which constraints the Nonsubject *Wh*-Interrogative Construction should impose on its filler daughter.

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

[57]Note that here again, the role of processing in explaining these contrasts could be curtailed by adding further constraints at some grain of construction, as appropriate.

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 (92):[58]

(92)
$$\begin{bmatrix} \text{FORM} & \langle \text{ who } \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \textit{det} & \\ \text{SELECT} & \textit{none} \end{bmatrix} \end{bmatrix} \\ \text{SEM} & x^* \\ \text{WH} & \{\ \} \\ \text{REL} & \{\ \mathbf{[}x\mathbf{,}\ person(x)\mathbf{]}\ \} \end{bmatrix}$$

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 (92) 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 Clause Construction interacts with the general Relative Clause Construction, as indicated in (93)–(94):

(93) ***Wh*-Relative Clause Construction:**

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

(94) **Relative Clause Construction:**

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

[58] 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.

According to (93), *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 (94), 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 *nom* (*nominal*) – an intermediate category type that must resolve to either *noun* or *prep*:

(95) **Finite *Wh*-Relative Clause Construction:**

$$fin\text{-}wh\text{-}rel\text{-}cl \Rightarrow \begin{bmatrix} wh\text{-}rel\text{-}cl & \\ \text{MTR} & [\text{SYN}\ [\text{CAT}\ [\text{VFORM}\ fin]]] \\ \text{DTRS} & \left\langle \left[\text{SYN} \begin{bmatrix}\text{CAT}\ nom \\ \text{VAL}\ \langle\,\rangle\end{bmatrix}\right], \text{X} \right\rangle \end{bmatrix}$$

Thus only NP and PP fillers are allowed in constructs licensed by this construction, as noted in (24) above.

The HFP ensures that the head daughter of a *fin-wh-rel-cl* construct is also finite and the semantic rule in (93), 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 phrase cannot head a relative clause, including the following, where the head daughter's "clause-type/meaning-type" is as indicated:

(96) 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 11. In addition, since no VAL value is specified for the head daughter in (95), nothing rules out *wh*-relatives like (97), where the italicized head daughter is a finite VP:

(97) the woman [[whose friend] *likes Kim*]. . .

[FIGURE 11 ABOUT HERE]

Relative clauses combine with a nominal expression, a CNP, to form a larger CNP in accordance with a head-functor construction. This gives rise to head-functor constructs like the one sketched in Figure 12, where the head daughter's SEL value is identified with the nominal head daughter, as indicated by the tag $\boxed{1}$. This construction can apply recursively, giving rise to "stacked" relative clauses of the sort shown in (98):

(98) 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 12 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:

(99) 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 (100):[59]

(100) **Infinitival *Wh*-Relative Clause Construction:**

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

(100) requires that the head daughter be specified as [VAL ⟨*fni*⟩], where the unexpressed subject of this phrase is a kind of null argument, as discussed in section 5.3 above. The constructs licensed by (100) will thus all be subjectless infinitival VPs (not Ss or CPs) with either an indefinite or definite reference. This correctly predicts contrasts like (101a,b), while freely allowing examples like (102):

(101) 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.

(102) 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*.]

[59] 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].

5.5 *The*-Clauses

The grammar of the Comparative Correlative (also known as the “More-the-Merrier” or the “Comparative Conditional”) construction) has been discussed by numerous researchers over the last few decades.[60] Here, I follow Borsley (2004) and Abeillé and Borsley (2006) in viewing sentences like (103a) in terms of a paratactic construction related to those instantiated in (103b–c):[61]

(103) 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 makes the reasonable assumption that there is 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*. This enables the analysis of comparative correlatives to proceed in terms of the construction in (104):[62]

(104) **Comparative Correlative Clause Construction:**

$$\textit{comp-corr-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & [\text{CREL } \textit{none}] \\ \text{SEM} & \ldots \end{bmatrix} \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & [\text{CREL } \textit{the}] \\ \text{SEM} & \phi \end{bmatrix}, \text{H:}\begin{bmatrix} \text{SYN} & [\text{CREL } \textit{the}] \\ \text{SEM} & \psi \end{bmatrix} \right\rangle \\ \text{HD-DTR} & H \end{bmatrix}$$

I base my semantic treatment on that of Brasoveanu (2008), who builds on previous semantic work on correlatives, e.g. that of Beck (1997). Brasoveanu argues that the semantic essence of this construction is a relation of correpondence that is predicated of the differentials constructed from the two *the*-clauses. On this view, the meaning of (105) is as sketched in (106):

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

(106) As the number of books you read increases, your degree of smartness increases. That is, there’s a systematic (monotonic) relation (call it **R**) between two differences (differentials):

[60]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.

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

[62]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.

1. the difference between the number of books you've read on a given occasion and the number you read on a previous[63] occasion, and
2. the difference between your degree of smartness on the later occasion and your degree of smartness at the previous one.

As Brasoveanu points out, the relation in question varies cross-linguistically. In Romanian, for example, the relevant relation is simple identity. As a result, though a sentence like (107) is true in English, its Romanian analog is false:

(107) 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. The comparative specifier *the* semantically introduces a degree parameter within each clause, that is, *the* functions as a degree specifier like *much* or *three feet* in *three feet/much taller than Sandy is*.

I will assume that the singleton set containing a degree parameter $[d, deg(d)]$ is both the REL value and the STORE value of the degree specifier *the*. These are inherited as the REL and STORE values of phrases containing *the*, in accordance with the general theory of pied piping and quantifier-parameter storage discussed earlier. Thus, phrases like the following are all specified as both [REL $\{[d, deg(d)]\}$] and [STORE $\{[d, deg(d)]\}$]:

(108) *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 posit the construction in (109) to license constructs of type *the-clause*:

(109) ***The*-Clause:**

$$
\textit{the-cl} \Rightarrow \begin{bmatrix} \textit{fill-hd-cxt \& decl-cl} & \\ \text{MTR} & \begin{bmatrix} \text{SYN} & [\text{CREL } \textit{the}\,] \\ \text{SEM} & \lambda \mathbf{V}[\mathbf{X}](\mathbf{Y}) \end{bmatrix} \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT } \textit{nonvrbl} \\ \text{VAL } \langle\,\rangle \end{bmatrix} \\ \text{SEM} & \mathbf{Y} \\ \text{REL} & \{[d, deg(d)]\} \end{bmatrix}, \begin{bmatrix} \text{SEM} & \mathbf{X} \\ \text{GAP} & \langle\, [\text{SEM } \mathbf{V}\,]\,\rangle \end{bmatrix} \right\rangle \end{bmatrix}
$$

[63] 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*.

As before, *nonvrbl* 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 $\{[d, deg(d)]\}$], it must contain an occurrence of the degree specifier *the*. Since the REL value is also part of the filler daughter's STORE set, this element will be identified with that of the gap and hence percolated up through the *the*-clause, following the same pattern of STORE inheritance illustrated in Figure 10 above for interrogative parameters. A well-formed construct of type *the-cl* is illustrated in Figure 13, and a comparative correlative construct in Figure 14.

[FIGURE 13 ABOUT HERE]

[FIGURE 14 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:

(110) 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"]

. . .

Each of these examples could correspond to a construction in a fine grain analysis. However, in the present treatment, (110d,e) are instances of the Topicalized Clause Construction (see section 5.1), leaving the others to independent treatment.

