GOSSE BOUMA, FRANK VAN EYNDE AND DAN FLICKINGER

CONSTRAINT-BASED LEXICA

1. INTRODUCTION

As the field of generative linguistics has developed, the lexicon has taken on an increasingly important role in the description of both idiosyncratic and regular properties of language. Always viewed as a natural home for exceptions, the lexicon was given relatively little work in the early years of transformational grammar. Then Chomsky proposed in 1970 (Chomsky, 1970) that similarities in the structure of deverbal noun phrases and sentences could be expressed in terms of a lexical relationship between the verb and its nominalization. Jackendoff (1975) characterized further lexical regularities in both morphology and semantics, and Bresnan (1976, 1982) pioneered the development of a syntactic framework (Lexical Functional Grammar) in which central grammatical phenomena such as passivization could be explained within the lexicon. A parallel line of work by Gazdar (1981) called Generalized Phrase Structure Grammar sought to provide a nontransformational syntactic framework, by employing metarules over a context-free grammar. Gazdar et al. (1985) constrained the power of those metarules by restricting them to lexically-headed phrase structure rules. Pollard and Sag (1987, 1994) built on the work in GPSG, outlining the more radically lexicalist framework of Head-driven Phrase Structure Grammar (HPSG), abandoning construction-specific phrase structure rules in favor of a small number of rule schemata interacting with a more richly articulated lexicon to capture relevant syntactic generalizations. As a well-known and widely used constraint-based grammar formalism[1] HPSG will serve us well in this chapter by providing a precise linguistic framework within which we can organize the relevant data and examine the technical devices available for analysis of that data. For those who are not familiar with the notation, we first provide a brief introduction to this framework.

[1] Much of the current research in HPSG is being carried out in connection with computer-based implementations that provide valuable testbeds for the formal analyses being developed. A good collection of these implementations can be found at the following URL: http://ling.ohio-state.edu/HPSG/Implementation.html

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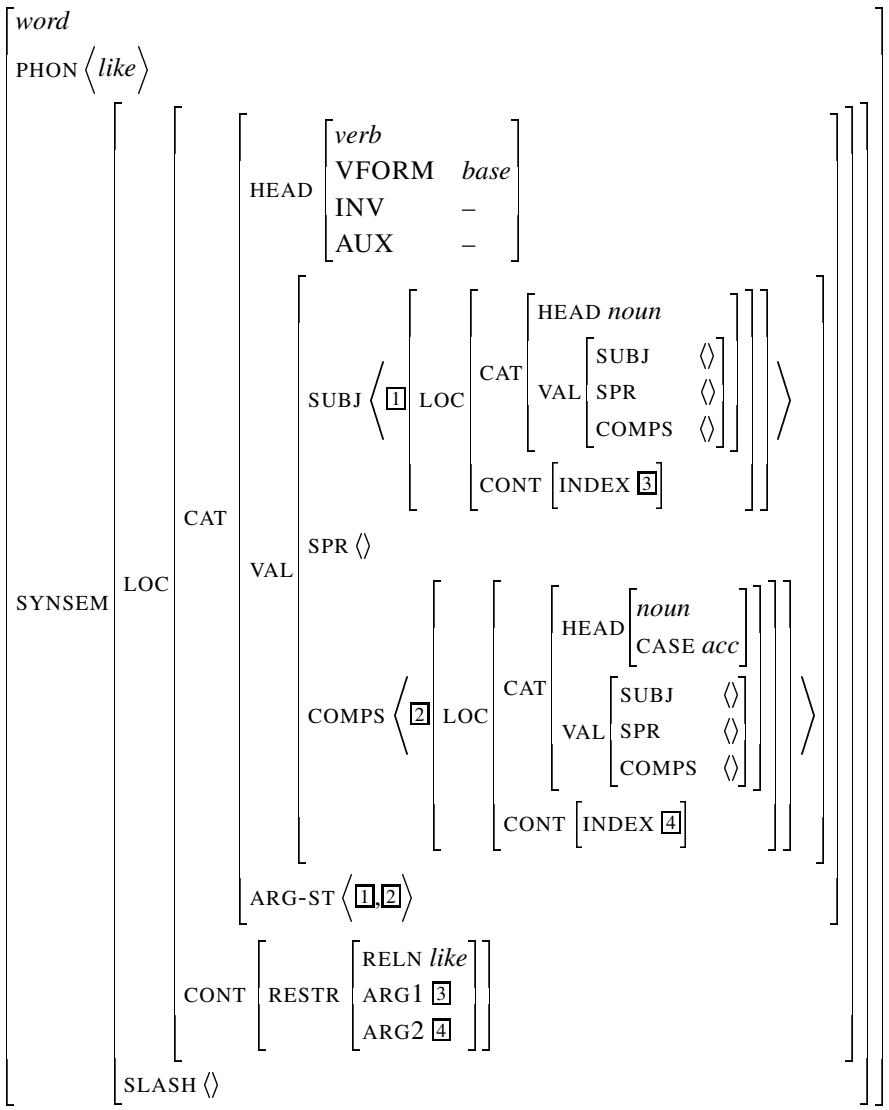


