

Towards a Semantics of X-Bar Theory

Jerry T. Ball

www.DoubleRTheory.com
Jerry@DoubleRTheory.com

Abstract

Grammar encodes meaning. X-Bar Theory captures an important grammatical generalization. What is missing is a semantics of X-Bar Theory. This paper is a step towards providing such a semantics. In the process of providing a semantics for X-Bar Theory, certain modifications to X-Bar Theory are proposed to bring it into closer alignment with that semantics. Referential and relational meaning are two key dimensions of meaning that get grammatically encoded. It is argued here that the relationship between a specifier and a head is essentially referential in nature—with the specifier determining the referential status of the overall expression. It is likewise argued that the relationship between a head and its complement(s) is essentially relational, and that only relational heads (e.g. verbs, prepositions, adjectives, but not nouns) take complements.

Grammar Encodes Meaning

I take it as axiomatic that grammar encodes meaning. This position is consistent with Langacker's claim (1987, p. 12) that "Grammar is simply the structuring and symbolization of semantic content." I also take seriously Jackendoff's Grammatical Constraint (1983, pp. 13-14) "...one should prefer a semantic theory that explains otherwise arbitrary generalizations about the syntax and the lexicon...a theory's deviations from efficient encoding must be vigorously justified, for what appears to be an irregular relationship between syntax and semantics may turn out merely to be a bad theory of one or the other."

X-Bar Theory is an important element of a larger theory of Universal Grammar. The basic claim is that humans are born with linguistic knowledge like that captured in X-Bar Theory. Heretofore, X-Bar Theory has been investigated in largely structural terms with little consideration of its underlying semantic basis. This paper is an attempt to provide a semantic basis for X-Bar Theory and to bring syntactic theory into closer alignment with semantic theory.

Two key dimensions of meaning that get grammatically encoded are referential meaning and relational meaning. As will be shown, X-Bar Theory, with some modification, can be explicated in terms of the encoding of these two dimensions of meaning. In particular, it is argued here that the relationship between a specifier and a head is essentially referential in nature—with the specifier determining the referential status of the overall expression. It is likewise argued that the relationship between a head and its

complement(s) is essentially relational, and that only relational heads (e.g. verbs, prepositions, adjectives, but not nouns) take complements.

Referential Meaning

Within X-Bar Theory, specifiers are often defined configurationally with a description like "daughter of the maximal projection (XP) which is sister to a non-minimal head (X')." The configurational definition of specifiers is widely accepted and specifiers are typically considered to be purely syntactic, making little or no contribution to meaning. I have even heard a transformational grammarian argue that the purely syntactic nature of specifiers provides evidence for the independent reality of syntax.

On the other hand, there is some recognition of the referential function of specifiers. For example, Speas (1990, p. 37) notes that in one use "...the term 'specifier' refers to closed-class elements such as degree words and determiners, which in some intuitive sense specify the reference of the phrase" but goes on to say that "this semantic sense of the term 'specifier' is irrelevant." (Note that degree words are treated here as modifiers, not specifiers.) Stowell (1989) suggests that "the special relation between D [determiner] and N [noun] might be a function of the status of CNPs [Common Noun Phrase] as referential expressions." Chomsky (1995, p. 240) suggests that "D may be the locus of what is loosely called 'referentiality'." On the other hand, Stowell and Chomsky now treat D as the head of DP and not a specifier, following the Functional Head Hypothesis. However, others (e.g. Ernst, 1991; Jackendoff, 2002) continue to argue for the treatment of D as a specifier. Earlier, Chomsky (1970, p. 210) suggested the treatment of determiners and auxiliary verbs as specifiers, a position consistent with this paper. Di Sciullo & Williams (1987, p. 50) suggest that "perhaps in general reference is associated only with maximal projections: NPs refer to objects, Infl' refers to time, Comp' refers to truth values." This is essentially the position adopted here except that Infl⁰ (a specifier) supports reference to situations (not time) and Comp⁰ (a specifier) supports reference to objectified situations (not truth values). That is, reference is associated with maximal projections, and specifiers combine with heads to form maximal projections. The fact that specifiers combine with heads to form maximal projections is a reflection of their referential function

The two basic types of referring expressions are object referring expressions which are grammatically encoded as definite and indefinite noun phrases and situation referring expressions which are grammatically encoded as finite and non-finite clauses. As evidence that it is the specifier that determines the grammatical (and referential type) of an expression consider