6.2 Lexical Gap-Binding

Certain lexical entries, e.g. one among the various entries 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 ⟨NP⟩]) that is coindexed with the adjective's subject. A lexical gap-binder thus has a lexical entry like (111) (ignoring the optional *for*-phrase argument):

(111)
$$\begin{bmatrix} \textit{adj-lxm} & \\ \textsc{form} & \langle \text{tough} \rangle \\ \textsc{syn} & \begin{bmatrix} \textsc{val} & \left\langle \text{NP}_i\,, \begin{bmatrix} \textsc{syn} & [\textsc{cat}\ [\textsc{vform}\ \textit{inf}]] \\ \textsc{sem} & X \\ \textsc{gap} & \left\langle \begin{bmatrix} \textsc{syn}\ \text{NP}[\textit{acc}]_i \\ \textsc{sem}\ \wp_2 \end{bmatrix} \right\rangle \oplus L \end{bmatrix} \right\rangle \end{bmatrix} \\ \textsc{sem} & \lambda X[\lambda \wp_1[\textbf{tough}(\lambda \wp_2[X](\wp_1))]] \\ \textsc{gap} & L \end{bmatrix}$$

Lexical items licensed by this entry interact with the GAP-based analysis of gaps discussed in section 4.2 above. Note that a word licensed by (111) will in general be gapless ([GAP ⟨ ⟩]), since L in (111) will in general be the empty list. Because of this, the GAP value of the AP projected by a lexical gap-binder is in general the empty list. However, when *tough*'s infinitival complement contains a second gap (when L is singleton), the projected AP will have a singleton GAP value, providing an account of multiple filler-gap examples like (53a) above.[64]

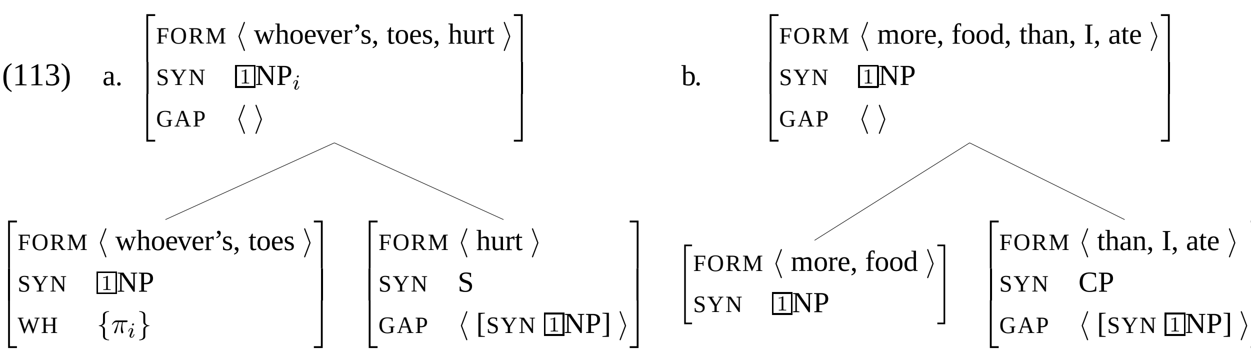
The gap-binding in *it*-clefts like (112) is also lexical in nature:

(112) It was Sandy that Kim thought Bo wanted to visit __ .

This 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 structures where a construct-initial daughter containing an appropriate element combines with an appropriate phrase containing a gap. This is illustrated for free relatives and comparatives in (113):

(113)


[64] For more detailed proposals for lexical gap-binding, see Pollard & Sag 1994, Bouma *et al.* 2001, and Levine & Hukari 2006.

Note that the mother in (113a) 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). For broadly compatible treatments of some of these phenomena, see Gazdar 1980, 1981, Klein 1981, Jacobson 1995, Lev 2005b, 2005a, and Kay & Sag to appear.

There are various other clausal modifiers where gap-binding takes place. These include finite relative clauses like (114), infinitival relatives like (115), and purpose clauses like (116):

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

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

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

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

(116) 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 (114); infinitival VP or S in (115)–(116)), but is built in terms of a special construction. For example, the *that*-less relative in (114a) could be licensed, following Sag (1997), via a construction admitting constructs that are both a *rel-cl* and a *subj-hd-cxt*, as shown in (117a):

(117) a. Mother: [FORM ⟨ they, liked, best ⟩, SYN S[SEL CNP$_i$], GAP ⟨ ⟩]

Daughters: [FORM ⟨ they ⟩, SYN [1]NP$_i$, WH { }] [FORM ⟨ liked, best ⟩, SYN VP, GAP ⟨ [SYN [1]NP$_i$] ⟩]

b. Mother: [FORM ⟨ they, liked, best ⟩, SYN S[SEL CNP$_i$], GAP ⟨ ⟩]

Daughter: [FORM ⟨ they, liked, best ⟩, SYN S, GAP ⟨ [SYN NP$_i$] ⟩]

The alternative, shown in (117b), 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 FG clauses in English, including topicalized clauses, *wh*-interrogatives, *wh*-exclamatives, *wh*-relatives, and *the*-clauses of the sort that appear within the Comparative Correlative construction. The FG constructions exhibit both commonalities and idiosyncrasies. The observed similarities are explained via a hierarchical organization of the constructs they license in terms of common supertypes that codify the properties shared at diverse grains. Constructional idiosyncrasy is accommodated by means of construction-specific constraints that must be satisfied together with the more general requirements of the superordinate types.

I have provided a detailed, surface-oriented syntactic and semantic analyses of these clauses in a framework where constructions are taken as basic. The treatment I have sketched is detailed, precisely formalized, and internally consistent. Moreover, the constraint-based analysis of extraction I have presented is independently motivated by the existence of numerous languages where words and constructions are sensitive to the presence or absence of a filler-gap dependency at intermediate levels along the extraction path.[65] My analysis provides a uniform account of the general properties of extraction dependencies within a given language, as well as a basis for the treatment of cross-linguistic generalizations.

As shown here in detail, particular FG constructions exhibit idiosyncrasies that an adequate grammar must account for if it is to begin to approximate a native speaker's knowledge of this theoretically critical domain. The 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.

I have also shown how the grammar of filler-gap constructions, all 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 *wh*-less relative clauses. In addition, I 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.

The account I have presented is surface-oriented, model-theoretic,[66] and strongly lexicalist. It thus embodies the design properties argued by Kaplan and Bresnan (1982), Jackendoff (1997, 2002), Culicover & Jackendoff (2005), and Sag & Wasow (in press) to be most compatible with what modern psycholinguistics tells us that competence grammars should look like. Despite a half

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

[66] I mean this 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.

century of intense investigation by thousands of researchers, it still remains 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 delineated in widely read generative-transformational textbooks. Far from being the epiphenomena disparaged by Chomsky in pronouncements that have been repeated countless times by generations of transformational grammarians, the notion of "grammatical construction" is more likely to be the cornerstone of explanatory adequacy in a linguistic theory that enables the development of precise analyses of scale.[67]

Appendix 1: Grammar Signature

Type Partitions:

Partition of *ling(uistic)-obj(ect)*: *list*(σ), *set*(σ) *sign*, *construct* (*cxt*, *phon(ological)-obj(ect)*, *syn(tactic)-obj(ect)*, *sem(antic)-obj(ject)*, *context-object (ctxt-obj)*, *cat(egory)*, *bool(ean)*, *expr-or-none*, *vform*, *case*, ...

Partition of *list*(σ): *nonempty-list*(σ), *empty-list* ($\langle\ \rangle$).

Partition of *set*(σ): *nonempty-set*(σ), *empty-set* ($\{\ \}$).

Partition of *sign*: *lex(ical)-sign*, *expr(ession)*

Partition of *expr*: *word, phrase*

Partition of *expr-or-none*: *expr*, *none*

Partition of *lex-sign*: *word*, *lex(eme)*

Partition of *cat(egory)*: *nonverbal*, *verbal*, ...

Partition of *nonv(e)rb(a)l*: *nom(inal)*, *adj(ective)*, *adv(erb)*

Partition of *nom*: *prep(osition)*, *noun*

Partition of *verbal*: *comp(lementizer)*, *verb*

Partition of *sem(antic)-obj(ect)*: *scope-obj(ect)*, *message*, *index*

[67] In addition, the general framework illustrated here has the potential to explain further properties of constructions. 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).