Figure 1. HPSG sign for *like*

As noted above, the constraints in such a lexical entry interact closely with those of the phrase structure schemata, exemplified by the Head-Subject rule schema shown in Figure 2, which combines a head such as a verb phrase with its subject.

Like lexical signs, phrasal signs contain a SYNSEM attribute which describes the mother node of the phrase; in addition, phrases introduce attributes

of this chapter much more abbreviated feature structures (AVMs) will be used, selecting only certain attributes of interest, and often suppressing outer attributes where the intention is clear. For a more complete presentation of the notation and the underlying HPSG framework, see Pollard and Sag (1994).

1.2. *Capturing lexical regularities*

A central challenge in a lexicalist framework like HPSG is to develop strategies for eliminating the massive redundancy present in fully specified lexical entries. Some aspects of this redundancy have always been recognized as properly lexical, such as the inflected forms of verbs and nouns, as well as words derived from other words by affixation. But other sources of redundancy in the lexicon, while motivated linguistically, are more specific to work in the HPSG framework, including modern treatments of unbounded dependencies (extraction phenomena) and argument attraction in verb clusters.

In addition to the explanatory benefits to the theory of grammar afforded by the elimination of redundancy in the lexicon, there are also significant practical benefits for the developer of an implementation of the grammar. Hand-coding of fully-specified lexical entries would be a difficult and time-consuming task, one prone to human error. Moreover, maintenance of such a redundant, detailed lexicon would prove to be difficult if not impossible, often requiring consistent adjustments to dozens or hundreds of entries.

To capture the lexical regularities found in inflection, derivation, and valence alternation, linguists have proposed a number of technical devices within constraint-based frameworks. The simplest of these is known as *underspecification*, where an attribute is given as its value a less specific type T, to indicate that any of the (more specific) subtypes of T can unify with that attribute's value. For example, a verb like *say*, which subcategorizes for a sentential complement, underspecifies that complement's attribute AUX to be *boolean*, thus accepting clauses headed either by auxiliary verbs ([AUX *plus*]) or by main verbs ([AUX *minus*]).

In addition to underspecification, standard HPSG offers two primary means of expressing the sharing of properties or constraints in the lexicon: one is the use of types arranged in inheritance hierarchies, presented in section 2; and the other is the specification of lexical rules which relate pairs of lexical entries, presented in section 3. In more recent work, a third means of capturing lexical regularities has emerged, employing relational constraints on types; these are presented in section 4. Having introduced the various methods for capturing lexical regularities, we then apply them in section 5 to the analysis of English subject-auxiliary inversion.