The dance; **to** dance
The drink; **to** drink
The kill; **to** kill
The splash; **to** splash
The farm; **to** farm
The cat; **to** cat (about)
The dog; **to** dog (someone)
The father; **to** father

Since the head has the same word form (e.g. “dance”, “drink”) in each contrasting expression, there is no basis for the head determining the grammatical type of the expression. Rather, it is the specifier—either the determiner “the” or the infinitive marker “to”—that determines the grammatical type of the expression. Thus, the specifier “the” picks out an objective (or noun) sense of “dance” and “drink” in forming a noun phrase, whereas the specifier “to” picks out an action (or verb) sense of these words in forming an infinitive phrase (or clause). Further, even in the case of words which have a strong action preference, the specifier “the” forces an object (or noun) reading as in the case of “the kill” or “the splash.” That is, “the” has the effect of objectifying the following head, often forcing action words to be interpreted as one of the typical participants in the action, rather than the action itself. Likewise “to” has the effect of relationalizing the following head. Thus, the words “cat” and “dog”—words which are almost always used in expressions that refer to particular kinds of objects—are relationalized by “to” and the base meanings of “cat” and “dog” as categories of objects are extended to support reference to relational attributes of those objects and not the objects themselves.

The ability of a word which is typically used as a verb to occur after a determiner, and a word which is typically used as a noun to occur after the infinitive marker “to” is highly, if not fully, productive. In both cases, the specifier determines the grammatical type of the expression. Where a contrasting noun or verb form exists, it is less acceptable as in

The argument; ***to** argument
 ***The** argue; **to** argue

The contrasting form blocks the productive use of the noun as a verb or the verb as a noun. One can, of course, construct examples that seem to be acceptable, if odd, as in “I don’t like to argue with you.” It is part of the creative use of language to use words outside their typical grammatical context. Clark’s (1983) nonce expression “he porched the newspaper” which I take to mean “he threw the

newspaper on the porch” is a classic example. Or the language learner may lack the appropriate verb form and resort to the verbal use of a noun form as in the “to argument” example above. It also appears to be the case that verbs expressing an instantaneous action are more easily objectified and used after a determiner (e.g. “the kick”, “the hit”, “the bite”) than other verbs. Verbs like “argue” which do not express instantaneous actions are less acceptable following a determiner.

The suggestion that the head determines the grammatical type of an expression can only be maintained through a circular argument that the head is necessarily of the same type as the embedding expression whenever a difference in type is apparent. Consider

The **running** of the bulls
 The **injured** were taken to hospital
 The **sad** are in need of cheering up
 The **cheering up** of the sad
 The **buy out** of the corporation
 The **porching** of the newspaper

The status of the head as the determinant of a noun phrase can only be maintained if we insist that the heads in these examples are nouns. That is, since we know that these expressions are noun phrases (because of the determiner), their heads are necessarily nouns and these nouns determine the type of the expressions. This circular argument has the unfortunate side effect of allowing most any word or expression to be a noun and clouds consideration of the important notion “part of speech.”

If specifiers and not heads determine grammatical type, then how can they be optional in many expressions? Some words are inherently specified and function to combine the head and specifier roles—obviating the need for a separate specifier. This is true of pronouns, proper nouns, and deictic words. Note that these words are inherently referential and it is this fact that makes the need for a separate specifier unnecessary. Also, the larger context may redundantly encode the referential type of an expression making the need for a specifier optional. Thus, the complementizer “that” (a specifier) in “I believe (that) he likes you” is optional since the verb “believe” subcategorizes for a clausal complement. The relative pronoun (another specifier) is also optional in some forms of relative clause. For example, the relative pronoun “which” in “the book (which) I gave you” is optional. In this case, the occurrence of the clause “I gave you...” following the subject “the book” establishes the clause as a relative clause and allows the specifier to be optional.

On the other hand, the optionality of specifiers is much less rampant than is assumed under some analyses. In particular, the suggestion that all non-head sisters must be maximal projections (with optional specifiers) is incoherent from a referential perspective. For example, under this assumption, “red” in “the red book”, is assumed to have the status of an AP (adjective phrase) with the optional specifier

not appearing since it is a non-head sister of the head “book”. But if “red” is not the maximal projection of an AP, being instead just a modifier of the head “book”, then there is no optional specifier. In fact, it is not clear what the “optional” specifier could be in this example. Sadler & Arnold (1994) argue that prenominal adjectives and adverbs that modify them (e.g. “very” in “the very red book”) are both bar zero. On their analysis, since they are not maximal projections, there is no missing specifier. In general, the assumption that all non-head sisters are maximal projections combined with the binary branching hypothesis results in a proliferation of phrase types where the specifier is at best optional, if even possible. In this regard, the suggestion that degree adverbs are specifiers in APs within NPs can be seen as an attempt to find something that can be an optional specifier where no specifier is possible (or needed).

