

# Mixed categories in HPSG

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## Abstract

It is often assumed that there is a small number of primitive, universal, and perhaps innate syntactic categories. Mixed category constructions involve lexical items that seem to be central members of more than one part of speech and so pose a problem for the standard view of syntactic categories. For example, the verbal gerund phrase in *Chris worried about Pat's frequently eating hamburgers* has some internal properties of a VP but the external distribution of an NP. The verbal gerund *eating* has both verbal and nominal properties. It combines with a direct object and an adverb, but it also combines with possessor and occurs as the object of a preposition. This paper presents an HPSG analysis of English verbal gerunds based on a more fine-grained theory of syntactic categories. A category like 'noun' is actually a bundle of recurring grammatical information represented as constraints on types in the hierarchical lexicon. Mixed categories have an atypical combination of information. For example, the verbal gerund shares the distributional properties of nouns and the selectional properties of verbs, but is not a member of either category per se. Since under this view different dimensions of grammatical information can, in principle, vary independently, the behavior of mixed categories creates no paradox.

## I INTRODUCTION

Grammatical categories are central to generative theories of grammar. In many ways, the study of syntax really is just the study of grammatical categories. It is typically assumed that there is a small number of primitive, probably universal, probably innate, grammatical categories N, V, A, and P, and that furthermore the properties of a phrase are primarily determined by the category of its head. That is, a verb phrase has the properties of a verb phrase by virtue of its being headed by a verb.

This view of parts of speech is in large part a legacy of traditional grammar. Since the advent of generative grammar, linguists have made considerable progress in the understanding of language. Not surprisingly, the traditional inventory of parts of speech has proven to be sufficient for the analysis of most constructions in English and for a broad range of other languages. Problems that have cropped up with the originally proposed parts of speech have been solved by decomposing them into bundles of binary features, allowing categories to be divided into subcategories and to be grouped into natural classes.

Despite this success, there remains a class of constructions, known as **transcategorial** or simply **mixed category** constructions, which do not fit well with any refinement of the four basic categories. These constructions involve lexical items which seem to be core members of more than one category simultaneously. In this paper I will look at a family of constructions, demonstrated in (1), which raises serious problems for this kind of approach to grammatical categories.

- (1) a. Everyone was impressed by Pat's artful folding of the napkins.
- b. Everyone was impressed by Pat's artfully folding the napkins.
- c. Everyone was impressed by Pat artfully folding the napkins.

Each of these examples involves a slightly different use of the deverbal noun *folding*. The **nominal gerund** use in (1a) is fully nominal and behaves like any other English common noun. The **verbal gerund** uses in (1b) and (1c), however, retain some of their verbal nature. These intermediate uses fall between the two categorial poles and show a mix of nominal and verbal properties which provide a challenge to any syntactic framework that assumes a strict version of X-bar theory.

Several alternatives to the traditional system of parts of speech have been proposed. McCawley (1982) argues for an approach that "... avoids the notion of syntactic category as such, operating instead directly in terms of a number of distinct factors which syntactic phenomena can be sensitive to; in this view, syntactic category names will merely be informal abbreviations for combinations of these factors" (185). A similar approach to categories was taken by Pollard and Sag (1987). In the course of describing Head-driven Phrase Structure Grammar (HPSG), an elaborated theory of syntactic information in terms of feature structures, they observe: "equipped with the notions of head features and subcategorization, we are now in a position to *define* conventional grammatical symbols such as NP, VP,

etc. in terms of feature structures of type sign” (68). They offer the following definition for ‘VP’:

$$(2) \left[ \begin{array}{l} \text{SYN} | \text{LOC} | \text{HEAD} | \text{MAJ } \textit{verb} \\ \text{SUBCAT } \langle \text{NP} \rangle \end{array} \right]$$

This decomposition of a syntactic category into features is quite different from the kind found in most statements of X-bar theory. Rather than making a more fine-grained distinction between categories in a single dimension (say, by adding more head features), (2) defines ‘VP’ in terms of two independently varying dimensions of syntactic information. ‘VP’ is distinguished from ‘V’ directly in terms of selectional saturation rather than indirectly via the interaction of subcategorization, phrase structure rules, and a categorial notion of bar level. And, ‘VP’ is distinguished from ‘NP’ in terms of lexical category (represented by the feature HEAD).

The structure of this paper is as follows. In the first section, I will discuss the properties of verbal gerunds, with particular attention paid to their status as mixed categories. Next, I will review some of the previous proposals offered to account for verbal gerunds. Finally, in the remainder of the papers I will present an analysis of mixed categories in as non-canonical combinations of properties from independent grammatical dimensions.

## 2 PROPERTIES OF VERBAL GERUNDS

### 2.1 *Verbal gerunds as nouns*

The nominal nature of verbal gerunds is shown most clearly by the external distribution of verbal gerund phrases (VGerPs). VGerPs occur in syntactic positions, such the complement of a preposition, that generally only admit NPs. VGerPs can also occur as a clause-internal subject:

- (3) a. I believe that Pat’s/Pat taking a leave of absence bothers you.
- b. Why does Pat’s/Pat taking a leave of absence bother you?
- c. It’s Pat’s/Pat taking a leave of absence that bothers you.

Unlike VGerPs and NPs, finite clauses are prohibited from appearing sentence-internally:

- (4) a. \*I believe that Pat took a leave of absence bothers you.
- b. \*Why does that Pat took a leave of absence bother you?
- c. \*It’s that Pat took a leave of absence that bothers you.

However, VGerPs are subject to no such constraint, as we see in (3). These examples show that, at least with respect to the prohibition against sentence-internal clausal arguments, VGers phrases behave like NPs and not like Ss.

It should be noted that while the distributions of NPs and VGerPs have considerable overlap, they are not identical. There is at least one context which admits VGerPs but not regular NPs. Jørgensen (1981) and Quirk et al. (1985:1230) discuss a class of predicative adjectives which select for an expletive subject and a VGerP complement, as in (5).

- (5) There's no use (you/your) telling him anything.

The fact that the complement's subject can appear in the possessive shows that the complement really is a VGerP and that this is not a case of subject-to-object raising. Examples such as this provide suggestive evidence that VGers form a distinct subtype of noun.

On the other hand, there are contexts which admit 'normal' NPs but not VGerPs. In particular, VGers cannot be possessive specifiers:

- (6) a. Pat's leave of absence's bothering you surprises me.  
b. \*Pat's/Pat taking a leave of absence's bothering you surprises me.

But, as Zwicky and Pullum (1996) observed, only a restricted subclass of what are otherwise clearly NPs can show up as possessives, for example, *this Tuesday* in (7).

- (7) a. This Tuesday is a good day for me.  
b. \*this Tuesday's being a good day for me

So, this suggests that VGers, like the other cases described by Zwicky and Pullum, fall into a "functionally restricted" subclass of nouns that cannot head possessive phrases. This should not be surprising. If VGers are nouns they are clearly non-canonical nouns, it is only natural that they VGerPs would not have the full distribution of more prototypical NPs.

## 2.2 Verbal gerunds as verbs

While the external syntax of verbal gerunds is much like that of NPs, their internal structure is more like that of VPs. For one, verbal gerunds take accusative NP complements, as in (8a), while the common nouns and nominal gerunds can only take a PP complements:

- (8) a. (Pat's/Pat) calling (\*of) the roll started each day.  
b. The calling \*(of) the roll started each day.

Another verb property of VGers is that they take adverbial modifiers, as in (9a). In contrast, true nouns take adjectival modifiers:

- (9) a. Pat disapproved of (me/my) quietly leaving before anyone noticed.
- b. The careful/\*carefully restoration of the painting took six months.

Similarly, VGers can be negated with the particle *not*. But, *not* cannot be used to negate a noun:

- (10) a. Pat's not having bathed for a week disturbed the other diners.
- b. \*The not processing of the election results created a scandal.

These facts have been used to motivate the claim that VGers must be verbs at some level. However, none of the behavior exhibited in (8)-(10) is unique to verbs. Some of the verb-like properties of gerunds are also shared by prepositions, adjectives, and determiners. Verbs, prepositions, adjectives, and VGers take adverbial modifiers, while common nouns take adjectival modifiers, as we see in the examples in (11).

- (11) a. Sandy rarely gets enough sleep.
- b. Sandy lives directly beneath a dance studio.
- c. Sandy's apartment has an insufficiently thick ceiling.
- d. Sandy grumbles about the dancers' nocturnally rehearsing Swan Lake.

Along the same lines, *not* can be used in some circumstances to negate adverbs, adjectives, prepositions, and determiners:

- (12) a. Not surprisingly, the defendant took the Fifth.
- b. The conference will be held in Saarbrücken, not far from the French border.
- c. Not many people who have gone over Niagara Falls live to tell about it.

These facts about modification and negation do not show that verbal gerunds must be verbs. What they show is that verbal gerunds, unlike common nouns, are part of a larger class of expressions which includes verbs.

The complementation facts also do not constitute a strong argument that verbal gerunds must be verbs. Verbs, prepositions and verbal gerunds, unlike common nouns, can take NP complements:

- (13) a. Robin sees the house.
- b. Robin searched behind the house.
- c. Robin's watching the house unnerved the tenants.

On the other hand, some verbs only take PP complements:

- (14) a. \*The strike extended two weeks.
- b. The strike extended through the summer.

What these examples show is that taking adverbial modifiers and NP complements are neither necessary nor sufficient conditions for verbhood. The fact that some verbal gerunds take accusative objects is therefore not especially striking. What is important to take away from these examples is that a verbal gerund, unlike a nominal gerund, takes the same complements as the verb from which it is derived:

- (15)
- a. Chris casually put the roast in the oven.
  - b. Chris's/Chris casually putting the roast in the oven appalled the visiting vegetarians.
  - c. Chris's casual putting of the roast in the oven appalled the visiting vegetarians.

So, what we can say is that a verbal gerund phrase headed by the *-ing* form of a verb has the same internal syntax as a VP headed by a finite form of that same verb.

### 2.3 Subtypes of verbal gerund phrases

The bottom line of the last two sections is given in (16). VGerPs have four basic properties that need to be accounted for:

- (16)
- a. A verbal gerund takes the same complements as the verb from which it is derived.
  - b. Verbal gerunds are modified by adverbs and not by adjectives.
  - c. The entire verbal gerund phrase has the external distribution of an NP.
  - d. The subject of the gerund is optional and, if present, can be either a genitive or an accusative NP.