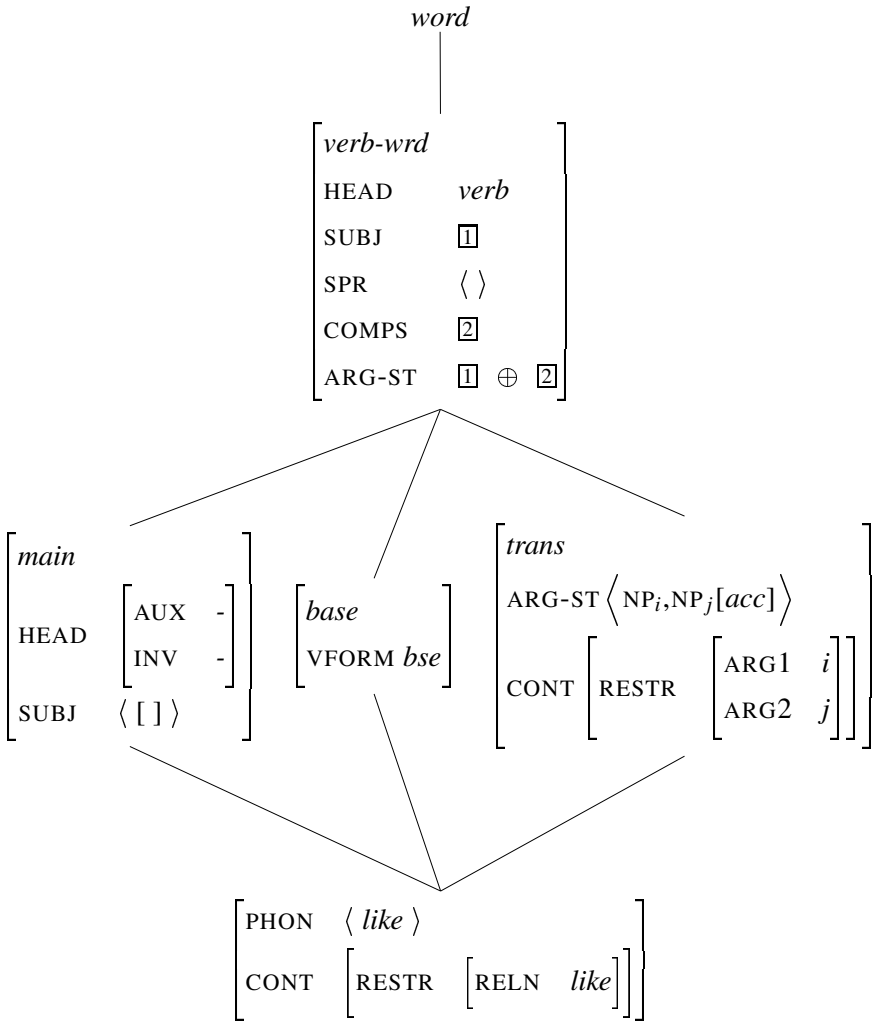


Figure 3. Fragment of the verbal inheritance hierarchy

and semantics is arbitrary, and cannot be predicted from general properties of the language.

A more complete picture of the lexical hierarchy would typically contain several other frames, such as *noun-wrd*, *determiner-wrd*, *adjective-wrd*, etc., which also inherit directly from *word*. Furthermore, next to *main*, there would be a frame *aux*, several frames for other verb forms and a (large) number of alternative frames for the various subcategorization types.

There are certain regularities within the hierarchy which are not made ex-

constraints which refer to deeply embedded parts of an AVM, it is convenient to assume a formal framework in which types may be the antecedent of implicational constraints. For instance, the information expressed by the frame *main* in Figure 3 may be expressed as an implicational constraint for the type *main*.