If heads do not determine phrase or clause type, what do they do? They determine the semantic category of object or situation to which the phrase or clause may be used to refer. For example, in “the murder,” “murder” determines the semantic category that “the murder” may be used to refer to, whereas, “the” determines the phrase to be a definite object referring expression—despite the fact that “murder” is an action category. Likewise in “he is sad,” “sad” determines the semantic type of situation that the expression may refer to, whereas “is” determines the expression to be a finite situation referring expression. Thus, the specifier determines the referential type of an expression, whereas, the head determines the semantic type to which the expression may be used to refer. It is referential type (e.g. definite object referring expression or finite situation referring expression) which corresponds most closely to the grammatical notion of phrase and clause. That is, it is the specifier and not the head which projects the grammatical type of the expression.

Recognizing the important role of specifiers leads immediately to a revision of X-Bar Theory that resolves some important issues. The confusion over whether Tense or V is the head of a TP (i.e. tensed phrase) results from the assumption that the head projects the category of TP. But if this is true, then Tense must be the head of TP as is assumed by Chomsky (1995). On the other hand, V is the central semantic category determining element of TP, with Tense filling a more peripheral semantic role. That is, V has a semantic prominence that does not hold for Tense. This leads Jackendoff (1977, 2002) to assume that V (projected thru VP) is the head of TP and not Tense. Recognizing that the role of a specifier and the role of a head are distinct, it is easy to see that Tense projects the type of TP, although V is the central semantic element. Similarly, for COMP. If COMP projects the type of CP, then COMP must be the head according to Chomsky (1995). But COMP is clearly a peripheral (and optional) element of CP with V (projected thru TP) being the central element. This conflict is resolved by making COMP the specifier which fulfills a peripheral, but type determining role, while making V (projected thru TP) the head or central semantic element of CP.

Cann (1999) comes close to the position put forward in this paper in arguing that specifiers are secondary heads whose features combine with the features of the head in the formation of a maximal projection. Cann argues against Chomsky’s (1995, p. 244) claim that only the features of the head project. There is clearly something unsatisfying in Chomsky’s (ibid. p. 246) claim that the word “the” in the expression “the book” is the head whose syntactic features project—especially in a bare representation where the categories NP and DP have been dispensed with. Yet, Chomsky recognizes that the determiner “the” projects the grammatical type of the overall expression and in an X-Bar Theory where the head necessarily projects the grammatical type, the determiner must be the head. Allowing both the specifier and the head to project features avoids this awkward position. Whether or not the specifier should be considered a “secondary head” hinges on the issue of what exactly the category of the parent is. I have argued above that the specifier is the determinant of the grammatical type of an expression and the head is the determinant of the semantic type of that expression. From a grammatical perspective, the specifier is the determining element and not the head. That is, the grammatical influence of the specifier overrides the semantic type of the head in determining the grammatical function of the overall expression.

Relational Meaning

I argued above that the relationship between a specifier and its head is essentially referential in nature. In this section, I contend that the relationship between a head and its complements is essentially relational in nature.

That the clause has a basic relational structure (on some level) is widely accepted. However, syntactically, relational structure is often subordinated to other considerations. Thus, structurally we have VPs and PPs which are relationally incomplete with the subject argument (in the case of a VP) and the modified argument (in the case of a PP) being treated as external to the construction. The overall effect is the appearance that syntactic form and relational form are distinct levels of representation.

In the case of PPs which typically function as modifiers of Ns, NPs and clauses, relational structure is subordinated to referential structure. For example, in the expression

The book on the table

the fact that the preposition “on” is a relation that takes two arguments “the book” and “the table” is subordinated to the referentially modifying relationship that exists between “on the table” and “the book”. That is, the expression as a whole is used to refer to a book which is on a table. Nonetheless, if we view “on the table” as a relational modifier (rather than a complement) of “the book”, then the relational structure is still there, albeit subordinated. The traditional syntactic treatment of expressions like

The book is on the table

is to make “is” the head with “on the table” functioning as a complement, subordinating the relational meaning of “on”. An alternative treats “on” as a relational head taking the complements “the book” and “the table” with “is” providing the specification needed to establish situational reference. This alternative captures the idea that the expression is about “being on” and not just “being”. The traditional treatment is suggested by correspondence with “Where is the book?” where the reference of “on the table” to a location is emphasized. The alternative treatment is suggested by correspondence with “What is the book on?” where the relational content of “is on” is emphasized.