These properties are shared by accusative subject (ACC-*ing*), genitive subject (POSS-*ing*), and subjectless (PRO-*ing*) VGerPs and are not shared by any other English constructions. The three types of verbal gerunds seem to be subtypes of a single common construction type, and any analysis of verbal gerunds ought to be able account for their similarities in a systematic way.

It is also important to point out, however, that there are differences among the three types which also must be accounted for. Of course, the most obvious difference is the definitional one: the case of the subject. In that respect, the POSS-*ing* VGerPs are more like NPs, while ACC-*ing* VGerPs are more like Ss.

#### 2.3.1 Quantifier scope

Another difference that Abney (1987) discusses relates to the scope possibilities for quantified subjects of verbal gerunds. A quantified expression in the subject of a POSS-*ing* VGerP can take wide scope, while a quantified expression in the subject of an ACC-*ing* VGerP cannot:<sup>1</sup>

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<sup>1</sup>*Every team appearing on television* can take wide scope in (17b) under the alternative and irrelevant reading in which *appearing on television* is a reduced relative clause modifying *team*.

- (17) a. Someone talked about every team's appearing on television.  
 $\exists x \forall y \text{ talk-about}'(x, \text{appear-on-tv}'(y))$   
 $\forall y \exists x \text{ talk-about}'(x, \text{appear-on-tv}'(y))$
- b. Someone talked about every team appearing on television.  
 $\exists x \forall y \text{ talk-about}'(x, \text{appear-on-tv}'(y))$

The same contrast can be seen between NPs and Ss:

- (18) a. Someone talked about every team's television appearance.  
 $\exists x \forall y \text{ talk-about}'(x, \text{appear-on-tv}'(y))$   
 $\forall y \exists x \text{ talk-about}'(x, \text{appear-on-tv}'(y))$
- b. Someone talked about when every team appeared on television.  
 $\exists x \forall y \text{ talk-about}'(x, \text{appear-on-tv}'(y))$

So, quantifier scope potential offers another piece of evidence that ACC-*ing* VGerPs are somehow clause-like, while POSS-*ing* VGerPs are somehow NP-like.

Portner (1992) uses operator scope potential to argue against the view that ACC-*ing* VGerPs are clauses at any level. He observes that while the scope of *not* is sometimes ambiguous in clauses, it is never ambiguous in VGerPs. For example, (19a) has two readings while (19b) allegedly has only one.

- (19) a. Pat is not happy for five minutes each day.  
 $\neg \text{for-five-minutes-each-day}'(\text{happy}'(\text{Pat}'))$   
 $\text{for-five-minutes-each-day}'(\neg \text{happy}'(\text{Pat}'))$
- b. Pat('s) not being happy for five minutes each day. . .  
 $\text{for-five-minutes-each-day}'(\neg \text{happy}'(\text{Pat}'))$

If ACC-*ing* VGerPs are really clauses, one might expect them to show the same scope ambiguities as clauses. Portner attributes the ambiguities seen in the clausal example to the presence of an I(nfl):

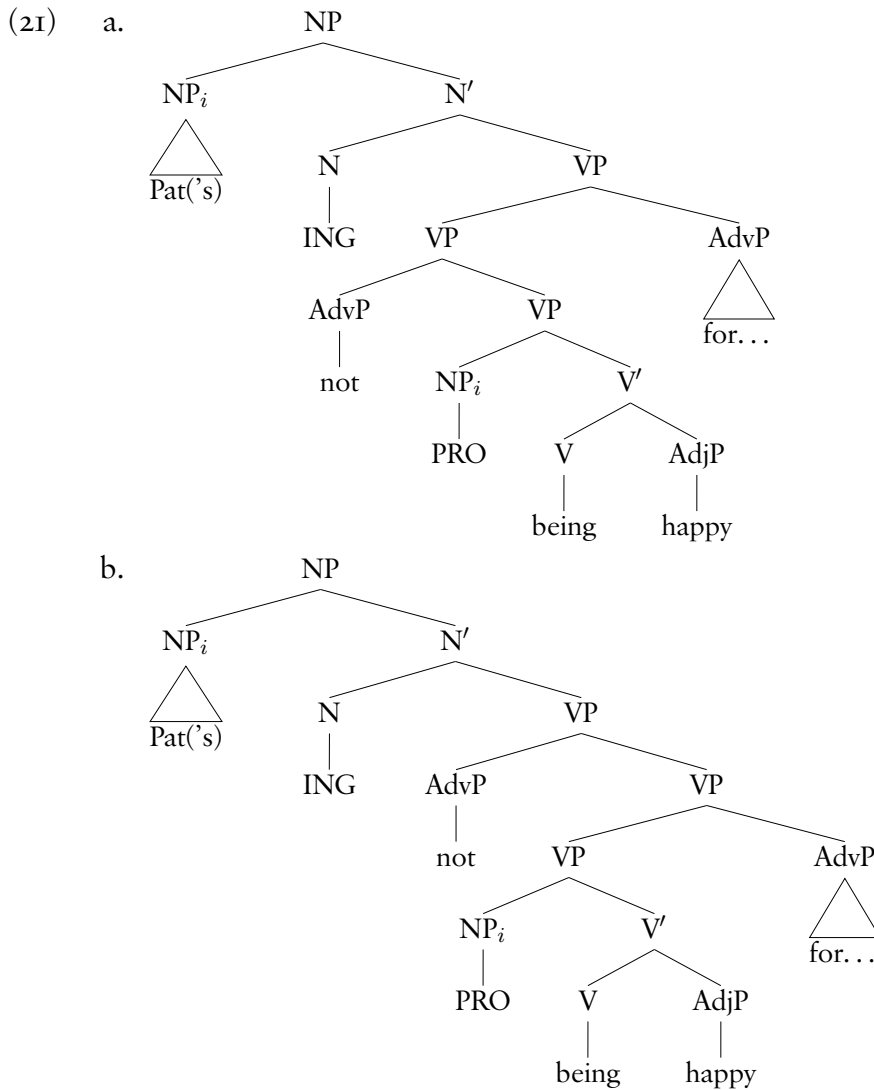
In the derivation of [(19a)], *be* raises from within its VP projection to I. Assuming that both *not* and *for five minutes each day* are adjoined to VP, this will result in the word order seen in [(19a)] as well as a scope ambiguity—based on which is adjoined c-commanding the other—between the negation and the temporal. If the gerund in [(19b)] had the internal structure of clauses. . . there is no reason why its *be* should not be able to undergo the same operation. (94)

So, he concludes, neither ACC-*ing* nor POSS-*ing* VGerPs are nominal clauses and therefore the difference between the two types must be semantic.

One problem with this line of reasoning is empirical. It is not at all clear that negation cannot have wide scope over an adverbial within a VGerP. For example, if we replace the temporal adjunct in (19b) with one containing the negative polarity item *any*, we can force a reading in which *not* has wide scope:

- (20) Pat('s) not being happy at any time [... is a cause for concern.]  
 ¬at-any-time'(happy'(Pat'))

It appears that both kinds of VGerPs allow both scope readings. This might still be a problem for an analysis that depends on ACC-ing VGerPs being clausal and POSS-ing VGerPs being non-clausal. Following Portner's logic, this might be used to argue that *all* VGerPs are clausal. However, as far as I can tell, contrary to the presupposition of this argument, the non-clausal structure ultimately adopted by Portner (1992:96) allows both scope readings. Following Abney (1987), Portner assumes that VGerPs are headed by a phonetically null noun *ING* which selects for a VP[+ing] complement, and the subject of the gerund (whether genitive or accusative) appears as the specifier of *ING*. As the structures in (21) demonstrate, this allows gerunds to show exactly the same structural ambiguity between VP adjuncts as finite clauses show.



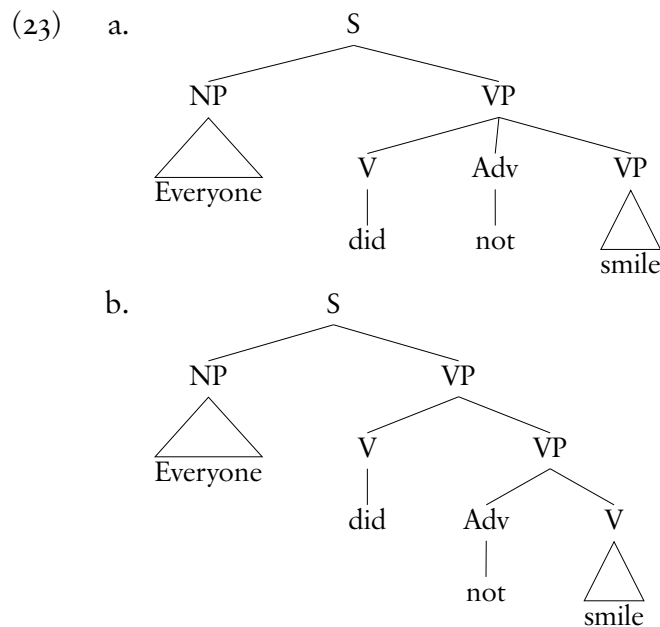
So, the conclusion to reach is that the evidence in (19) has no bearing on the question of whether some gerunds are nominal clauses.

Portner's second argument against treating ACC-*ing* VGerPs as clauses, based on quantifier scope, is potentially more compelling. Portner observes another contrast between clauses and ACC-*ing* VGerPs (and non-contrast between ACC-*ing* and POSS-*ing* VGerPs):

- (22) a. Everyone did not smile.  
 $\neg\forall x \text{ smile}'(x)$   
 $\forall x \neg\text{smile}'(x)$
- b. Everyone('s) not smiling [... bothered Pat.]  
 $\forall x \neg\text{smile}'(x)$

In a finite clause with both the negative particle *not* and a quantifier like *every*, either logical operator can take wide scope over the other. However, in parallel examples of VGerPs, only the quantifier can take wide scope. Portner is somewhat unclear on how the derivation in (22a) works, but he assumes that the reading with wide scope negation crucially depends on the presence of an IP. Either *not* raises at LF to adjoin to IP or *everyone* lowers (via reconstruction) from [Spec, IP] back into the VP and below negation. Since neither of the (b) examples are ambiguous, regardless of the case of the subject, he concludes that gerunds never have an I and are never clausal.