Partition of *scope-obj(ect)*: *gen(eralized)-quan(tifier), param(eter),*

Partition of *message*: *austinean, prop(ositionally)-constr(ucted)*

Partition of *austinean* (*aus*): *proposition* (*p*), *outcome*

Partition of *prop-constr*: *question, fact*

Partition of *construct (cxt)*: *phr(asal)-cxt, lex(ical)-cxt*

Partition of *phr-cxt*: *h(eade)d-cxt* and *nonh(eade)d-cxt*

Partition of *phr-cxt*: *cl(ause)* and *non-cl(ause)*

Partition of *hd-cxt*: *aux-initial-cxt (ai-cxt), hd-comp(lement)-cxt, subj(ect)-hd-cxt, fill(er)-hd-cxt, comp-corr-cl*. . .

Partition of *subj(ect)-hd-cxt*: *subj-pred(icate)-clause*, . . .

Partition of *non-headed-cxt*: *coordinate-cxt*, . . .

Partition of *clause*: *core-cl, noncore-cl*

Partition of *core-cl*: *decl-cl, int(errogative)-cl, imp(erative)-cl, excl(amative)-cl*,. . .

Partition of *noncore-cl*: *rel(ative)-cl, comp-corr-cl*, . . .

Partition of *decl-cl*: *subj-pred-cl, top(icalized)-cl*, . . .

Partition of *int-cl*: *pol-int-cl, wh-int-cl*, . . .

Partition of *wh-int-cl*: *subj-wh-int-cl, ns-wh-int-cl*

Partition of *excl-cl*: *ai-excl-cl, wh-excl-cl*, . . .

Partition of *rel-cl*: *wh-rel-cl*, . . .

Partition of *wh-rel-cl*: *fin-wh-rel-cl, inf-wh-rel-cl*

Partition of *fill-hd-cl*: *top-cl, wh-int-cl, wh-excl-cl, wh-rel-cl, the-cl*, . . .

Partition of *bool*: *plus* (+), *minus* (−)

Partition of *vform*: *fin-or-inf, pres(ent)-part(iciple), perf(ect)-part(iciple), pass(ive)-part(iciple), base, ger(und)*

Partition of *fin-or-inf*:, *fin(ite), inf(initive)*

Partition of *case*:, *nom(inative), acc(usative)*

Feature Declarations:

$$\textit{sign}: \begin{bmatrix} \textsc{phon} & \textit{phon-obj} \\ \textsc{form} & \textit{list}(\textit{formative}) \\ \textsc{syn} & \textit{syn-obj} \\ \textsc{sem} & \textit{sem-obj} \\ \textsc{ctxt} & \textit{ctxt-obj} \\ \textsc{gap} & \textit{list}(\textit{sign}) \\ \textsc{wh} & \textit{set}(\textit{scope-obj}) \\ \textsc{rel} & \textit{set}(\textit{param}) \\ \textsc{store} & \textit{set}(\textit{scope-obj}) \end{bmatrix}$$

$$\textit{lex-sign}: \begin{bmatrix} \textsc{arg-st} & \textit{list}(\textit{expr}) \end{bmatrix}$$

$$\textit{construct}: \begin{bmatrix} \textsc{mtr} & \textit{sign} \\ \textsc{dtrs} & \textit{list}(\textit{expr}) \end{bmatrix}$$

$$\textit{hd-cxt}: \begin{bmatrix} \textsc{hd-dtr} & \textit{sign} \end{bmatrix}$$

$$\textit{syn-obj}: \begin{bmatrix} \textsc{cat} & \textit{cat} \\ \textsc{val} & \textit{list}(\textit{expr}) \\ \textsc{crel} & \textit{the}, \textit{if}, \ldots\ \textit{none} \end{bmatrix}$$

$$\textit{cat}: \begin{bmatrix} \textsc{sel} & \textit{expr-or-none} \end{bmatrix}$$

$$\textit{vrbl}: \begin{bmatrix} \textsc{vform} & \textit{fin}, \textit{inf}, \ldots \\ \textsc{ic} & \textit{bool} \end{bmatrix}$$

$$\textit{verb}: \begin{bmatrix} \textsc{aux} & \textit{bool} \\ \textsc{inv} & \textit{bool} \end{bmatrix}$$

$$\textit{noun}: \begin{bmatrix} \textsc{case} & \textit{case} \end{bmatrix}$$

Appendix 2: Some Grammatical Constructions of English

Headed Construction (Head Feature Principle):

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

Head-Complement Construction:

$$hd\text{-}comp\text{-}cxt \Rightarrow \begin{bmatrix} hd\text{-}cxt & \\ \text{MTR} & \begin{bmatrix} \text{SYN} & [\text{VAL} \; \langle \, Z \, \rangle \;] \\ \text{SEM} & \mathbf{FR}_{\langle NP,p \rangle}(X_0, \ldots, X_n) \end{bmatrix} \\ \text{DTRS} & \langle \, H \, , Y_1\text{:}[\text{SEM } X_1], \ldots, Y_n\text{:}[\text{SEM } X_n] \, \rangle \\ \text{HD-DTR} & H\text{:}\begin{bmatrix} word & \\ \text{SYN} & [\text{VAL} \; \langle Z, Y_1, \ldots, Y_n \rangle \;] \\ \text{SEM} & X_0 \end{bmatrix} \end{bmatrix}$$

Subject-Head Construction:

$$subj\text{-}hd\text{-}cxt \Rightarrow \begin{bmatrix} hd\text{-}cxt & \\ \text{MTR} & [\text{SYN} \; [\text{VAL} \; \langle \, \rangle]] \\ \text{DTRS} & \langle \, X \, , \; H\text{: } [\text{VAL} \; \langle \, X \, \rangle \;] \, \rangle \\ \text{HD-DTR} & H \end{bmatrix}$$

Clause Construction:

$$clause \Rightarrow \begin{bmatrix} cxt & \\ \text{HD-DTR} & [\text{SYN} \; [\text{VAL} \; \langle \, (sign) \, \rangle]] \end{bmatrix}$$

Core Clause Construction:

$$core\text{-}cl \Rightarrow \begin{bmatrix} clause & \\ \text{MTR} & \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{SEL} & none \\ \text{VFORM} & fin\text{-}or\text{-}inf \end{bmatrix} \end{bmatrix} \\ \text{SEM} & message \end{bmatrix} \end{bmatrix}$$

Declarative Clause Construction:

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

Subject-Predicate Construction:

$$
\textit{subj-pred-cl} \Rightarrow \begin{bmatrix} \textit{subj-hd-cxt \& decl-cl} & \\ \text{MTR} & \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{VFORM} & \textit{fin} \\ \text{INV} & - \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \mathbf{FR}(\sigma_1, \sigma_2) \end{bmatrix} \\ \text{DTRS} & \left\langle [\text{SEM } \sigma_1] \text{ , } [\text{SEM } \sigma_2] \right\rangle \end{bmatrix}
$$

Aux-Initial Construction:

$$
\textit{ai-cxt} \Rightarrow \begin{bmatrix} \textit{hd-cxt} & \\ \text{MTR} & [\text{SYN} \ \ [\text{VAL} \ \ \langle\ \rangle\ ]] \\ \text{DTRS} & \langle\ X_0, X_1, \ldots X_n\ \rangle \\ \text{HD-DTR} & X_0 : \begin{bmatrix} \textit{word} & \\ \text{SYN} & \begin{bmatrix} \text{CAT} & [\text{INV} \ \ +] \\ \text{VAL} & \langle\ X_1,\ldots,X_n\ \rangle \end{bmatrix} \end{bmatrix} \end{bmatrix}
$$

Interrogative Clause Construction:

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

Exclamative Clause Construction:

$$
\textit{excl-cl} \Rightarrow \begin{bmatrix} \textit{core-cl} & \\ \text{MTR} & [\text{SEM} \ \ \textit{fact}] \\ \text{DTRS} & \textit{list}\left(\begin{bmatrix} \text{REL} & \{\ \} \end{bmatrix}\right) \end{bmatrix}
$$