In the case of VPs, the situation is more complex. The treatment of the subject as external to VP may have more to do with trade-offs in the encoding of pragmatic meaning than referential meaning. Thus, it is generally recognized that the subject is an argument of the head of the VP on some level, even if that relational reality is subordinated to other concerns. In a grammatical theory limited to a single level of representation like that being put forward here and in Chomsky’s minimalist program, some mechanism for simultaneously representing all dimensions of meaning is needed. Trade-offs in the encoding of multiple dimensions of meaning in a single linear dimension result in the diversity of grammatical forms that is evident in language.

There may be expressions where relational meaning is fully subordinated as in

He put the book on the table

where the relationship between “the book” and “on the table” is fully subordinated to the requirement for the complement “on the table” of “put” to be a referring expression. In this case, the relational meaning of “on” is only reconstructed via inference from the actual input.

In X-Bar Theory, the basic parts of speech are often defined in terms of the features $[\pm N]$ and $[\pm V]$ as follows:

Noun	$[+N] [-V]$	$[\text{sem,obj}]$
Adjective	$[+N] [+V]$	$[\text{sem,rel}]$
Verb	$[-N] [+V]$	$[\text{sem,rel}]$
Preposition	$[-N] [-V]$	$[\text{sem,rel}]$
Adverb	$[???] [???]$	$[\text{sem,rel}]$

Given just two features, only four distinct, non-functional parts of speech are identifiable. This is a clear limitation of this element of X-Bar Theory since it provides no basis for defining adverbs which by most accounts are a separate non-functional part of speech. Further, while these features are clearly motivated for the noun and verb categories, there is less motivation for defining the adjective category as $[+N][+V]$, and hardly any motivation for defining the preposition category as $[-N][-V]$.

From a relational perspective, the key feature of each part of speech is its relational status and the semantic feature-value pair $[\text{sem,value}]$ is suggested to represent this. A

categorization based on the sem feature for the primary (i.e. non-functional) parts of speech is provided above.

Note that nouns are $[\text{sem,obj}]$ (object), whereas, all the other primary parts of speech are $[\text{sem,rel}]$ (relation). That is, only nouns are non-relational. If nouns are non-relational, then there is no semantic basis for suggesting that they take complements, although most, if not all, X-Bar Theory based approaches take it for granted that nouns do take complements. From a relational perspective, X-Bar Theory is seen as an overgeneralization in that it allows all types of heads, including non-relational nouns, to take complements. In treatments of noun complementation, the preposition that almost always occurs as part of the complement is typically ignored since it is often just a semantically washed out preposition (e.g. “of”, “at”) as in

The book of love

The preposition is ignored despite the fact that the expression is ungrammatical without it:

*The book love

On the other hand, it is generally recognized that noun “complements” are almost always optional. This is true even in the case of deverbal nouns where the complements of the deverbal noun occur in prepositional phrases and not bare noun phrases as in the verbal use

The kick of the football by the kicker

Despite this grammatical evidence, prepositional phrases following nouns are frequently treated as complements. The alternative is to treat them as modifiers, not complements. This is the position adopted here. From a relational perspective, modifiers are non-head, relational expressions. Thus, the prepositional phrases “of the football” and “by the kicker” are relational expressions that modify rather than complement the head.

Relational heads require specification to establish their referential status. For verbs, the specifying function may be marked by the tense on the verb as in

He kicked the ball.

For verb participles, adjectives and prepositions a separate specifier is required as in

The man **is** running
The man **is** sad
The book **is** on the table

Relations used as modifiers do not require separate specification since they are part of a referring expression which has its own specification

The **running** man

The **sad** man
The book **on the table**

Adverbs are relations that modify relations and do not typically function as heads and do not need specification:

The **very** sad man
He ran **quickly**

Degree adverbs are modifiers, not specifiers.