Portner's argument is reasonably sound, given his assumptions about the syntax of negation. However, recent lexical analyses of English negation (Kim 1995, Kim and Sag 1995) offer an alternative account for the ambiguity of (22a) that does not entail Portner's conclusion. Kim and Sag argue that there are two *nots* in English. One is an adverb that negates the non-finite constituent that it appears to the left of, while the other is introduced by lexical rule as a complement of a finite auxiliary verb and negates the whole clause. This is the source of the ambiguity in (22a). Kim and Sag propose the following two structures for (22a):



In (23a), *not* is a complement of *did* and has scope over the entire clause, while in (23b), *not* is adjoined to *smile* and has scope only over the lower VP. In the (19b) and (22b), on the other hand, there is no finite auxiliary and only the adverbial *not* can occur. Kim and Sag further argue that this lexical analysis can better account the properties of English negation and for the differences between English and French than can Pollock's (1989) head movement analysis. So, given Kim and Sag's well-motivated analysis of negation, the absence of ambiguity in these gerund example suggests that they are non-finite but tells us nothing about whether they are clauses.

### 2.3.2 Pied piping

Yet another difference between the two subtypes of gerund phrases with subjects is that POSS-*ing* but not ACC-*ing* VGerPs with WH subjects can front under 'pied piping' in restrictive relative clauses. This is what we see in (24).

- (24) a. Every candidate whose losing the election Chris wrote about sued the newspaper.  
 b. \*Every candidate who(m) losing the election Chris wrote about sued the newspaper.

The same contrast can be seen between NPs and Ss in (25).

- (25) a. Every candidate whose loss Chris wrote about sued the newspaper.  
 b. \*Every candidate for who(m) to lose the election Chris wrote about sued the newspaper.

The same generalizations about pied piping holds for WH questions, as we see in (26) and (27).

- (26) a. Pat wonders whose winning the election Chris wrote about.  
 b. \*Pat wonders who(m) winning the election Chris wrote about?
- (27) a. Pat wonders whose victory Chris predicted.  
 b. \*Pat wonders for whom to win the election Chris expected.

POSS-*ing* VGerPs, like NPs, can appear as the leftmost constituent of a WH question, while ACC-*ing* VGerPs, like clauses, cannot.

While some have taken this as another piece of evidence that ACC-*ing* VGerPs are clauses, Portner (1992) argues against this conclusion by pointing out that ACC-*ing* examples like (24) and (26) are just as bad without pied piping, as shown in (28).

- (28) a. \*Every candidate who(m) Chris wrote about losing the election sued the newspaper.  
 b. \*Who(m) did Chris write about winning the election?

So, he concludes that the ungrammaticality of (24b) has nothing to do with restrictions on pied piping and that the best generalization to account for this data is that ACC-*ing* VGerPs are “generally impossible with subject WH’s” (116). However, this generalization falsely predicts that ACC-*ing* VGerPs with WH subjects should be ungrammatical even in constructions which allow clauses with WH subjects. One such construction is the multiple WH question:

- (29) a. Pat wonders who wrote about whose victory.  
 b. Pat wonders who expected for whom to win the election.

ACC-*ing* VGerPs, like clauses, can in fact occur with WH subjects in multiple WH questions:

- (30) a. Pat wonders who wrote about whose winning the election.  
 b. Pat wonders who wrote about who(m) winning the election.

What this evidence shows is that at some level POSS-*ing* VGerPs have something in common with NPs while ACC-*ing* VGerPs have something in common with clauses.

### 3 PREVIOUS ANALYSES

An ideal analysis of verbal gerunds in English would be able to account for their mixed verbal/nominal properties, summarized in (31), without the addition of otherwise unmotivated mechanisms.

(31)

Verb	Verbal Gerund	Noun
Govern NPs	Govern NPs	Don't govern NPs
Adverbs	Adverbs	Adjectives
<i>Not</i>	<i>Not</i>	Not <i>not</i>
Subjects	Subjects/specifiers	Specifiers
S distribution	NP distribution	NP distribution

Pullum (1991:775ff) makes a specific proposal as to what devices ought to be avoided, setting out three “theoretical desiderata” that any analysis of verbal gerunds should satisfy: strong lexicalism, endocentricity, and null licensing. **Strong lexicalism** is the principle that syntactic operations do not affect the internal structure of words and, conversely, that morphological operations do not apply to syntactic structures. **Endocentricity** is the principle that “EVERY constituent has (at least) one distinguished daughter identified as its head.” **Null-licensing** is a principle intended to restrain the proliferation of phonologically null elements. Pullum proposes that “no phonologically zero constituent should be posited that is neither semantically contentful nor syntactically bound.” In particular, this principle would rule out phonologically null heads.

In addition to Pullum’s proposed virtues, I would suggest a fourth: it is important to show how the properties of verbal gerunds are motivated. Many constructions have properties that are not fully predictable and yet are also not completely arbitrary. We can say that such signs are **motivated**. The standard example of motivation, due to Saussure (1916), is the contrast between French *vingt* ‘twenty’ and *dix-neuf* ‘nineteen’. Both are arbitrary associations of form and meaning, but unlike *vingt*, *dix-neuf* “suggests its own terms and other terms associated with it (e.g., *dix* ‘ten’, *neuf* ‘nine’, *vingt-neuf* ‘twenty-nine’, *dix-huit* ‘eighteen’, *soixante-dix* ‘seventy’, etc.)” (131). Given the linguistic system that it is embedded in (i.e., the grammar of French), the pairing of the form *dix-neuf* with the meaning ‘nineteen’ is not surprising, even if it is not strictly predictable. Likewise, while the properties of mixed categories are not strictly predictable, they are not surprising given the properties of more prototypical nouns and verbs. Any analysis of verbal gerunds should be able to show they fit into the language’s overall system of categories.

### 3.1 Pullum (1991)

Pullum (1991) proposes an analysis of verbal gerunds that exploits the flexibility of the GPSG Head Feature Convention (HFC) to allow V to project an NP under certain circumstances. Pullum starts with the following rule for ordinary possessed NPs:

$$(32) \quad N[\text{BAR}:2] \rightarrow N[\text{BAR}:2, \text{POSS}:+], H[\text{BAR}:1]$$

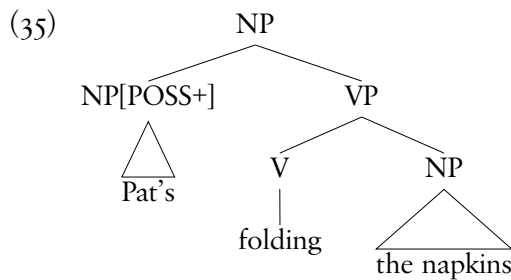
The head of the phrase is only specified for the feature *BAR*. The HFC requires that the mother and the head daughter match on all features, so long as they do not conflict with any “absolute condition on feature specifications” (780). So, for instance, for the rule in (32) this will ensure that the head daughter will match the mother in its major category and that the phrase will be headed by an N. Given this background, Pullum observes that *POSS-ing* VGerPs can be accounted for by introducing a slightly modified version of the previous rule:

$$(33) \quad N[\text{BAR}:2] \rightarrow (N[\text{BAR}:2, \text{POSS}:+]), H[\text{VFORM}:prp]$$

This rule differs from the rule in (32) only in the feature specification on the head daughter: in (33), the head daughter is required to be [*VFORM:prp*]. An independently motivated Feature Co-occurrence Restriction (FCR) given in (34) requires that any phrase with a *VFORM* value must be verbal.

$$(34) \quad [\text{VFORM}] \supset [V:+, N:-]$$

This constraint overrides the HFC, so the rule in (33) will only admit phrases with *-ing* form verb heads. However, the left-hand side of the rule is the same as that of (32), so (33) will give verbal gerund phrases the following structure:



This reflects the traditional description of VGerPs as ‘verbal inside, nominal outside’ quite literally by giving VGerPs a VP node dominated by an NP node. However, Pullum’s analysis only applies to POSS-*ing* VGerPs and has nothing to say about ACC-*ing* VGerPs at all. VGerPs. He suggests that ACC-*ing* and POSS-*ing* VGerPs “must be analyzed quite differently” (766), but by treating them as unrelated constructions, he fails to capture their similarities.

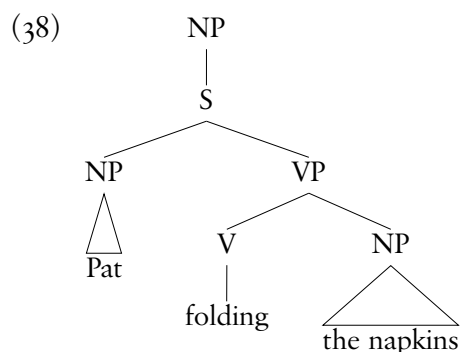
This is not merely a shortcoming of the presentation. There does not seem to be any natural way to assimilate ACC-*ing* VGerPs to Pullum’s analysis. The simplest way to extend (33) to cover ACC-*ing* VGerPs is to add the following rule:

(36) N[BAR:2] → (N[BAR:2]), H[VFORM:prp]

Since the default case for NPs is accusative, this rule will combine an accusative NP with an -*ing* form VP. This rule neatly accounts for the similarities between the two type of verbal gerunds, but not the differences. Following the direction of Hale and Platero’s (1986) proposal for Navajo nominalized clauses, we might try (37) instead.

(37) N[BAR:2] → H[SUBJ:+, VFORM:prp]

The feature SUBJ indicates whether a phrase contains a subject and is used to distinguish VPs from Ss. A VP is a V[BAR:2, SUBJ:-] while an S is V[BAR:2, SUBJ:+]. So, (37) would assign an ACC-*ing* VGerP the structure in (38).



It is plausible that this rule might account for the differences in semantic type and quantifier scope potential between the two types of gerund phrases.<sup>2</sup> This analysis

<sup>2</sup>It is less clear how it can account for the difference in pied-piping, since nothing in the GPSG treatment of relative clauses rules out examples like (25b) (see Pollard and Sag 1994, 214ff).

cannot, however, properly account for PRO-*ing* VGerPs. Since the possessive NP in (33) is optional, it treats PRO-*ing* VGerPs as a subtype of POSS-*ing* VGerPs even though, as we have seen, PRO-*ing* VGerPs have more in common with ACC-*ing* VGerPs. Furthermore, I do not think it is possible to account for the control properties of PRO-*ing* VGerPs in this type of analysis, since the agreement FCR in (39) will block projection of the gerund's AGR value to the top-level NP node.