(2) *main* → [SYNSEM [LOC [CAT [HEAD [*verb* ; INV - ; AUX -] ; VAL [SUBJ ⟨ [ ] ⟩]]]]]

This implication states that every AVM of type *main* also has to satisfy the constraint on the right-hand side of the arrow.[4]

One of the reasons why inheritance is such a powerful tool is the fact that it can be extended with a notion of nonmonotonicity. Nonmonotonic inheritance means that if class C_2 with property P_2 inherits from class C_1 with property P_1, where P_1 and P_2 are incompatible, inheritance of the conflicting information from P_1 is blocked. Thus, the property P_1 is only a default for classes inheriting from C_1, as it may be suppressed on subclasses by providing a conflicting property. The classical example involves birds and penguins. Birds have the property that they can fly. Penguins are birds, but cannot fly. The *cannot-fly* property suppresses the *fly* property in this case, even though **penguin** is a subclass of **bird**.

Nonmonotonicity appears to be a natural requirement for constraint-based, hierarchical lexica. One of the typical properties of generalizations about lexical items is that they have exceptions. This is true in particular of derivational and inflectional morphology, but may hold for other dimensions of grammatical information as well.[5] For instance, English verbs in general take an ordinary NP as subject. If one includes such a property in the definition of **verb**, however, 'weather'-verbs such as *rain* must be treated as exceptions as they take only expletive NP's as subject. Also, *subject raising* verbs are exceptional, as the question whether they select an ordinary NP or an expletive as subject depends on the restrictions imposed by the verb heading their VP-complement. Proposals for nonmonotonic extensions of constraint-based grammars can be found in Bouma (1992), Carpenter (1992c), and Lascarides et al. (1996). Most implemented systems restrict themselves to monotonic

[4] See Götz and Meurers (1997) for discussion.

[5] See Thomason (1997) for a recent overview.

Regular instances of derivational morphology can be captured with lexical rules similar to those used to account for inflectional morphology. Sag and Wasow (1997), for example, present the following lexical rule for agent-nominalization (*run-runner*).

$$(4)\quad \left[\begin{array}{ll} \textit{verb} & \\ \text{PHON} & \boxed{1} \\ \text{ARG-ST} & \left\langle \text{NP}_i\ ,.. \right\rangle \\ \text{CONT} & \left[\text{RESTR} \left[\text{AGENT} \quad i\right]\right] \end{array}\right] \Rightarrow \left[\begin{array}{ll} \textit{noun} & \\ \text{PHON} & f_{er}(\boxed{1}) \\ \text{CONT} & \left[\text{INDEX} \quad i\right] \end{array}\right]$$

Agent-nominalization takes as input a verb, and produces a noun. The function f_{er} attaches the suffix *-er* to the stem of the verb. The index of the agent role of the verb is token-identical to the index of the corresponding noun.

3.2. *Valence Alternation*

Apart from inflection and derivation, there is a third class of lexical rules to be found in the literature, usually referred to as valence alternation rules. These rules are used to account for the fact that some word classes appear systematically with different, but related, subcategorization requirements. One way to think about valence alternation rules is as a special kind of derivational rules: they produce derived lexical entries, but the morphophonological effects are limited (i.e. often the phonological form of the input and output is identical, in some cases the relationship follows an inflectional paradigm).

Following a proposal in Pollard and Sag (1994; pp 145 ff.), one might account for the extraposition of the subject clause in (5b) by means of the lexical rule in (6).

(5) a. That I do not know his favourite recipes bothers me.

b. It bothers me that I do not know his favourite recipes.

$$(6)\quad \left[\begin{array}{ll} \text{SUBJ} & \left\langle \text{S}[\textit{comp}] \right\rangle \\ \text{COMPS} & \boxed{1} \end{array}\right] \Rightarrow \left[\begin{array}{ll} \text{SUBJ} & \left\langle \text{NP}[\textit{it}] \right\rangle \\ \text{COMPS} & \boxed{1} \oplus \left\langle \text{S}[\textit{comp}] \right\rangle \end{array}\right]$$

This rule removes an element from COMPS, while adding the local features of the removed element to SLASH. This accounts for the fact that *read* in (10a) selects for an object complement, whereas *read* in (10b) instead introduces a *slashed*-category, which will licence the initial WH-phrase *which book*.