Polar Interrogative Clause Construction:

$$
\textit{pol-int-cxt} \Rightarrow \begin{bmatrix} \textit{ai-cxt \& int-cl} & \\ \text{MTR} & \begin{bmatrix} \text{SYN} & [\text{CAT} \; [\text{IC} \; +]\,] \\ \text{SEM} & \lambda\{\;\}[\mathbf{FR}_p(X_1,\ldots,X_n)] \end{bmatrix} \\ \text{DTRS} & \langle\, [\text{SEM } X_1]\,, \ldots, [\text{SEM } X_n]\, \rangle \end{bmatrix}
$$

Inverted Propositional Clause Construction:

$$
\textit{inv-prop-cl} \Rightarrow \begin{bmatrix} \textit{ai-cxt \& decl-cl} & \\ \text{MTR} & \begin{bmatrix} \text{SYN} & [\text{CAT} \; [\text{IC} \; +\,]\,] \\ \text{GAP} & \textit{nelist} \\ \text{SEM} & \mathbf{FR}_p(X_1,\ldots,X_n) \end{bmatrix} \\ \text{DTRS} & \left\langle [\text{SEM } X_1], \ldots, [\text{SEM } X_n] \right\rangle \end{bmatrix}
$$

Inverted Exclamative Clause:

$$
\textit{inv-excl-cl} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} \; [\text{CAT} \; [\text{IC} \; + \;]] \\ \text{SEM} \; fact(\mathbf{FR}_p(X_1,\ldots,X_n)) \end{bmatrix} \\ \text{DTRS} & \left\langle [\text{SEM } X_1], \ldots, [\text{SEM } X_n] \right\rangle \end{bmatrix}
$$

Filler-Head Construction

$$
\textit{fill-hd-cxt} \Rightarrow \begin{bmatrix} \textit{hd-cxt} & \\ \text{MTR} & \begin{bmatrix} \text{SYN} & [\text{VAL} \; L_1\,] \\ \text{GAP} & L_2 \end{bmatrix} \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & X \\ \text{STORE} & \Sigma \end{bmatrix},\; H \right\rangle \\ \text{HD-DTR} & H : \begin{bmatrix} \textit{phrase} & \\ \text{SYN} & \begin{bmatrix} \text{CAT} & \textit{verbal} \\ \text{VAL} & L_1 \end{bmatrix} \\ \text{GAP} & \left\langle \begin{bmatrix} \text{SYN} & X \\ \text{STORE} & \Sigma \end{bmatrix} \right\rangle \oplus L_2 \end{bmatrix} \end{bmatrix}
$$

Topicalized Clause Construction:

$$
\textit{top-cl} \;\Rightarrow\; \begin{bmatrix}
\textit{fill-hd-cxt \& decl-cl} & \\
\textsc{mtr} & \begin{bmatrix} \textsc{syn} & [\textsc{cat} \;\; [\textsc{ic} \;\; +]] \\ \textsc{sem} & \lambda \mathbf{X}[\mathbf{Y}](\mathbf{Z}) \\ \textsc{gap} & \langle\, \rangle \end{bmatrix} \\
\textsc{dtrs} & \left\langle \begin{bmatrix} \textsc{sem} & Z \\ \textsc{wh} & \{\,\} \\ \textsc{rel} & \{\,\} \end{bmatrix}, H \right\rangle \\
\textsc{hd-dtr} & H{:}\begin{bmatrix} \textsc{syn} & \begin{bmatrix} \textsc{cat} & \begin{bmatrix} \textsc{inv} & - \\ \textsc{vform} & \textit{fin} \end{bmatrix} \\ \textsc{val} & \langle\, \rangle \end{bmatrix} \\ \textsc{sem} & \mathbf{Y} \\ \textsc{gap} & \langle\, [\textsc{sem} \;\; \mathbf{X}\,]\, \rangle \end{bmatrix}
\end{bmatrix}
$$

***Wh*-Exclamative Clause Construction:**

$$
\textit{wh-excl-cl} \Rightarrow \begin{bmatrix}
\textit{fill-hd-cxt \& excl-cl} & \\
\textsc{mtr} & [\textsc{sem} \;\; fact(\mathbf{Q}_v(\lambda X[Y](Z)))\,] \\
\textsc{dtrs} & \left\langle \begin{bmatrix} \textsc{cat} & \textit{nonvrbl} \\ \textsc{sem} & Z \\ \textsc{wh} & \{\mathbf{Q}_v\} \\ \textsc{rel} & \{\,\} \end{bmatrix}, \begin{bmatrix} \textsc{syn} & \begin{bmatrix} \textsc{cat} & \begin{bmatrix} \textsc{inv} & - \\ \textsc{vform} & \textit{fin} \end{bmatrix} \\ \textsc{val} & \langle\;\rangle \end{bmatrix} \\ \textsc{sem} & Y \\ \textsc{gap} & \langle\, [\textsc{sem}\; X]\, \rangle \end{bmatrix} \right\rangle
\end{bmatrix}
$$

***Wh*-Interrogative Clause Construction:**

$$
\textit{wh-int-cl} \;\Rightarrow\; \begin{bmatrix}
\textit{int-cl \& fill-hd-cxt} & \\
\textsc{mtr} & \left[\textsc{sem} \;\; \lambda\{\pi, \ldots\}[\lambda \mathbf{X}[\mathbf{Y}](\mathbf{Z})]\right] \\
\textsc{dtrs} & \left\langle \begin{bmatrix} \textsc{syn} & [\textsc{cat}\; \textit{nonvrbl}] \\ \textsc{sem} & \mathbf{Z} \\ \textsc{wh} & \{\pi\} \end{bmatrix}, \begin{bmatrix} \textsc{sem} & \mathbf{Y} \\ \textsc{gap} & \langle\, [\textsc{sem} \;\; \mathbf{X}\,]\, \rangle \end{bmatrix} \right\rangle
\end{bmatrix}
$$

Nonsubject *Wh*-Interrogative Clause Construction:

$$
\textit{ns-wh-int-cl} \Rightarrow \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{wh-int-cl}} \\
\text{MTR} & [\text{VAL} \ \langle\ \rangle] \\
\text{DTRS} & \left\langle \text{X}\ ,\ \left[\text{SYN} \left[\begin{array}{ll}
\text{CAT} & \left[\begin{array}{ll} \text{INV} & W \\ \text{IC} & W \end{array}\right] \\
\text{VAL} & \langle\ \rangle
\end{array}\right]\right] \right\rangle
\end{array}\right]
$$

Subject *Wh*-Interrogative Clause Construction:

$$
\textit{subj-wh-int-cl} \Rightarrow \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{wh-int-cl \& subj-hd-cxt}} \\
\text{MTR} & [\text{VAL} \ \langle\ \rangle] \\
\text{DTRS} & \left\langle \text{X}\ ,\ \left[\text{SYN} \left[\begin{array}{ll}
\text{CAT} & \left[\begin{array}{ll} \text{VFORM} & \textit{fin} \\ \text{INV} & - \end{array}\right] \\
\text{VAL} & \langle\ \rangle
\end{array}\right]\right] \right\rangle
\end{array}\right]
$$

Relative Clause Construction:

$$
\textit{rel-cl} \Rightarrow \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{clause}} \\
\text{MTR} & \left[\text{SYN} \left[\text{CAT} \left[\begin{array}{ll} \text{INV} & - \\ \text{IC} & - \\ \text{SEL} & \text{CNP} \end{array}\right]\right]\right] \\
\text{DTRS} & \textit{list}([\text{WH} \ \{\ \}])
\end{array}\right]
$$