(39) [AGR]  $\supset$  [V:+, N:-]

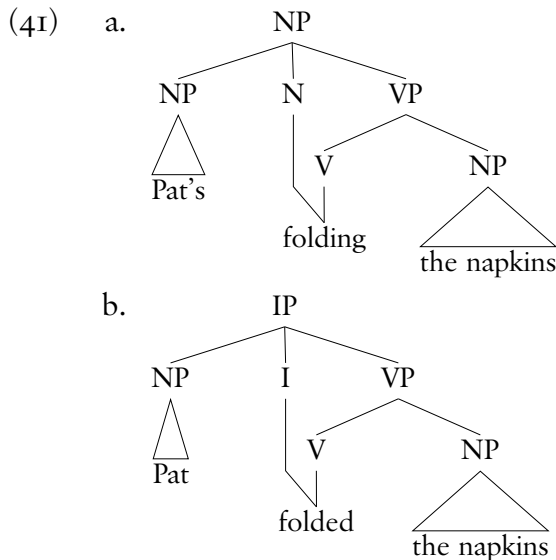
Because complement control is mediated by AGR specifications, there will be no way to capture the parallel behavior of subjectless infinitives and gerunds. Finally, structures like (38) raise doubt as to whether the notion of head embodied by the HFC has any content at all. In this case, the only head specification shared by the mother and the head daughter is [BAR:2], and this match comes about not by the HFC but by the accidental cooperation of the rule in (37) with the FCR in (40).

(40) [+SUBJ]  $\supset$  [V:+, N:-, BAR:2]

I think it is fair to classify (37) as an exocentric rule. So, the only clear way to extend Pullum's analysis to account for ACC-*ing* VGerPs violates one of the theoretical desiderata that are the primary motivators for his analysis in the first place.<sup>3</sup>

### 3.2 *Wescoat (1994)*

Wescoat (1994), on the other hand, proposes to preserve phrasal endocentricity by allowing a single word to project two different unordered lexical categories and therefore two different maximal phrases. He proposes that verbal gerunds have a structure like (41a), parallel to the clause in (41b).

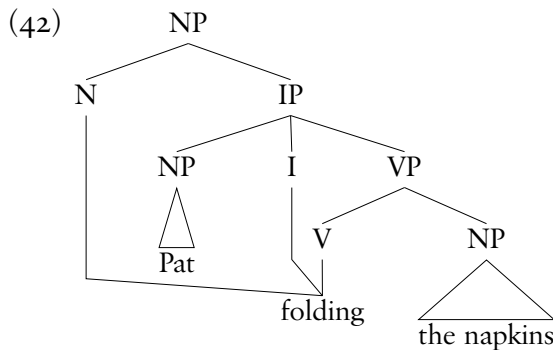


<sup>3</sup>In addition, there are quite general formal problems with the default nature of the GPSG Head Feature Convention (Shieber 1986, Bouma 1993).

In these trees, the N and I nodes, respectively, are **extrasequential**. That is to say, they are unordered with respect to their sisters. This structure preserves syntactic projection, but at the cost of greatly complicating the geometry of the required phrase structure representations in ways that do not seem to be independently motivated (but see Wescoat (1996) for an application of lexical sharing to Hindi noun incorporation).

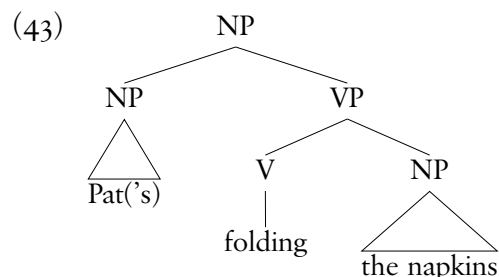
Even assuming Wescoat's formal mechanism can be justified, the analysis shown in (41a) runs into problems with POSS-*ing* VGerPs. In order to account for the non-occurrence of adjectives and determiners with gerunds in Late Modern English, Wescoat adds a stipulation that the N node associated with a gerund must be extrasequential. Since adjectives and determiners must precede the N they attach to, this stipulation prevents them from occurring with gerunds. But, possessors also have to precede the head noun in their NP, so this stipulation should also prevent gerunds from occurring with possessors. Since there is no way an ordering restriction could distinguish between adjectives and determiners on the one hand and possessors on the other, Wescoat has no choice but to treat possessors in POSS-*ing* VGerPs as subjects with unusual case marking, not as specifiers. In so doing, he fails to predict that POSS-*ing* VGerPs, unlike ACC-*ing* VGerPs, share many properties of head/specifier constructions.

On the other hand, Wescoat's approach would extend to cover the ACC-*ing* VGerPs that are problematic for other analyses. A natural variant of (38) using lexical sharing would be:



In this structure, both the N and the I nodes associated with *folding* are extrasequential. This tree seems to be fully consistent with all of Wescoat's phrase structure tree axioms. But, because it is not clear from his discussion how non-categorial features get projected, it is hard to say whether this kind of analysis could account for the differences between the two types of VGerPs. For instance, the contrast in (25) is typically attributed to the fact that projection of WH features is clause-bounded. This is what motivates the introduction of an S node in (38). However, it is not obvious that the introduction of an IP in (42) will prevent any features from projecting from the head *painting* directly to the top-most NP. If the N, I, and V nodes in (42) are really sharing the same lexical token, then the same head features should be projected to the NP, IP, and VP nodes. Otherwise, in what sense are the three leaf nodes 'sharing' the same lexical token? Without further development of these issues, it is hard to evaluate Wescoat's analysis.

Despite their technical differences, these approaches share a common underlying motivation. Very similar proposals have been made by Hale and Platero (1986) for Navajo nominalized clauses, by Aoun (1981) for Arabic participles, by van Riemsdijk (1983) for German adjectives, and by Lefebvre and Muysken (1988) for Quechua gerunds. While these analyses differ greatly in their technical details, they all involve a structure more or less like the tree in (43), and so require weakening the notion of head to allow a single lexical item to head both an NP and a VP simultaneously.<sup>4</sup>



The assumptions underlying (43) are those mentioned above: that the basic categories are N, V, A, and P, and that the properties of a phrase are determined by the lexical category of its head.

In the following sections of this paper I will explore an analysis of verbal gerunds that takes into account the varying sources of syntactic information by exploiting HPSG's fine-grained categorial representations and thus calls into question the assumption underlying analyses involving categorial change-over.

#### 4 THEORETICAL PRELIMINARIES

Recent work in Construction Grammar (Goldberg 1995, Fillmore and Kay in press) and Head-driven Phrase Structure Grammar (Pollard and Sag 1994) provide the basis for an analysis of mixed categories which can account for their hybrid properties without the addition of otherwise unmotivated mechanisms. In this section, I will outline the theoretical devices which will play a role in the analysis.

The basic unit of linguistic structure in HPSG is the **sign**. Signs are "structured complexes of phonological, syntactic, semantic, discourse, and phrase structural information" (Pollard and Sag 1994:15) represented formally by **typed feature structures** (TFSs), as in (44):

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<sup>4</sup>Borsley and Kornflit (this volume) point out that the structure in (43) provides insight into the cross-linguistic distribution of gerunds, while the analysis presented here does not. However, it should be noted that the present analysis is compatible with Croft's (1991) functional explanation for the observed cross-linguistic patterns.

$$(44) \left[ \begin{array}{l} \text{word} \\ \text{PHON} \\ \\ \\ \text{SYNSEM | LOCAL} \\ \\ \\ \text{CONT} \end{array} \left[ \begin{array}{l} \langle \text{book} \rangle \\ \\ \text{CAT} \\ \\ \text{CONT} \end{array} \left[ \begin{array}{l} \text{HEAD} \\ \\ \text{VALENCE} \\ \\ \text{INST} \end{array} \left[ \begin{array}{l} \left[ \begin{array}{l} \text{noun} \\ \text{CASE case} \end{array} \right] \\ \left[ \begin{array}{l} \text{SUBJ } \langle \rangle \\ \text{COMPS } \langle \rangle \\ \text{SPR } \langle \text{DetP} \rangle \end{array} \right] \\ \left[ \begin{array}{l} \text{book-rel} \\ 3\text{sg} \end{array} \right] \end{array} \right] \right] \right]$$

This TFS represents part of the lexical entry for the common noun *book*. A sign consists of a PHON value and a SYNSEM value, a structured complex of syntactic and semantic information.

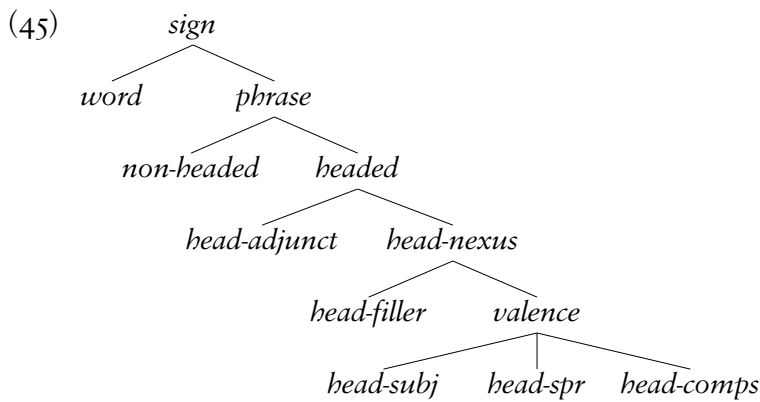
Every linguistic object is represented as a TFS of some type, so linguistic constraints can be represented as constraints of TFSs of a certain type. The grammar of a language is represented as a set of constraints on types of signs. In order to allow generalizations to be stated concisely, linguistic types are arranged into a multiple inheritance **hierarchy**. Each type inherits all the constraints associated with its super-types, with the exception that default information from higher types can be overridden by conflicting information from a more specific type.<sup>5</sup>

In addition to allowing generalizations to be expressed, the type hierarchy also provides a natural characterization of motivation, in the Saussurean sense discussed above. In Construction Grammar, default inheritance is used to give a formal characterization of such system-internal motivation: “A given construction is *motivated* to the degree that its structure is inherited from other constructions in the language... An optimal system is a system that maximizes motivation.” (Goldberg 1995:70) Thus, the type hierarchy reflects the way in which constructions are influenced by their relationships with other constructions with the language and allows what Lakoff (1987) calls the “ecological niche” of a construction within a language to be captured as part of the formal system.