(10) a. Kim believes Sandy has read the book.

b. Which book does Kim believe Sandy has read?

Following a proposal in Miller (1992), a number of authors (van Noord and Bouma, 1994; Manning et al., 1997; Kim and Sag, 1995) have also proposed a lexical rule which allows heads to select for their adjuncts. The proposed lexical rule adds adjuncts to the COMPS list of verbs. One of the striking aspects of such a rule is that it must be able to apply to its own output (as a verb may combine with more than a single adjunct).

3.3. *Formal and Computational Aspects*

One problematic aspect of lexical rules is that they are heavily underspecified. Roughly speaking, the input specification of a lexical rule contains information specifying to which lexical entries the rule applies (i.e. passive applies to [VFORM *bse*] lexical entries). The output specification contains the information which holds for the output, but not for the input (i.e. the result of passive is [VFORM *passp*]). The interpretation of such linguistic rule specifications is that all information in the input which is not mentioned in the output specification (i.e. for which the output specification does not provide explicit information) is to be included in the result of applying the rule to a given lexical entry. A different way of expressing this is that, by default, information in the input is assumed to be included in the output. Proposals for a formalization of the kind of default mechanism this would require can be found in Bouma (1992) and Lascarides et al. (1996).

A rather different solution to solving the default copying problem is implicit in attempts to integrate lexical rules with the hierarchical approach to the lexicon. In the approach of Flickinger et al. (1985) lexical rules relate frames to frames. The lexical rule for passive, for instance, takes as input a lexical entry inheriting from *base* and *transitive*, and has as output an entry which inherits from *passive*. The value of PHON, the valence features, and the semantics of the output are defined explicitly in terms of the input. All other information relevant to the output, but not idiosyncratic to the specific entry to which the rule applies, is added to the output by means of *inheritance* (i.e. from frames that are supertypes of *passive*) and *not copied* between input and output.

procedural, transformational flavour of lexical rules, it is not surprising that several authors have argued for approaches in which the use of lexical rules is kept at a minimum, or even completely eliminated. All of these proposals have in common that they make use of implicational constraints and relations to constrain the value of certain features.

4. Alternatives for Lexical Rules

Constraint-based grammar formalisms have in general been very successful in eliminating those parts of linguistic theory which are difficult to understand in declarative terms. In syntax, for instance, declarative alternatives for transformations, feature percolation mechanisms, or indexing operations are included in practically every constraint-based grammar formalism. Constraint-based approaches to phonology (Bird, 1995; Mastroianni and Carpenter, 1994) have proven that the notion of a phonological rule as applying to one representation and producing another, is superfluous in a system where (possibly complex) constraints apply to (underspecified) phonological representations. Computational semantics, finally, has shown that rules for quantifier storage and retrieval can be eliminated in a formalism using underspecified semantic representations and constraints (Alshawi, 1992; Copestake et al., 1997). There are several proposals in the literature in which constraint-based alternatives for lexical rules are developed. These are reviewed below.

4.1. *Constraint-based approaches to inflection*

Kathol (1994) and Krieger and Nerbonne (1993) outline an approach to inflection in which the phonological form of an inflected word is defined by means of a relational constraint (Kathol) or distributed disjunction (Krieger and Nerbonne) defined on PHON and the relevant agreement features. For instance, Kathol presents the following definition of adjectives in German:

(11) *adj-word* $\rightarrow$ $\begin{bmatrix} \text{PHON} & \boxed{3} \\ \text{STEM} & \boxed{1} \\ \text{HEAD} & \begin{bmatrix} \text{INFL} & \boxed{2} \end{bmatrix} \end{bmatrix} \wedge r_{adj}(\boxed{1},\boxed{2},\boxed{3})$