***Wh*-Relative Clause Construction:**

$$
\textit{wh-rel-cl} \Rightarrow \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{fill-hd-cxt} \ \& \ \textit{rel-cl}} \\
\text{MTR} & \left[\text{SEM} \quad \lambda P \lambda x[\lambda\wp[\mathbf{X}](\mathbf{Y}) \wedge \mathbf{R}(x) \ \wedge \ P(x)]\ \right] \\
\text{DTRS} & \left\langle \left[\begin{array}{ll} \text{SYN} & [\text{VAL} \ \langle\ \rangle] \\ \text{SEM} & \mathbf{Y} \\ \text{REL} & \{[x, \mathbf{R}]\} \end{array}\right], \left[\begin{array}{ll} \text{SEM} & \mathbf{X} \\ \text{GAP} & \langle\ [\text{SEM}\ \wp\ ]\ \rangle \end{array}\right] \right\rangle
\end{array}\right]
$$

Finite *Wh*-Relative Clause Construction:

$$
\textit{fin-wh-rel-cl} \Rightarrow \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{wh-rel-cl}} \\
\text{MTR} & [\text{SYN}\ [\text{CAT}\ \ [\text{VFORM}\ \ \textit{fin}]]] \\
\text{DTRS} & \left\langle \left[\text{SYN} \left[\begin{array}{l}\text{CAT}\ \textit{nom} \\ \text{VAL}\ \langle\ \rangle\end{array}\right]\right], \text{X} \right\rangle
\end{array}\right]
$$

Infinitival *Wh*-Relative Clause Construction:

$$
\textit{inf-wh-rel-cl} \Rightarrow \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{wh-rel-cl}} \\
\text{MTR} & [\text{SYN}\ [\text{CAT}\ \ [\text{VFORM}\ \ \textit{inf}]]] \\
\text{DTRS} & \langle\ [\text{SYN}\ \ [\text{CAT}\ \textit{prep}]]\ , [\text{SYN}\ [\text{VAL}\ \langle\ \textit{fni}\ \rangle\ ]]\ \rangle
\end{array}\right]
$$

***The*-Clause:**

$$
\textit{the-cl-cxt} \Rightarrow \left[\begin{array}{ll}
\text{MTR} & \left[\begin{array}{ll}\text{SYN} & [\text{CREL}\ \ \textit{the}\ ] \\ \text{SEM} & (\iota\Delta : [\lambda V.X](Y))\end{array}\right] \\
\text{DTRS} & \left\langle \left[\begin{array}{ll}
\text{SYN} & \left[\begin{array}{l}\text{CAT}\ \textit{adjectival} \\ \text{VAL}\ \langle\ \rangle\end{array}\right] \\
\text{SEM} & Y \\
\text{WH} & \{\ \} \\
\text{REL} & \{\Delta\}
\end{array}\right], \left[\begin{array}{ll}
\text{CAT} & [\text{VFORM}\ \textit{fin}] \\
\text{SEM} & X \\
\text{GAP} & \langle[\text{SEM}\ V\ ]\rangle
\end{array}\right] \right\rangle
\end{array}\right]
$$

Comparative Correlative Clause:

$$
comp\text{-}corr\text{-}cl \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & \begin{bmatrix}\text{CREL} & none \\ \text{VAL} & \langle\,\rangle\end{bmatrix} \\ \text{SEM} & \begin{array}{l} \forall t_1 \forall t_2, t_1 < t_2 \forall\Delta\,[[\Delta \geq 0\ \& \\ \Delta = (\text{MAX}\{\mathbf{d} : [\text{at } t_2]\mathbf{X}\} - \\ \{\mathbf{d} : [\text{at } t_1]\mathbf{X}\})] \Rightarrow\ \exists\Delta'[\Delta' \geq 0\ \& \\ \Delta' = (\text{MAX}\{\mathbf{d'} : [\text{at } t_2]\mathbf{Y}\} - \\ \text{MAX}\{\mathbf{d'} : [\text{at } t_1]\mathbf{Y}\})\ \&\ \mathbf{R}(\Delta,\Delta')\,]] \end{array} \\ \text{STORE} & \{\,\} \end{bmatrix} \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & \begin{bmatrix}\text{CREL} & the \\ \text{VAL} & \langle\,\rangle\end{bmatrix} \\ \text{SEM} & \mathbf{X} \\ \text{STORE} & \{[\mathbf{d},\mathbf{deg(d)}]\} \end{bmatrix}, H{:}\begin{bmatrix} \text{SYN} & \begin{bmatrix}\text{CREL} & the \\ \text{VAL} & \langle\,\rangle\end{bmatrix} \\ \text{SEM} & \mathbf{Y} \\ \text{STORE} & \{[\mathbf{d'},\mathbf{deg(d')}]\} \end{bmatrix} \right\rangle \\ \text{HD-DTR} & H \end{bmatrix}
$$

Appendix 3: Feature Abbreviations

ARG-ST(ARGUMENT-STRUCTURE), AUX(AUXILIARY), CAT (CATEGORY), CNTXT (CONTEXT), CREL (CORRELATIVE), DTRS (DAUGHTERS), HD-DTR (HEAD-DAUGHTER), IC (INDEPENDENT-CLAUSE), INV (INVERTED), MTR (MOTHER), PHON (PHONOLOGY), REL (RELATIVE), SEL (SELECT), SEM (SEMANTICS), SYN (SYNTAX), VAL (VALENCE), VFORM (VERB-FORM)

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WH-Word	Interrogative	Exclamative	Relative	Example
who (Noun)	$+$	$-$	$+$	*who*
whose(Det)	$+$	$-$	$+$	*whose book*
what(Noun)	$+$	$\%$	$-$	*what*
what(Det$_{sing}$)	$+$	$-$	$-$	*what book*
what(Det$_{pl}$)	$+$	$+$	$-$	*what stories*
what(Degree word)	$+$	$+$	$-$	*what fun*
which(Noun)	$-$	$-$	$+$	*which*
which(Det)	$+$	$-$	$+$	*which book*
how(Adv$_{manner}$)	$+$	$-$	$\%$	*how*
how(Adj)	$+$	$-$	$-$	*how*
how(Degree word)	$+$	$+$	$-$	*how tall*
when(Adv$_{time}$)	$+$	$-$	$+$	*when*
where(Adv$_{place}$)	$+$	$-$	$+$	*where*
why(Adv$_{reason}$)	$+$	$-$	$+$	*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