Considerable work in HPSG has focused on examining the hierarchical structure of the lexicon (e.g., Flickinger 1987, Riehemann 1993). More recent research has investigated applying the same methods of hierarchical classification to types of phrasal signs. Expanding on the traditional X-bar theory presented in Pollard and Sag (1994), Sag (in press) develops an analysis of English relative clauses based on a multiple inheritance hierarchy of construction types, where a **construction** is some form-meaning pair whose properties are not predictable either from its component parts or from other constructions in the language.

A relevant part of the basic classification of constructions is given in (45).

<sup>5</sup>The details of default inheritance are not relevant to this paper, but Lascarides et al. (1996) suggest how such a system might be formalized.



Phrases can be divided into two types: endocentric *headed* phrases and exocentric *non-headed* phrases. Since syntactic constraints are stated as constraints on particular types of signs, the Head Feature Principle can be represented as (46), a constraint on all signs of the type *headed*.

(46)

$$\left[ \begin{array}{l} \textit{headed} \\ \text{SYNSEM} \mid \text{CAT} \mid \text{HEAD} \boxed{1} \\ \text{HEAD-DTR} \mid \text{SYNSEM} \mid \text{CAT} \mid \text{HEAD} \boxed{1} \end{array} \right]$$

Headed phrases are also subject to the following constraint on valence features:

(47)

$$\left[ \begin{array}{l} \textit{headed} \\ \text{SYNSEM} \mid \text{CAT} \mid \text{VALENCE} \left[ \begin{array}{l} \text{SUBJ} \quad \boxed{1} - \boxed{2} \\ \text{SPR} \quad \boxed{3} - \boxed{2} \\ \text{COMPS} \boxed{4} - \boxed{2} \end{array} \right] \\ \text{HEAD-DTR} \mid \text{SYNSEM} \mid \text{CAT} \mid \text{VALENCE} \left[ \begin{array}{l} \text{SUBJ} \quad \boxed{1} \\ \text{SPR} \quad \boxed{3} \\ \text{COMPS} \boxed{4} \end{array} \right] \\ \text{NON-HEAD-DTR} \mid \text{SYNSEM} \boxed{2} \end{array} \right]$$

This constraint ensures that undischarged valence requirements get propagated from the head of a phrase. In the case of, say, a head/modifier phrase, the non-head daughter  $\boxed{2}$  will not be a member of the SUBJ, SPR, or COMPS value of the head, and so the valence values will be passed up unchanged. In the case of, say, a head/complement phrase,  $\boxed{2}$  will be on the head's COMPS list  $\boxed{4}$ , so the mother's COMPS value is the head's COMPS value minus the discharged complement.

Headed phrases are further divided into *head-adjunct* phrases and *head-nexus* phrases. Head/nexus phrases are phrases which discharge some grammatical dependency, either a subcategorization requirement (*valence*) or the SLASH value of an unbounded dependency construction (*head-filler*). Finally, *valence* phrases can be subtyped according to the kind of subcategorization dependency they discharge: subject, specifier, or complement. For example, head/specifier constructions obey the constraint in (48).

$$(48) \left[ \begin{array}{l} \textit{head-spr} \\ \text{HEAD-DTR} | \text{SYNSEM} | \text{CAT} | \text{VALENCE} | \text{SPR} \boxed{1} \\ \text{NON-HEAD-DTR} | \text{SYNSEM} \boxed{1} \end{array} \right]$$

In addition, constructions inherit constraints from the cross-cutting classification of phrases into either *clauses* or *non-clauses*. Among other things, clauses are subject to the following constraint (further constraints on clauses will be discussed in §5.2):

$$(49) \left[ \begin{array}{l} \textit{clause} \\ \text{SYNSEM} | \text{LOCAL} \left[ \begin{array}{l} \text{CAT} | \text{VALENCE} | \text{SUBJ list}(\textit{PRO}) \\ \text{CONT } \textit{psoa} \end{array} \right] \end{array} \right]$$

This constraint states that the `SUBJ` list of a clause must be a list of zero or more *PRO* objects. This ensures that either the clause contains an overt subject (and so the `SUBJ` list is empty) or the unexpressed subject (e.g., in control constructions) is *PRO*, a special type of `SYNSEM` object that at minimum specifies accusative case and pronominal semantics (either *ppro* or *refl*). Note that this *PRO* is quite unlike the homonomous empty category of Chomsky and Lasnik (1977). Its purpose is only to put constraints on the argument structure of a verb in a control structure, and it does not correspond to a phonologically unrealized position in the phrase structure. In addition, the constraint in (49) restricts the semantic type of their content: the `CONT` value of a clause must be a *psoa* object (i.e., a proposition).

These two hierarchies define a set of constraints on phrasal signs. A syntactic construction is a meaningful recurrent bundle of such constraints. One way to think of constructions is as the syntactic equivalent of what in the lexical domain would be called morphemes. In terms of the theory of phrasal types presented here, a construction is a phrasal sign type that inherits from both the *phrase* hierarchy and the *clause* hierarchy. Since a construction licenses a type of complex sign, it must include information about how both the form and the meaning are assembled from the form and the meaning of its component parts. A construction may inherit some aspects of its meaning from its supertypes. In contrast to the strictly head-driven view of semantics presented by Pollard and Sag (1994), a construction may also have idiosyncratic meaning associated with it.

Some of the basic constructions of English are shown in Figure 1. The *fin-head-subj-cx* and the *nonfin-head-subj-cx* constructions combine a subcategorized for subject with a finite and non-finite head, respectively. The finite version, for normal English sentences like *They walk* requires a nominative subject. The non-finite version, for ‘minor’ sentence types like absolutes or Mad magazine sentences (Lambrecht 1990), requires an accusative subject. The *noun-poss-cx* construction combines a noun head with a determiner or possessive specifier to form a phrase with a *nom-obj* (i.e., an index bearing unit) as the `CONT` value. To be more precise, the construction type *noun-poss-cx* is subject to the following constraint:

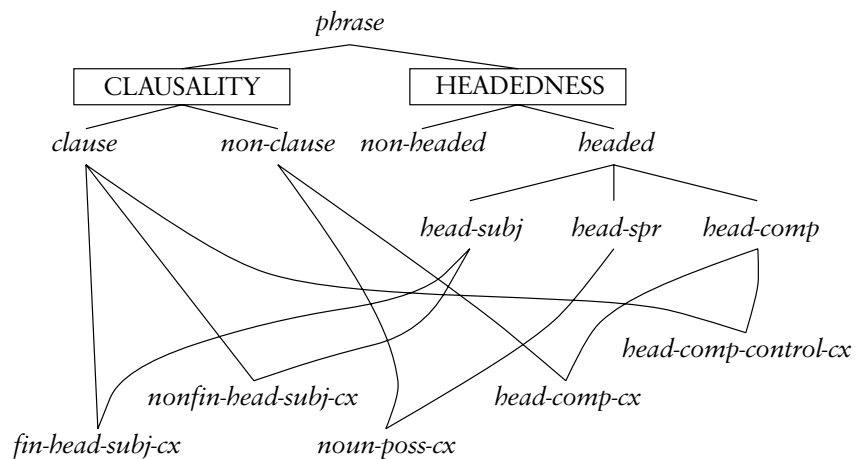
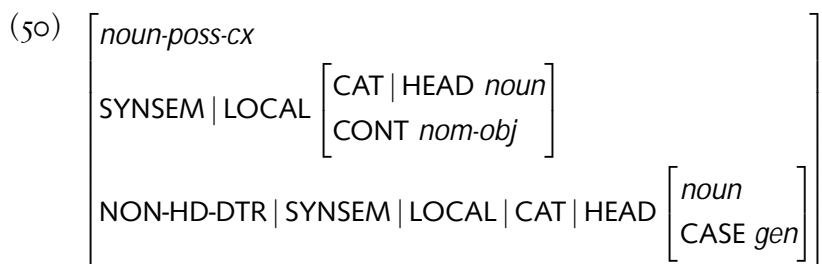


Figure 1: English construction types



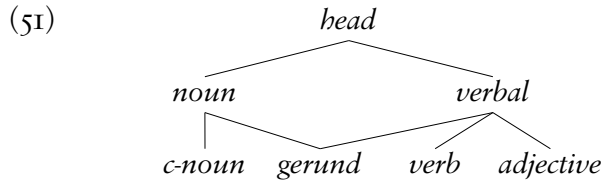
The two head/complement constructions both combine a head with its selected for complements, but differ as to whether the resulting phrase can function as a clause and is subject to constraint in (49).

## 5 A NEW ANALYSIS OF VERBAL GERUNDS

Words in HPSG select for arguments of a particular category. Therefore, categorial information, projected from the lexical head following the Head Feature Principle, determines the external distribution of a phrase. Selectional information, from a lexical head's valence features, determines what kinds of other phrases can occur in construction with that head. Finally, constructional information, represented as constraints on particular constructions, controls the combination of syntactic units. Within each of these three domains, verbal gerund phrases show fairly consistent behavior. What is unusual about verbal gerunds is their combination of noun-like categorial properties with verb-like selectional properties.

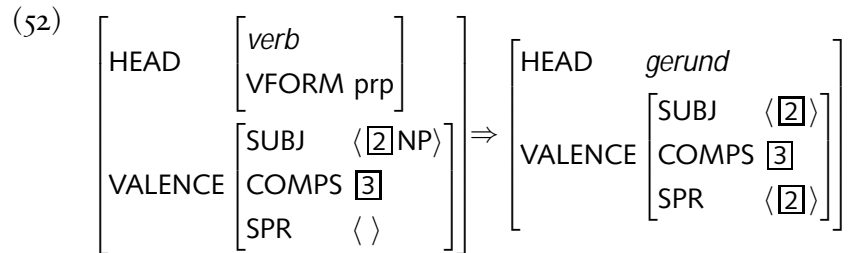
Given the theoretical background of the previous section, we can account for the mixed nominal and verbal properties of verbal gerunds that seem puzzling given many standard assumptions about syntactic structure. The categorial properties of verbal gerunds are determined by their lexically specified head value. Like all other linguistic objects, types of head values can be arranged into a multiple

inheritance type hierarchy expressing the generalizations across categories. The distribution of verbal gerunds can be accounted for by the (partial) hierarchy of head values in (51).