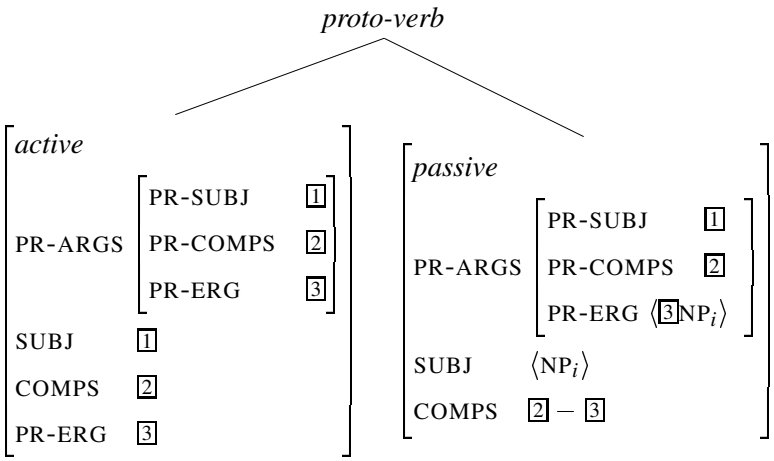
This implicational constraint states that all AVM's of type *adj-word* must satisfy the r_{adj} relation, which is a relation between the values of STEM (the uninflected stem form of an adjective), INFL (a bundle of inflectional features), and PHON (the inflected form of the adjective). The definition of r_{adj} is basically a table, containing entries such as the following:

The constraint-based approach sees inflection as a constraint, which will instantiate the value of PHON relative to a set of agreement features, or, alternatively, constrains the possible values for the agreement features relative to a given PHON value. The difference between this approach and the lexical rule-based one sketched in section 3 is that no rule-application is involved, and thus thorny issues such as the relationship between input and output, or order of rule-application, do not arise. Another advantage of this approach is that it is immediately compatible with a hierarchical approach to the lexicon, whereas the interaction of inheritance and lexical rules is much more complicated.

4.2. *Valence Alternation*

Kathol (1994) considers an analysis of (adjectival) passive where both the active and passive forms of a verb are instances of a *proto-verb*, which contains the information common to both. A *proto-verb* has subsorts for active and passive, in which the values for PROTO-SUBJ and PROTO-COMPS have been linked in appropriate ways to the values for SUBJ and COMPS respectively.

(15)



The type for *passive* identifies the ergative argument object of transitive verbs with the actual subject. The proto-ergative argument corresponds to the (proto-)object of transitive verbs, and to the proto-subject of unaccusative verbs, and thus this subtype generalizes over both personal and impersonal passives. If the ergative argument is the (proto)-object, it will be a member of PR-COMPS, but not of COMPS. This account of passive covers both personal and impersonal passives.

The use of *proto* attributes is reminiscent of the use of a feature such as STEM, ROOT or MORPH-BASE, whose value is a full-blown feature struc-

5. A Case Study : Subject-Auxiliary Inversion

In the previous sections, we have presented and compared various methods for capturing lexical generalizations. For concreteness' sake they have been exemplified with treatments of inflection, derivation and valence alternation, but –overall– the emphasis was on the formal and computational properties of the different methods. In this section we take another –complementary– perspective. Starting from a specific phenomenon, i.e. Subject-Auxiliary Inversion in English, we present three ways in which the relevant lexical generalizations can be captured and evaluate them with respect to their empirical adequacy. The three methods are underspecification, lexical rules and constraint-based inheritance. Although we will plead in favour of the latter, we do not want to suggest that this choice is always the most appropriate one. The purpose of this section is not to show that one or another method is inherently superior to the other ones, but rather to argue that the choice between them is not only a matter of taste or of formal considerations, but also of empirical adequacy. As a background for the discussion we first sketch the HPSG treatment of the English auxiliaries.