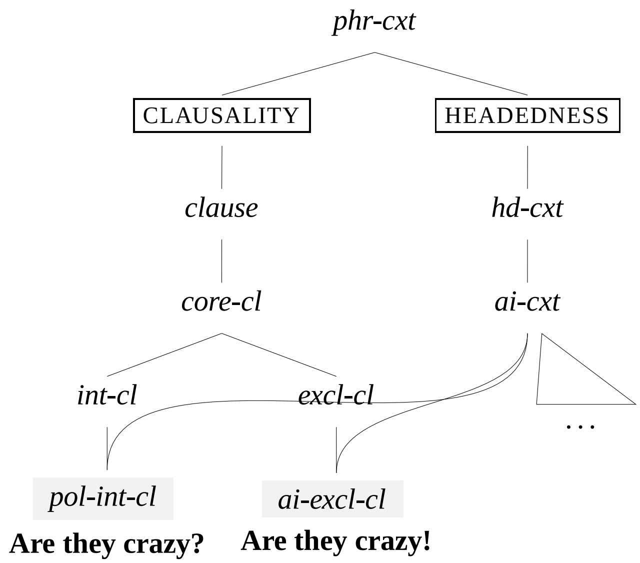

Figure 3: Two Types of Aux-Initial Clause

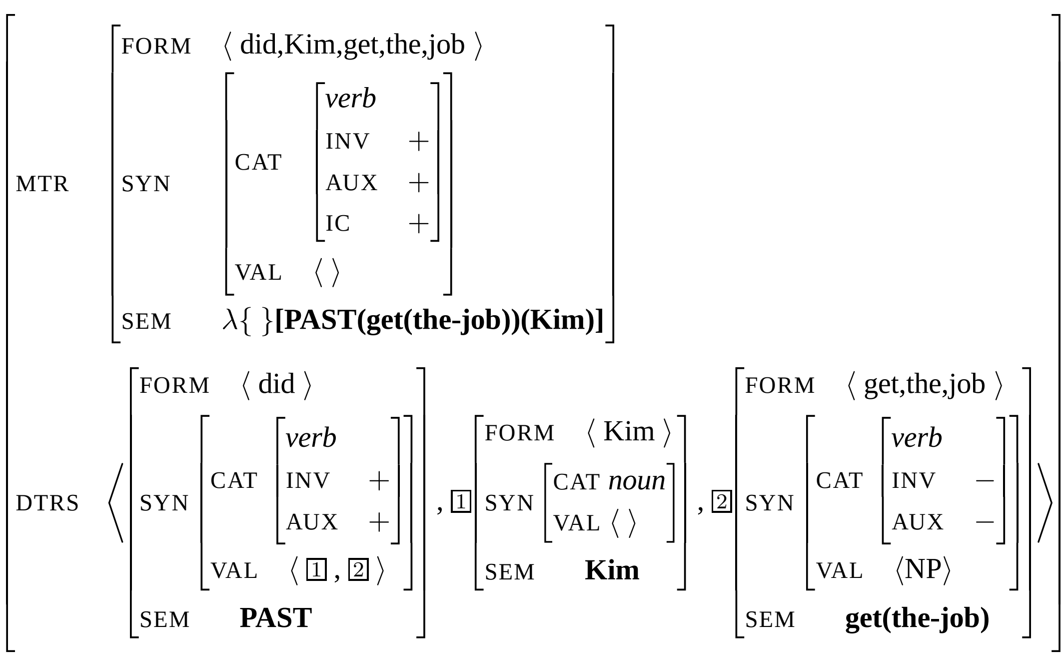

Figure 4: A Construct Licensed by the Polar Interrogative Construction

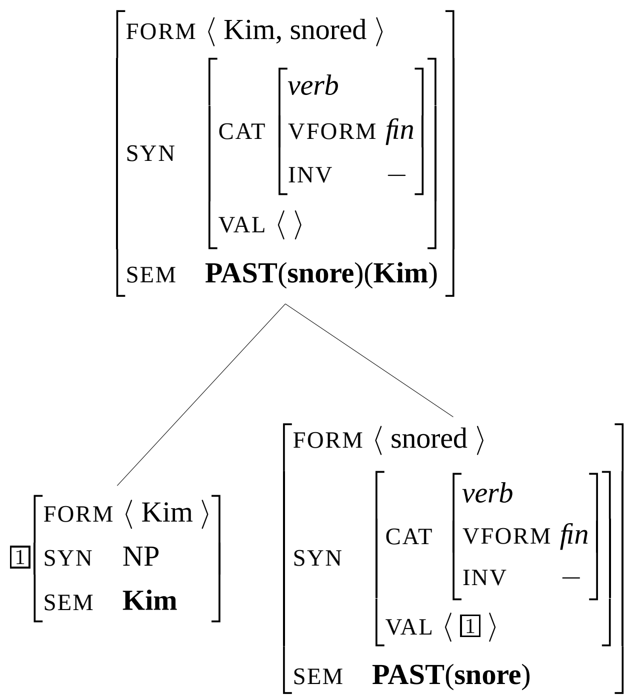

Figure 5: A Construct Licensed by the Subject-Predicate Construction

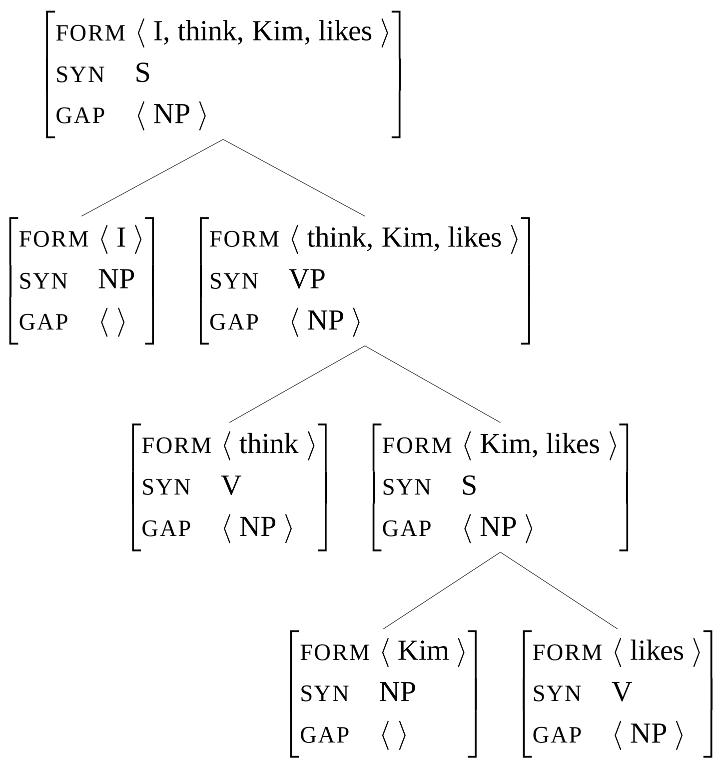

Figure 6: An Incomplete Derivation Showing “Inheritance” of GAP-Specifications