Since *gerund* is a subtype of *noun*, a phrase projected by a gerund will be able to occur anywhere an NP is selected for. Thus, phrases projected by verbal gerunds will have the external distribution of NPs. Adverbs modify objects of category *verbal*, which include verbs, adjectives, and verbal gerunds, among other things. Since adjectives only modify *c(ommon)-nouns*, VGerPs will contain adverbial rather than adjectival modifiers. This cross-classification directly reflects the traditional view of gerunds as intermediate between nouns and verbs. In this respect, it is nothing new: in the second century BC Dionysius Thrax analyzed the Greek participle as a “separate part of speech which ‘... partakes of the nature of verbs and nouns’” (Michael 1970:75). But, by formalizing this intuitive view as a cross-classification of HEAD values, we can localize the idiosyncratic behavior of verbal gerunds to the lexicon.

The position of *gerund* in this hierarchy of head values provides an immediate account of the facts in (16b) and (16c). The remaining two gerund properties in (16) can be accounted for most simply by the lexical rule in (52).



This rule produces a lexical entry for a verbal gerund from the present participle form of the verb. The verbal gerund differs syntactically from the participle in two ways: it is of category *gerund* and it selects for both a specifier and a subject. Since a verbal gerund selects for the same complements as the verb it is derived from, the phrase formed by a verbal gerund and its complements will look like a VP. And, since a gerund selects for both a subject and a specifier, it will be eligible to head either a *nonfin-head-subj-cx* construction, which combines a head with an accusative NP subject, or a *noun-poss-cx* construction, which combines a head with a genitive NP specifier. POSS-*ing* VGerPs will inherit all the constraints that apply to possessive constructions in general, for example, the restrictions on the specifier NP and on pied piping. Since the subject and specifier are identified with each other, no verbal gerund will be able to combine with both a subject and a specifier. The combination of properties created by the lexical rule is unusual

for English, but the properties themselves are all inherited from more basic types. This mixture of verbal and nominal characteristics reflects the verbal gerund's intermediate position between nouns and verbs in the hierarchy of categories.

### 5.1 Some examples

To see how these constraints interact to account for the syntax of verbal gerunds, it will be useful to consider an example of each type. First, consider the (partial) lexical entry for the present participle of the verb *fold*, in (53).

(53)

PHON	<i>&lt;folding&gt;</i>																								
SYNSEM   LOCAL	<table style="border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding-right: 10px; vertical-align: middle;">CAT</td> <td style="padding-left: 10px;"> <table style="border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">HEAD</td> <td style="padding-left: 10px;"> <table style="border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding-right: 10px;"><i>verb</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">VFORM</td> <td style="padding-left: 10px;">prp</td> </tr> </table> </td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">ARG-ST</td> <td style="padding-left: 10px;"><i>&lt;[1], [2]&gt;</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">VALENCE</td> <td style="padding-left: 10px;"> <table style="border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">SUBJ</td> <td style="padding-left: 10px;"><i>&lt;[1] NP<sub>[3]</sub>&gt;</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">COMPS</td> <td style="padding-left: 10px;"><i>&lt;[2] NP<sub>[4]</sub>&gt;</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">SPR</td> <td style="padding-left: 10px;"><i>&lt;&gt;</i></td> </tr> </table> </td> </tr> </table> </td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px; vertical-align: middle;">CONT</td> <td style="padding-left: 10px;"> <table style="border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding-right: 10px;"><i>fold-rel</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">ACTOR</td> <td style="padding-left: 10px;"><i>[3]</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">UNDERGOER</td> <td style="padding-left: 10px;"><i>[4]</i></td> </tr> </table> </td> </tr> </table>	CAT	<table style="border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">HEAD</td> <td style="padding-left: 10px;"> <table style="border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding-right: 10px;"><i>verb</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">VFORM</td> <td style="padding-left: 10px;">prp</td> </tr> </table> </td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">ARG-ST</td> <td style="padding-left: 10px;"><i>&lt;[1], [2]&gt;</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">VALENCE</td> <td style="padding-left: 10px;"> <table style="border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">SUBJ</td> <td style="padding-left: 10px;"><i>&lt;[1] NP<sub>[3]</sub>&gt;</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">COMPS</td> <td style="padding-left: 10px;"><i>&lt;[2] NP<sub>[4]</sub>&gt;</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">SPR</td> <td style="padding-left: 10px;"><i>&lt;&gt;</i></td> </tr> </table> </td> </tr> </table>	HEAD	<table style="border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding-right: 10px;"><i>verb</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">VFORM</td> <td style="padding-left: 10px;">prp</td> </tr> </table>	<i>verb</i>	VFORM	prp	ARG-ST	<i>&lt;[1], [2]&gt;</i>	VALENCE	<table style="border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">SUBJ</td> <td style="padding-left: 10px;"><i>&lt;[1] NP<sub>[3]</sub>&gt;</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">COMPS</td> <td style="padding-left: 10px;"><i>&lt;[2] NP<sub>[4]</sub>&gt;</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">SPR</td> <td style="padding-left: 10px;"><i>&lt;&gt;</i></td> </tr> </table>	SUBJ	<i>&lt;[1] NP<sub>[3]</sub>&gt;</i>	COMPS	<i>&lt;[2] NP<sub>[4]</sub>&gt;</i>	SPR	<i>&lt;&gt;</i>	CONT	<table style="border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding-right: 10px;"><i>fold-rel</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">ACTOR</td> <td style="padding-left: 10px;"><i>[3]</i></td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 10px;">UNDERGOER</td> <td style="padding-left: 10px;"><i>[4]</i></td> </tr> </table>	<i>fold-rel</i>	ACTOR	<i>[3]</i>	UNDERGOER	<i>[4]</i>
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From this lexical entry, the Verbal Gerund Lexical Rule produces the corresponding entry in (54).

(54)

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The two entries differ only in the shaded features. The output of the lexical rule is of category *gerund*, rather than *verb*, and the gerund selects for both a subject and a specifier. All other information about the verb gets carried over from the input to the lexical rule.

Now we turn to the constructions which this gerund is eligible to head. We will look at two cases: POSS-*ing* VGerPs and ACC-*ing* VGerPs. First we will look at