5.1. *The English Auxiliaries*

Following a tradition which goes back to Ross (1969) and Pullum and Wilson (1977), HPSG treats the English auxiliaries as complement taking verbs. The auxiliary of the perfect, for instance, is analysed as a verb which takes a participial VP as its complement and a nominative NP as its subject (Figure 4).[9]

The auxiliary forms a *head-complement* phrase with the participial VP and the resulting finite VP forms a *head-subject* phrase with the pronoun. The fact that the subject of the auxiliary is understood as the subject of its participial complement is made explicit in its valence features: the first (and only) member of the auxiliary's SUBJ list is identical to the one (and only) member of the SUBJ list of its VP complement. In this respect, perfect *have* is similar to other subject raising verbs, such as *tend* and *seem*.[10] What makes the auxiliaries special, though, is their particular behavior with respect to

[9] The representation only mentions the head and valence features. For reasons of perspicuity we have adopted a tree style notation, using the PHON values as the leaves, but –if necessary– this can be converted straightforwardly into the more ornate AVM notation, which was adopted in Figure 2.

[10] The subject raising treatment is appropriate for most of the English auxiliaries, but not for all. The British stative *have*, for instance, as in *He has no money*, is a plain transitive verb. Other exceptions are discussed in Van Eynde (1998; p. 213-4).

(18) a. Down came the rain.

b. In the corner stood a black arm chair.

A syntactic characteristic of stylistic inversion is that it concerns the entire VP. As a consequence, if the verb has any complements or adjuncts, these dependents precede the subject as well.

(19) a. Into the room strode solemnly the men I had been waiting for.

b. *Into the room strode the men I had been waiting for solemnly.

Subject-Aux inversion, on the other hand, only concerns the verb, so that its complements and/or adjuncts follow the subject. In other words, while the subject is clause final in stylistic inversion, it is not in the case of Subject-Aux inversion (modulo ellipsis).

A second qualification concerns the form of the auxiliaries. In order to be invertible, the auxiliary has to be tensed or subjunctive: nonfinite forms and imperatives—with the exception of *don't*—cannot be involved in Subject-Aux inversion. For the sake of concreteness, Figure 5 gives a survey of the relevant forms.

The table only mentions the forms with [+AUX] uses. This explains the absence of *dares*, *needs* and *needed*, which are invariably used as main verbs, and hence non-invertible.

The contracted negatives are listed separately, since they are autonomous lexical units: neither their forms nor their meanings can be derived compositionally from the ones of the auxiliary and the negation marker *not*, as demonstrated at length in Zwicky and Pullum (1983). Some of the contracted negatives are rarely used, especially in American English; they have been put between square brackets.

Of the subjunctive forms, the one of the copula is certainly invertible.

(20) That is pretty much the kind of foreign policy the next President, be he Clinton or Dole, will provide. (TIME, 11/4/96, p.47)

The auxiliary *have* has also got a separate form for the subjunctive, but it is used so rarely that we have only found some non-inverted uses, as in

(21) Chapter 10 restates a general overview, lest it have been lost in the intervening furor. (Jackendoff 1977, p.27)

We assume, though, that the inverted use of this form is—in principle—not impossible. The auxiliary *do*, on the other hand, does not occur in the subjunctive: this form only exists for the transitive main verb *do*.

and *have* show the typical [−AUX] property of requiring DO support in case of emphasis and negation.

Having defined in more precise terms what Subject-Aux Inversion involves, we can now address the question of its analysis.

Since HPSG is a monostratal framework, it does not make use of any movement transformations: there is, for instance, no operation which moves the auxiliary from a canonical d-structure position to a pre-subject s-structure position, as in GB. Instead, there is only one stratum of syntactic representation, and the order of the words in that representation corresponds to the surface word order. As a consequence, the inverted constructions are not derived from their non-inverted counterparts, but generated as they are. The task of spelling out what they have in common is left to the lexicon, especially to the AVMs of the invertible auxiliaries. How this can be modeled will be discussed in some detail in the rest of this section.