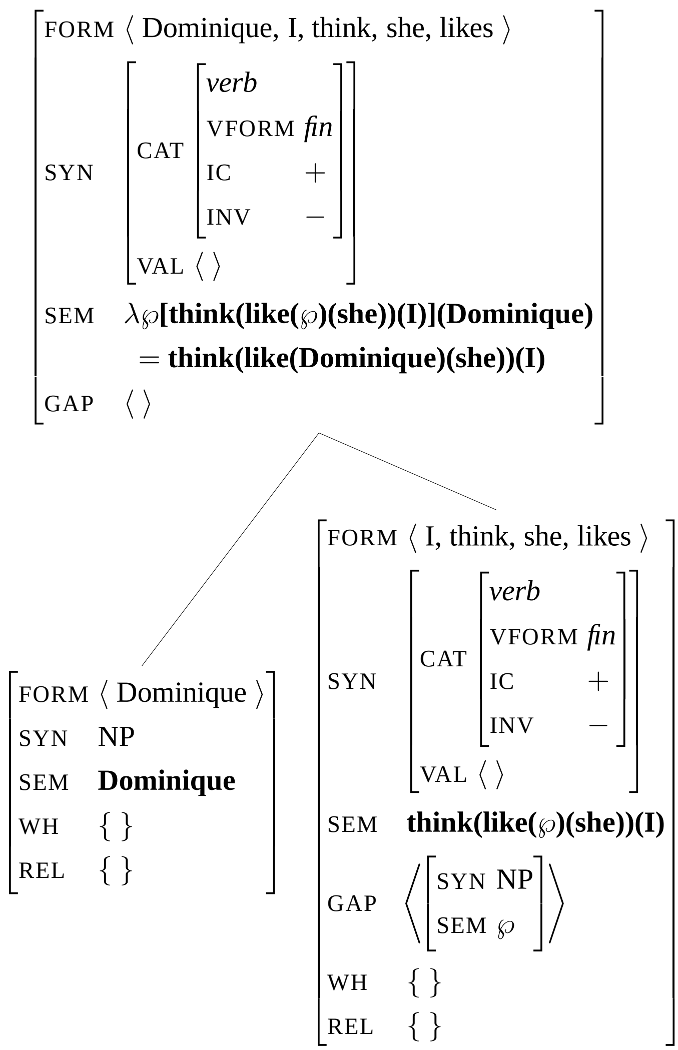

Figure 7: A Construct Licensed by the *Topicalized Clause* Construction

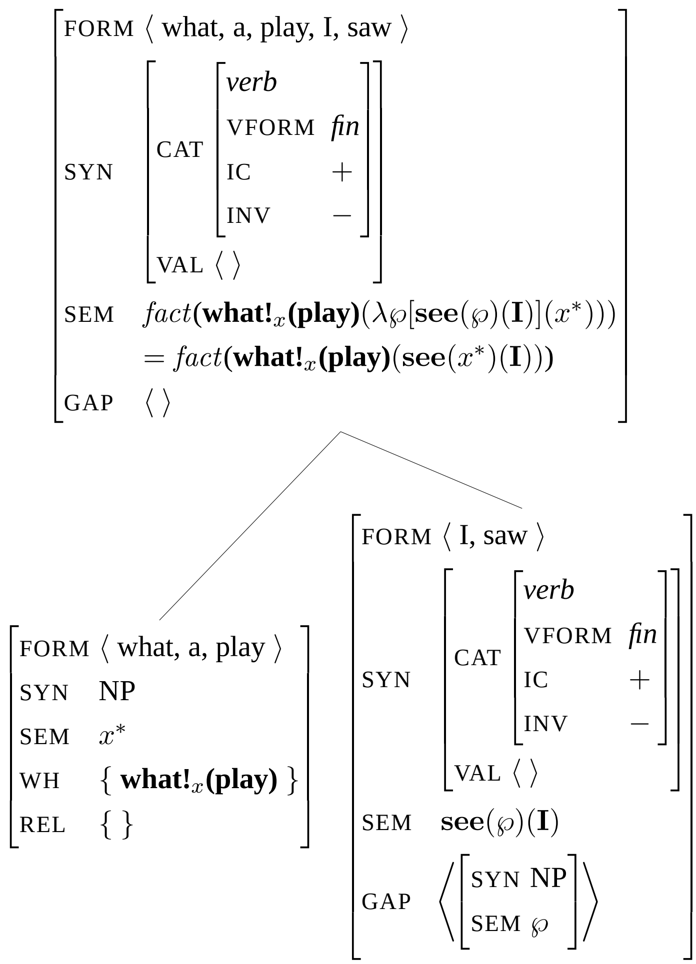

Figure 8: A Construct Licensed by the *Wh-Exclamative Clause* Construction

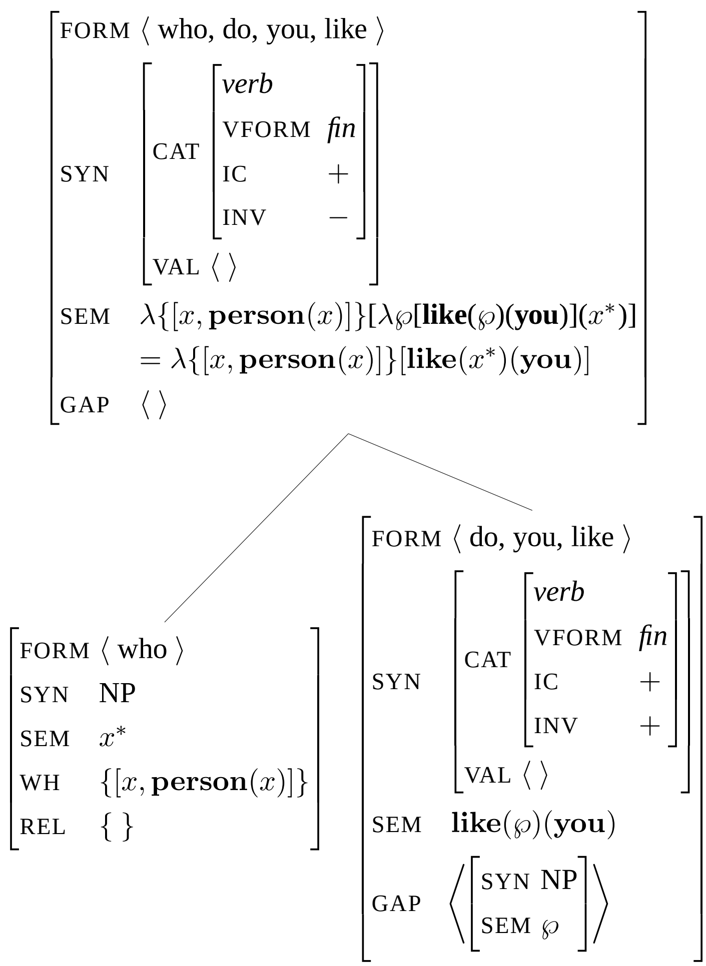

Figure 9: A Construct Licensed by the Nonsubject *Wh*-Interrogative Clause Construction