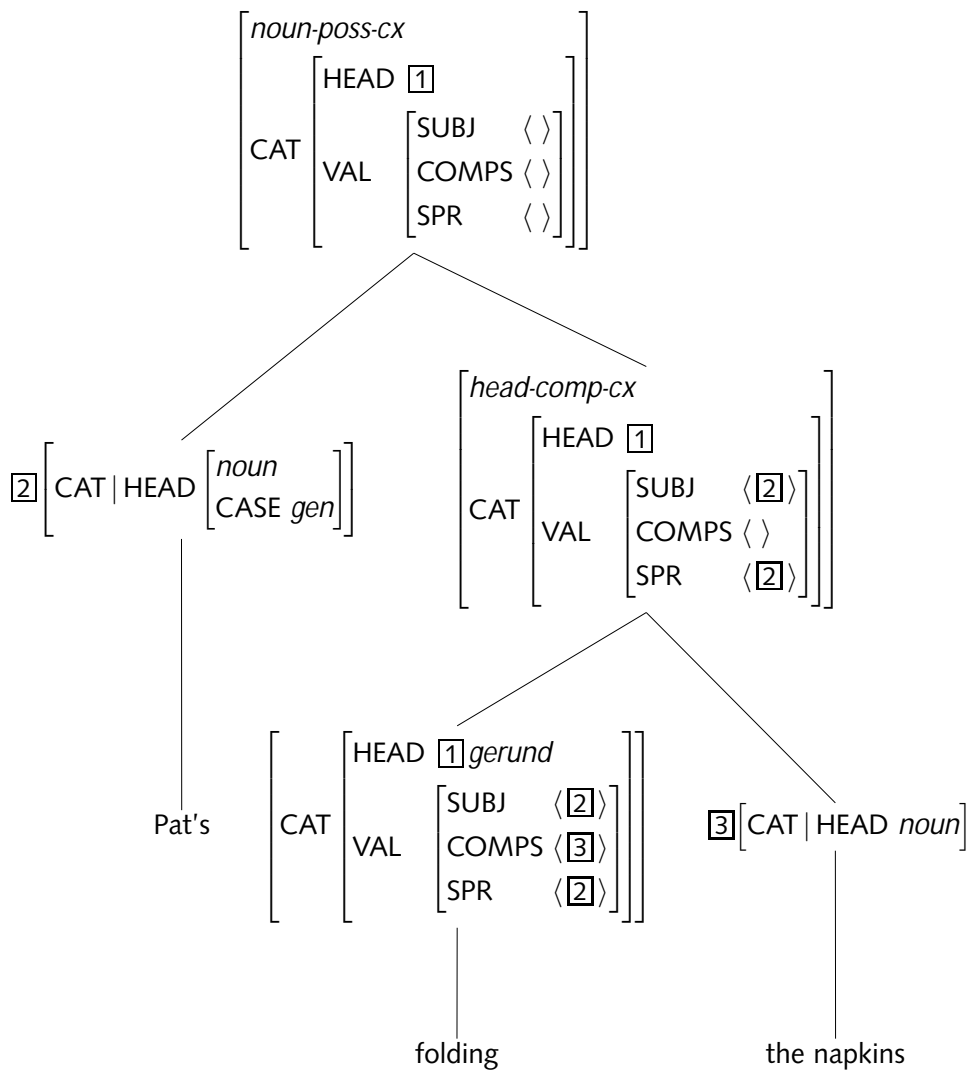


Figure 2: *Pat's folding the napkins*

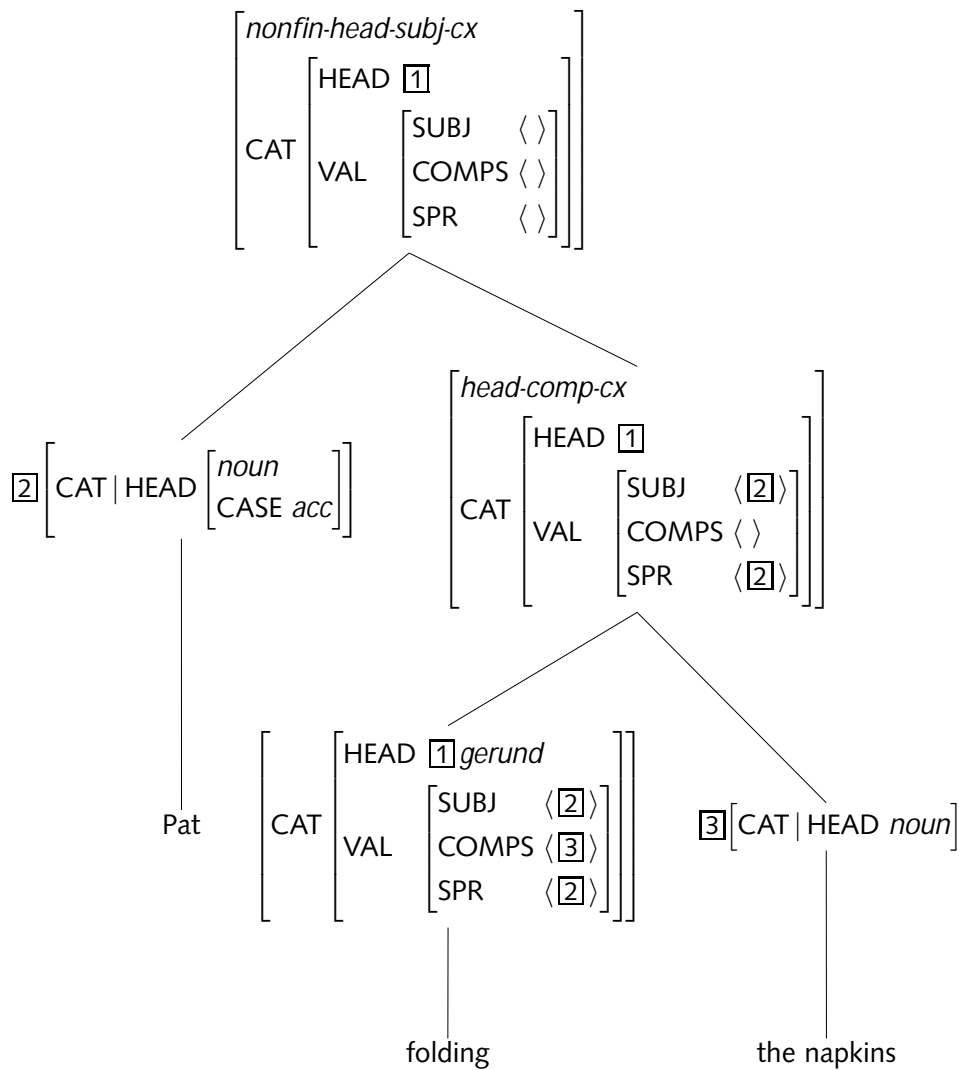


Figure 3: *Pat folding the napkins*

the structure of the phrase *Pat's folding the napkins*, shown in Figure 2. The head of this phrase, *folding*, is a verbal gerund formed by the lexical rule in (52). It combines with its complement NP (marked  $\boxed{3}$ ) via the *head-comp-cx* construction. It then combines with a genitive specifier to form a *noun-poss-cx* construction. Note that the formulation of the Valence Principle in (47) allows *Pat's* to satisfy both the subject and the specifier requirement of the gerund simultaneously. However, since the construction this phrase is an instance of is a sub-type of *head-spr*, *Pat's* will only have the properties of specifier.

An equivalent example with an accusative subject is given in Figure 3, for the phrase *Pat folding the napkins*. This example differs from the previous example only in the way the subject combines with the head. The *nonfin-head-subj-cx* combines a non-finite head with an accusative subject. As before, *Pat* cancels both the subject and the specifier requirement of the head, but in this case it will have

only subject properties.

## 5.2 *Pied piping*

The pied piping contrast between *ACC-ing* and *POSS-ing* VGerPs also follows from the fact that the former are clauses while the latter are not. To show how this result is achieved, I will first sketch the HPSG treatment of pied piping developed by Pollard and Sag (1994), Sag (in press) and Sag and Ginzburg (1996). The basic fact that needs to be accounted for is shown in (55).

- (55) a. Who failed the exam?  
 b. Whose roommate's brother's neighbor failed the exam?

In a WH question, the left-most constituent must contain a WH word, but that WH word can be embedded arbitrarily deep. This dependency is encoded by the non-local feature *QUE*. Question words are marked with a non-empty value for the *QUE*, whose value is a set of generalized quantifiers. WH words also introduce an interrogative quantifier in the semantics, which gets assigned scope by a constraint-based version of Cooper storage (Cooper 1983, Pollard and Sag 1994).

Take a sentence like (55a). This is an instance of the construction *wh-subj-inter-cl*, which combines a subject and a head to form an interrogative clause. This construction is subject to the constraint in (56).

$$(56) \left[ \begin{array}{l} wh\text{-}inter\text{-}cl \\ \text{SYNSEM} \mid \text{LOCAL} \mid \text{CONT} \mid \text{QUANTS} \langle \dots, \boxed{1}, \dots \rangle \\ \text{NON-HD-DTR} \mid \text{SYNSEM} \mid \text{NON-LOCAL} \left[ \begin{array}{l} \text{REL} \{ \} \\ \text{QUE} \{ \boxed{1} \} \end{array} \right] \end{array} \right]$$

This constraint requires that the subject have somewhere inside it a WH word which contributes an interrogative quantifier. The presence of a WH word is indicated by the phrase's non-empty *QUE* value. The WH word can be anywhere inside the subject, so long as its *QUE* value is passed up to the top of the phrase. This quantifier then gets retrieved from the quantifier store and is given scope at the level of the interrogative clause.

The interrogative word *who* is optionally specified for a non-empty *QUE* value, as in (57).

$$(57) \left[ \begin{array}{l} \text{SYNSEM} \left[ \begin{array}{l} \text{LOCAL} \left[ \begin{array}{l} \text{CAT} \left[ \text{HEAD } noun \right] \\ \text{CONT} \boxed{1} [ \text{which}(\boxed{2}) \mid \text{person}(\boxed{2}) ] \end{array} \right] \\ \text{NON-LOCAL} \left[ \begin{array}{l} \text{REL} \{ \} \\ \text{QUE} \{ (\boxed{1}) \} \end{array} \right] \end{array} \right] \end{array} \right]$$

In addition, the lexical entries for all lexical heads obey the Non-local Amalgamation Principle in (58).

(58) For each non-local feature  $\mathbf{f}$ ,

$$\left[ \begin{array}{l} \text{SYNSEM} \left[ \begin{array}{l} \text{LOCAL} \left[ \text{CAT} \mid \text{ARG-ST} \left\langle \left[ \mathbf{f} \sigma_1 \right], \dots, \left[ \mathbf{f} \sigma_n \right] \right\rangle \right] \\ \text{NON-LOCAL} \left[ \mathbf{f} \sigma_1 \uplus \dots \uplus \sigma_n \right] \end{array} \right] \end{array} \right]$$

This constraint ensures that the QUE value of a head is the union of the QUE values of its arguments. These lexical constraints cause the force the head of any phrase that contains a governed WH word to have a non-empty QUE value reflecting that fact.

Next, the REL-QUE Inheritance Constraint, in (59), ensures that the value of QUE gets passed from the head daughter to the mother.

$$(59) \left[ \begin{array}{l} \text{head-nexus} \\ \text{SYNSEM} \mid \text{NON-LOCAL} \left[ \begin{array}{l} \text{REL} \boxed{1} \\ \text{QUE} \boxed{2} \end{array} \right] \\ \text{HEAD-DTR} \mid \text{SYNSEM} \mid \text{NON-LOCAL} \left[ \begin{array}{l} \text{REL} \boxed{1} \\ \text{QUE} \boxed{2} \end{array} \right] \end{array} \right]$$

This is a default constraint. Constructions that bind off a REL or QUE value rather than passing it up will override (59) with a more specific constraint. Finally, to guarantee that only questions contain interrogative words, clauses are subject to the constraint in (60).

$$(60) \left[ \begin{array}{l} \text{clause} \\ \text{SYNSEM} \mid \text{NON-LOCAL} \left[ \begin{array}{l} \text{REL} \{ \} \\ \text{QUE} \{ \} \end{array} \right] \end{array} \right]$$

This requires all clauses to have an empty QUE values. This means that any QUE value introduced by the lexical entry of an interrogative word must be bound off by an appropriate interrogative construction, ruling out declarative sentences like *Chris flunked which student*. REL and QUE binding is specified for particular relative and interrogative clause types. For instance, WH subject interrogative construction obeys the following constraint:

$$(61) \left[ \begin{array}{l} \text{wh-subj-inter-cl} \\ \text{HD-DTR} \mid \text{SYNSEM} \mid \text{NON-LOCAL} \mid \text{QUE} \{ \boxed{2} \} \\ \text{NON-HD-DTR} \mid \text{SYNSEM} \mid \text{NON-LOCAL} \mid \text{QUE} \{ \boxed{2} \} \end{array} \right]$$

This constraint conflicts with and overrides (59), so the non-empty QUE value does not percolate any higher than the interrogative clause.

These constraints provide a completely general, head-driven account of pied piping in both relative clauses and questions. Consider first the non-gerund examples in (62).

- (62) a. Whose failure was expected?  
 b. \*For whom to fail was expected?

In (62a), *failure* will take on the non-empty QUE value of its specifier *whose*. The constraint in (59) passes the QUE value of *failure* (that is, an interrogative quantifier *whose*) up to the entire phrase *whose failure*. The WH subject interrogative clause construction forms the interrogative clause *whose failure was expected?* A similar chain of identities passes up the QUE value of *whom* in (62b) to the clause *for whom to fail*. But, this violates (60), and the example is ruled out.

Now it should be clear how this theory of pied piping carries over to the verbal gerund examples in (63).

- (63) a. I wonder whose failing the exam surprised the instructor.  
 b. \*I wonder who(m) failing the exam surprised the instructor.

The structure of these examples is given in Figure 4. In (63a), *failing* picks up the QUE value of *whose* and passes it up to the phrase *whose failing the exam*. Since this is an example of a POSS-*ing* VGerP, a type of *noun-poss-cx* construction, it is not subject to (60). In (63b), though, the subject of the question is a non-finite head/subject clause, which by (60) must have an empty QUE value. This conflicts with both the constraints on QUE percolation and with (56), and the sentence is ungrammatical. The difference between POSS-*ing* and ACC-*ing* VGerPs with respect to pied piping follows directly from independently motivated constraints on constructions types. Any analysis which treats the subject case alternation as essentially free variation would be hard pressed to account for this difference without further stipulations.