X-Bar Theory (Revisited)

Based on the semantic analysis presented in this paper a revised version of X-Bar Theory is presented. Note that although the default order of constituents for English is reflected in these rules, the linear precedence is abstracted out as in GPSG (Gazdar et al. 1985) and other orders are possible. Also, like GPSG, features sets (other than $[\pm N]$ and $[\pm V]$) are introduced and individual features need not take on binary values. Further, given that referential meaning as reflected in the specifier/head relationship and relational meaning as reflected in the head/complement relationship are largely orthogonal, only two levels are posited instead of the more common three levels. Further, there is no assumption that the combining of a head with its complements is internal to the combining of a specifier with its head. Actually, the converse is claimed in the appendix.

Specifier/Head Rules

1. $H^1[\text{ref},R][\text{sem},S] \Rightarrow \text{Spec}[\text{ref},R], H^n[\text{sem},S]$
2. $H^1[\text{ref},R][\text{sem},S] \Rightarrow H^0[\text{sem},S], \text{Af}[\text{ref},R]$
3. $H^1[\text{ref},R][\text{sem},S] \Rightarrow H^0[\text{ref},R][\text{sem},S]$

Head/Complement Rule

4. $H^n[\text{sem},\text{sit}] \Rightarrow \text{Comp}_1[\text{comp},\text{subj}], H^n[\text{sem},\text{rel}], \text{Comp}_{2,3,4}[\text{comp},C]$

Head/Modifier Rule

5. $H^n \Rightarrow \text{Mod}, H^n$

Terminology

$[\text{ref},R]$ = referential feature

$R = \{\text{def}, \text{indef}, \text{fin}, \text{inf}\}$

def = definite

indef = indefinite

fin = finite

inf = infinite

$[\text{sem},S]$ = semantic category feature

$S = \{\text{obj}, \text{rel}, \text{sit}\}$

obj = object

rel = relation

sit = situation

$[\text{comp},C]$ = complement feature

$C = \{\text{subj}, \text{do}, \text{io}, \text{comp}\}$

subj = subject

do = direct object

io = indirect object

comp = complement

$H^n = H^0$ or H^1 (H = head)

H^1 implies $[\text{ref},R][\text{sem},S]$

H^0 implies $[\text{sem},S]$

Spec implies $[\text{ref},R]$ (Spec = specifier)

Mod implies $[\text{sem},\text{rel}]$ (Mod = modifier)

Comp implies $[\text{ref},R][\text{sem},S]$

Af = affix

The first three rules represent the specifier/head relationship. Rule 1 is the case of an explicit specifier. Rule 2 handles affixes that provide specification (e.g. plural marker on noun, tense marker on verb). Rule 3 handles inherently specified lexical items (e.g. pronoun, proper noun). In all three rules, the key to a maximal projection (H^1) is availability of the $[\text{ref},R]$ feature on one of the constituents that forms the maximal projection. Without this feature there is no maximal projection. Also note that the head on the right hand side of the rule 1 is H^n to allow for multiple specification as in “**all the men**”, “**the books**”, “**has kicked**”.

Rule 4 represents the head/complement relationship. 0, 1 or 2 complements ($\text{Comp}_{2,3,4}[\text{comp},C]$) are allowed in addition to the subject complement ($\text{Comp}_1[\text{comp},\text{subj}]$). Note that the complements are maximal projections capable of referring. Only relational heads (i.e. $[\text{sem},\text{rel}]$) may take complements. The relational head may be either H^0 or H^1 . Note that the head on the left hand side of the rule is $[\text{sem},\text{sit}]$. The combination of a relational head with its complements results in a situation. The head/complement rule allows for multiple complements and does not comply with the binary branching hypothesis. It treats the subject as a complement unlike most versions of X-Bar Theory that assume subjects are specifiers, but closer to versions that treat the subject as base generated internal to VP and raised to TP specifier. Since the subject says nothing about the referential status of the clause in which it occurs, it is a poor candidate for being a specifier. On the other hand, since the subject is an argument of the relational head of a clause it is a good candidate for being a complement.

Rule 5 represents the head/modifier relationship. Modifiers may combine with either H^0 or H^1 level constituents with the resulting constituent having the same bar level. The semantic features that a modifier contributes to the head are not explored in this paper.

Summary

Providing a semantic basis for X-Bar Theory is a highly laudable objective. It follows naturally from acceptance of Jackendoff's Grammatical Constraint. This paper is a step in that direction. Much detailed analysis is needed to flesh out the consequences of providing a semantic basis for X-Bar Theory. See the appendix for some initial suggestions. No doubt additional modifications will be needed. This paper provides an outline of what such a semantics is likely to look like.