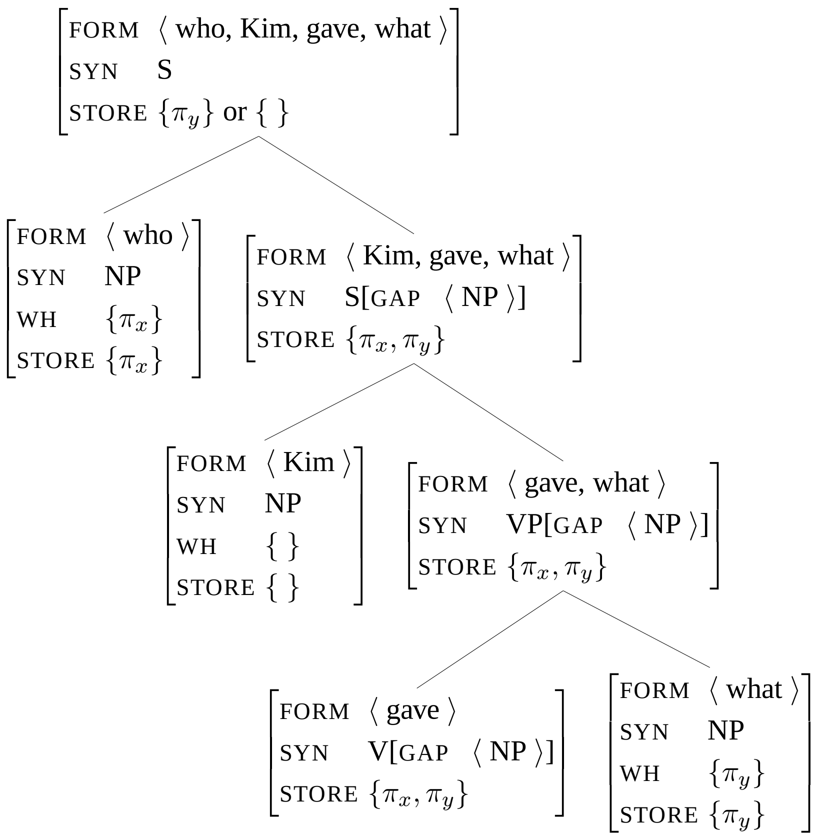

Figure 10: Stored Parameters in a Multiple *Wh*-Interrogative

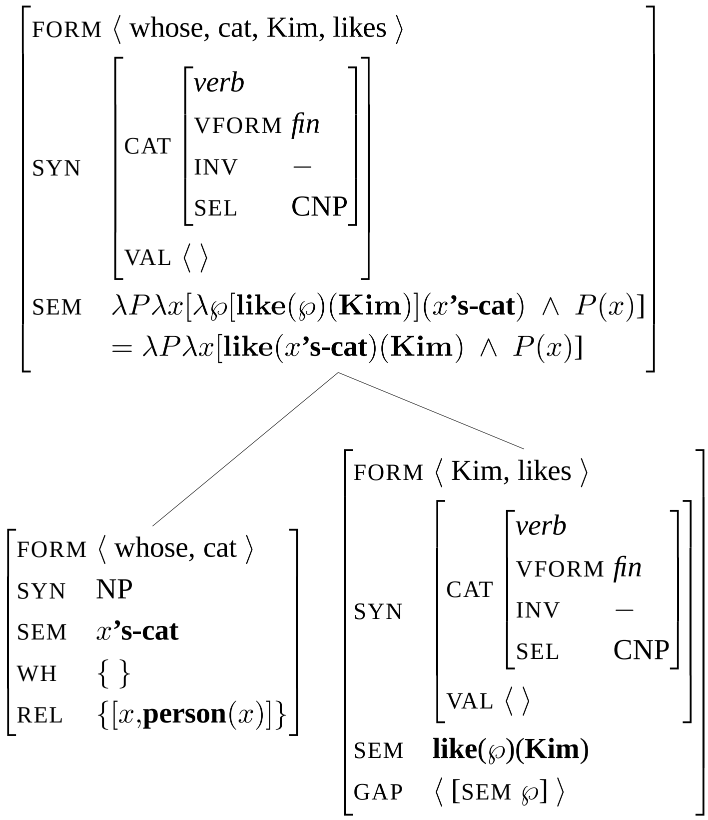

Figure 11: A Construct Licensed by the Finite *Wh*-Relative Clause Construction

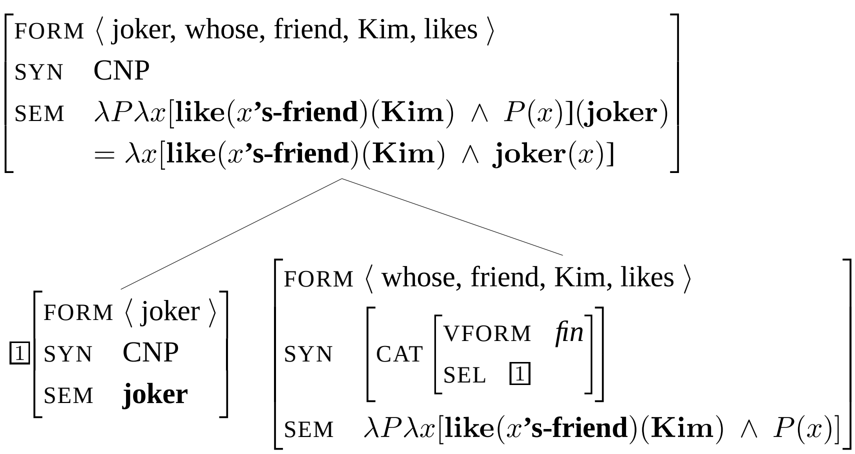

Figure 12: A Nominal-Modifier Construct

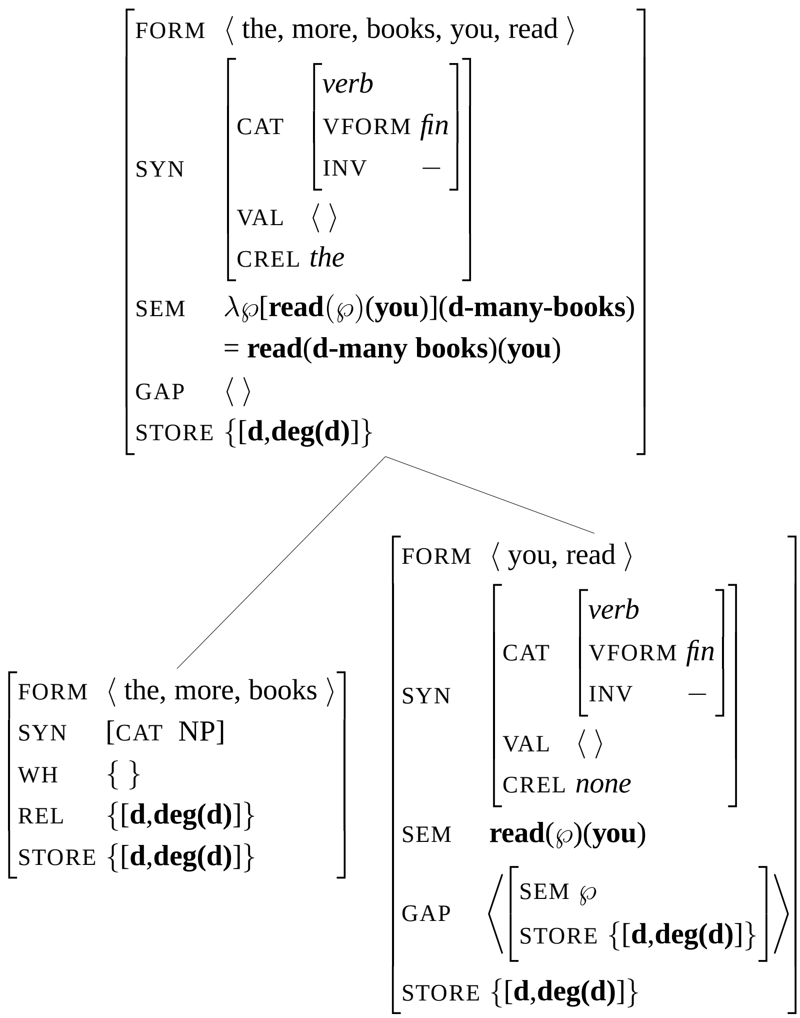

Figure 13: A *The*-Clause

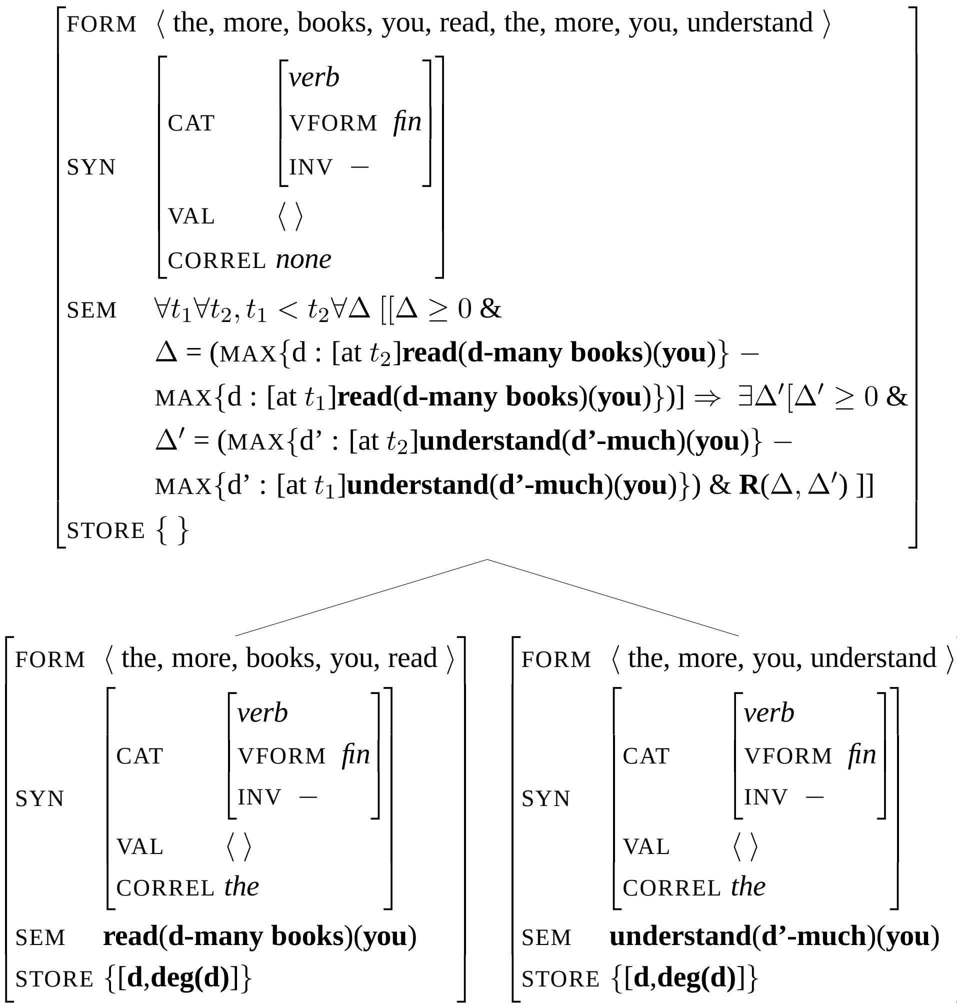

Figure 14: A *Comparative-Correlative* Clause