By adapting Ginzburg's (1992) theory of interrogatives to Sag's (in press) analysis of pied piping, we can also account for the behavior of VGerPs in multiple WH questions. For multiple WH questions, Ginzburg (1992:331) suggests "the need for syntactic distinctions between forms that are, intuitively, interrogative syntactically and semantically and forms that are declarative syntactically, but have interrogative contents." In a multiple WH question, WH words which are left-most in their clause (either as subjects or as fillers) have both interrogative syntax and interrogative semantics. They pass up a non-empty QUE value in exactly the same way as in ordinary WH questions. WH words which are not clause initial, on the other hand, have only interrogative semantics. While they introduce an interrogative quantifier into the quantifier store, they have an empty QUE value. This is what accounts for the non-contrast in (64).

- (64) a. I wonder who was surprised by whose failing the exam.  
 b. I wonder who was surprised by who failing the exam.

The structures of (64) is given Figure 5. Note that I have assumed Pollard and Yoo's (1996) head-driven QSTORE collection here, but I have crucially *not* adopted their analysis of multiple WH questions. Unlike (63b), (64b) does not run afoul of (60), the

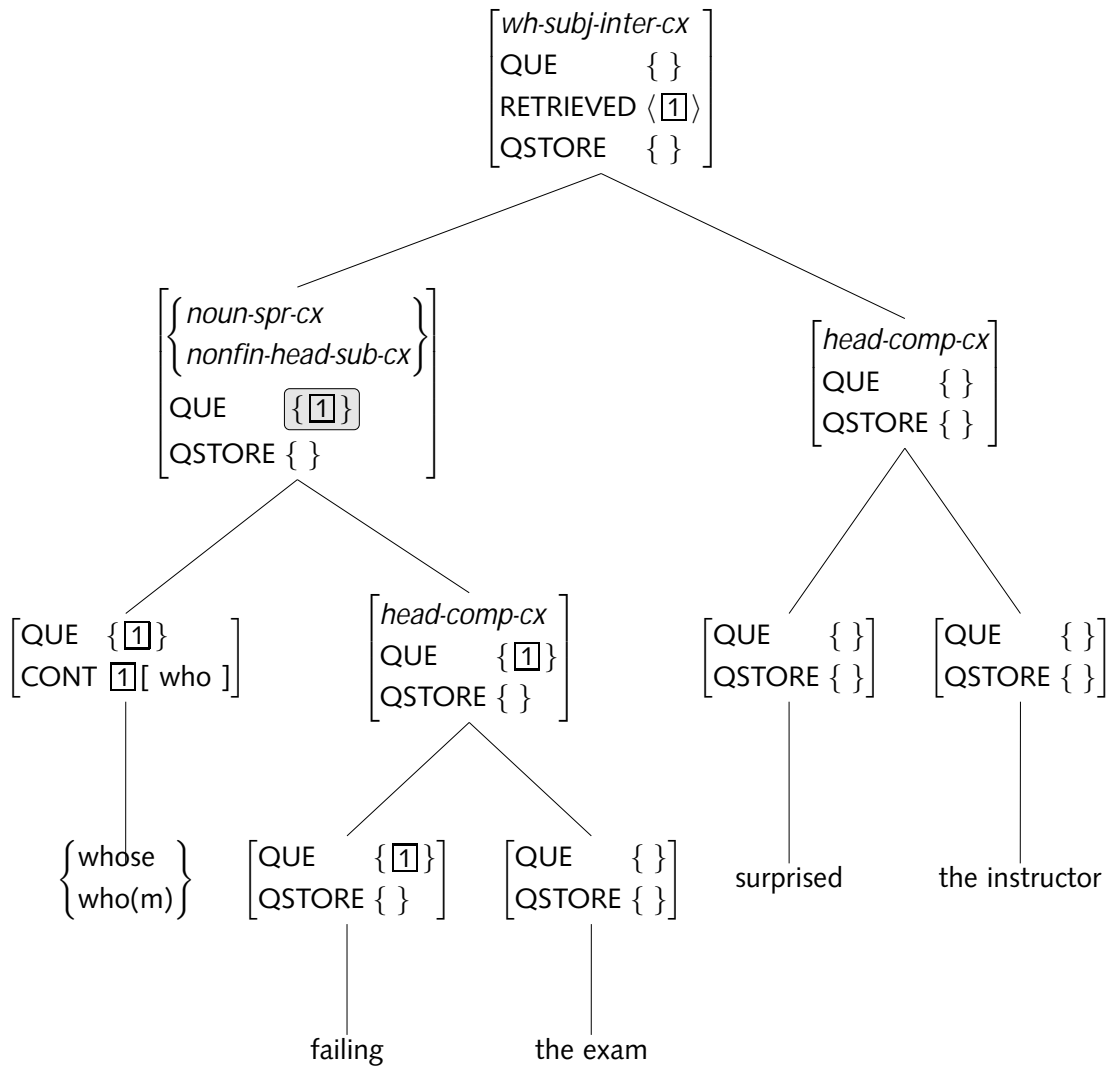


Figure 4: *whose/\*whom failing the exam surprised the instructor?*

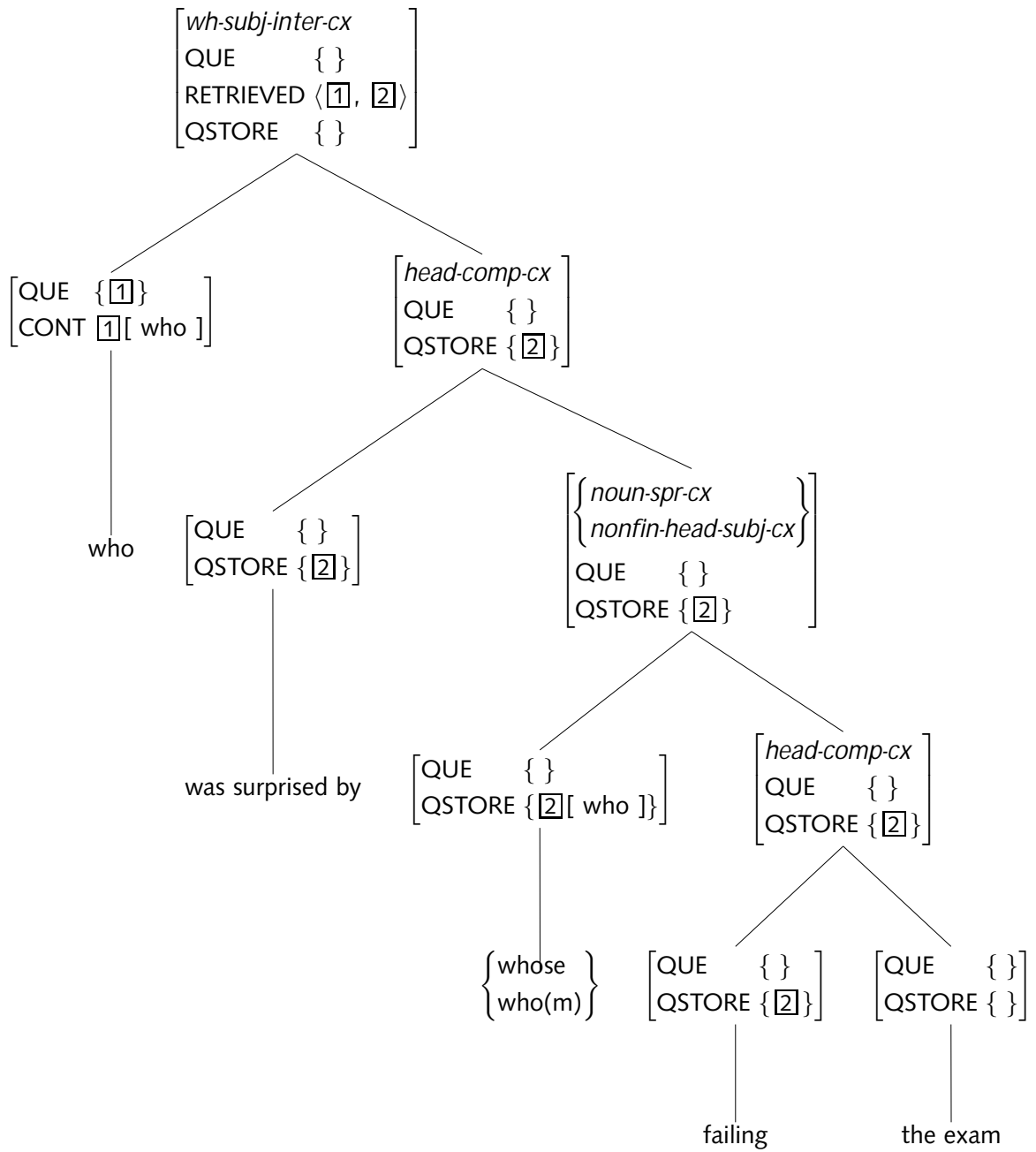


Figure 5: *Who was surprised by whose/whom failing the exam?*

constraint requiring clauses to have empty QUE values. Since the ACC-ing VGerP *who failing the exam* appears in situ, it is only interrogative semantically and its QUE value is empty. No constraints prohibit an interrogative quantifier from being passed up via the quantifier storage mechanism and so both (64a) and (64b) are grammatical.

## 6 CONCLUSION

The constructions that combine a verbal gerund with its complements and its subject or specifier are the same constructions used for building NPs, VPs, and clauses. This reflects the traditional view that VGerPs are built out of pieces of syntax ‘reused’ from other parts of the grammar. In one sense, under this analysis a verbal gerund together with its complements really is like V-bar. Both are instances of the same construction type and both are subject to any constraints associated with that construction. In the same way, a verbal gerund plus an accusative subject really do form a clause, while a verbal gerund plus a genitive subject really do form an NP. So, these two types of VGerPs inherit the constraints on semantic type and pied piping associated with the construction type of which they are an instance. However, in a more important sense, a verbal gerund plus its complements forms a VGer-bar, which combines with an accusative or genitive subject to form a VGerP. The analysis presented here allows this similarity to be captured without weakening HPSG’s strong notion of endocentricity.

By exploiting HPSG’s hierarchical classification of category types and its inventory of elaborated phrase structure rules, we are able to account for the mixed behavior of English verbal gerunds without adding any additional theoretical mechanisms or weakening any basic assumptions. The analysis presented here does not require syntactic word formation and thus preserves lexical integrity. It also does not require any phonologically null elements of abstract structure, and it allows us to maintain the strong notion of endocentricity embodied by the HPSG Head Feature Principle. Finally, by making crucial reference to syntactic constructions, this analysis allows us to capture on the one hand the similarities among the sub-types of VGerPs and on the other their similarities to other English phrase types.

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