Chomsky (1995, p. 246) eschews his own X-Bar Theory in the minimalist program where he states that “standard X-bar theory is thus largely eliminated in favor of bare essentials.” However, if X-Bar Theory can be given a coherent semantic basis, then it may well turn out to be the basis of LF (logical form), the single level of “syntactic” representation that remains in the minimalist program.

Appendix

The rules above are very general and only weakly constrained. Additional featural constraints can be posited in more specialized variants of these rules.

- 1a. $H^1[ref,R_a][sem,obj] \Rightarrow Spec[ref,R_a], H^n[sem,obj]$
 where $R_a = \{def, indef\}$
- 1b. $H^1[ref,R_b][sem,rel] \Rightarrow Spec[ref,R_b], H^n[sem,rel]$
 where $R_b = \{fin, inf\}$
- 1c. $H^1[ref,R_a][sem,obj][sem,rel] \Rightarrow$
 $Spec[ref,R_a][sem,obj], H^0[sem,rel]$
- 1d. $H^1[ref,R_a][sem,rel][sem,obj] \Rightarrow$
 $Spec[ref,R_b][sem,rel], H^0[sem,obj]$
- 1e. $H^1[ref,def][sem,obj][sem,sit] \Rightarrow$
 $Spec[sub,comp][ref,def][sem,obj], H^1[ref,fin][sem,sit]$
 where [sub,comp] is a complementizer subtype feature

Rules 1a and 1b are specialized specifier/head rules that are constrained for referential and semantic type such that def/indef reference type and obj semantic type co-occur and fin/inf reference type and rel semantic type co-occur. Rule 1c specifically licenses deverbal nouns and rule 1d specifically licenses the relational use of nouns. Note that multiple semantic features are allowed on the head and are not mutually exclusive. $Spec[ref,R_a][sem,obj]$ is an object specifier and $Spec[ref,R_b][sem,rel]$ is a relation specifier. $H^1[ref,R_a][sem,obj]$ corresponds to NP (i.e. object referring expression) and $H^1[ref,R_b][sem,rel]$ corresponds to VG (verb group) (i.e. relation referring expression). Rule 1e specializes the function of a complementizer. $H^1[ref,def][sem,obj][sem,sit]$ corresponds to an objectified situation referring expression. Note the [ref,def] feature on the specifier and the [ref,fin] feature on the relational head.

- 4a. $H^1[ref,fin][sem,sit] = \text{finite clause} \Rightarrow$
 $Comp_1[comp,subj], H^1[ref,fin][sem,rel], \dots$
- 4b. $H^1[ref,inf][sem,sit] = \text{non-finite clause} \Rightarrow$
 $t_i[comp,subj], H^1[ref,inf][sem,rel], \dots$
 where $t_i[comp,subj] = \text{subject trace}$

Rules 4a and 4b are specializations of the head/complement rule. The fact that a finite clause [ref,fin] requires a subject whereas a non-finite clause [ref,inf] does not shows that the specifier/head rules and the head/complement rule are not entirely orthogonal. However, it is the presence of the [ref,inf] feature which licenses the subject trace and this suggests that the relationship between a specifier and head is internal to the relationship between a head and its complements and not the other way around.

- 5a. $H^n[sem,obj] \Rightarrow Mod[-adv], H^n[sem,obj]$
- 5b. $H^n[sem,rel] \Rightarrow Mod[+adv], H^n[sem,rel]$
- 5c. $H^n[sem,sit] \Rightarrow Mod[+adv], H^n[sem,sit]$
- 5d. $H^1[ref,R_a][sem,obj] \Rightarrow H^1[ref,R_a][sem,obj],$
 $Mod[sub,wh-rel][ref,R_a], H^1[ref,R_b][sem,sit]$

Rules 5a, b, c and d are specializations of the head/modifier rule. The head/modifier relationship can be specialized by the addition of an adverb feature ($[\pm adv]$) to capture the distinction between modification of relations and situations (i.e. by adverbs) and modification of objects (i.e. by other modifiers).

Additional featural constraints can be introduced to reflect the difference between pre- and post-modification. The head/complement rule could be expanded to reflect the basic clause types put forward in Quirk, Greenbaum, Leech & Svartvik (1972) (SVC, SVA, SV, SVO, SVOC, SVOA, SVOO), although the expanded head/complement rules may handle adverbials (A) and complements (C) somewhat differently. Assuming the existence of rules at differing levels of specialization, the most specialized rule that matches the linguistic expression will have precedence over more general rules.

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