5.2. *Underspecification*

A good example of an underspecification analysis is the one of Pollard and Sag (1994, 40-43); in order to model inverted constructions they employ a phrase type in which the verb simultaneously combines with its subject and its complements (Figure 6).

While the structure is rather different from the one of the non-inverted clause,[11] the AVM of the auxiliary is not: the only difference concerns the value of its INV feature. As a consequence, if the value of this feature is left underspecified, it is possible to capture both the inverted and non-inverted uses of the auxiliary in terms of one AVM. Which value it takes in a specific context is determined by the properties of the phrase in which it appears: in a phrase of type *head-subject-complements*, for instance, the value of INV has to be *plus*, whereas in phrases of type *head-subject* and *head-complements* it has to be *minus*. This treatment also provides a straightforward way to prevent the inversion of the non-invertibles; if they are assigned a negative INV value, they will not be accepted as heads of a *head-subj-comps* phrase.

In spite of its elegance, though, this analysis cannot be maintained as it is, since it ignores the fact that the auxiliaries do not always have the same syntactic and semantic properties in their [+INV] and [−INV] uses. Some examples of such discrepancies are discussed in Gazdar et al. (1982). One concerns the contracted negative *aren't*, which is compatible with the first person singular in its [+INV] use, but not in its [−INV] use.

[11] On the reasons for assigning a flat [Verb-NP-XP] structure rather than a binary one, such as [Verb-[NP-XP]] or [[Verb-NP]-XP], see Gazdar et al. (1985, p. 73).

(26) a. Mustn't I go?

b. He mustn't leave now.

While the most natural interpretation of [+INV] *mustn't* is the one with wide scope negation, as in the paraphrase *Isn't it the case that I must go?* (Palmer 1987, p. 127), its [–INV] counterpart can only have narrow scope negation. Yet another verb of this type is deontic *shouldn't*, which has narrow scope negation in its [–INV] use, and wide scope negation in its [+INV] use (Palmer 1987, p. 133).

In the words of Gazdar et al. (1982, p. 611): "Contrasts of this sort are exactly what one is led to expect once the lexicon distinguishes [+INV] and [–INV] forms." For the underspecification approach, such contrasts are an obvious problem, since they demonstrate that the AVMs of the [+INV] and [–INV] auxiliaries must be kept distinct.

5.3. *Valence alternation by lexical rule*

A treatment which postulates distinct AVMs for the [–INV] and [+INV] auxiliaries is the one which makes use of a lexical rule. For the sake of exposition, let us take the one of Warner (1993, pp. 83-5).[12]

$$[\text{+AUX, +FIN, –BSE, SUBJ} \left\langle \boxed{1}\,\text{XP} \right\rangle, \text{COMPS} \left\langle \ldots \right\rangle] \quad \Rightarrow$$
$$[\text{+AUX, +INV, +FIN, –BSE, SUBJ} \left\langle\ \right\rangle, \text{COMPS} \left\langle \boxed{1}\,\text{XP}, \ldots \right\rangle]$$

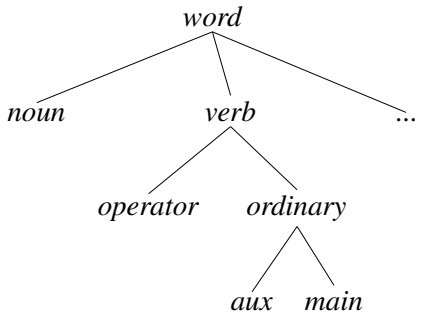
In other words, for every nonimperative finite auxiliary with an XP on its SUBJ list, there is a [+INV] counterpart in which the subject is the least oblique complement.

Typical of this treatment is that the inverted subject is not treated as a subject daughter, but rather as the least oblique complement of the verb. Such an analysis was first proposed in Borsley (1989) for the treatment of Welsh VSO clauses, and was later extended to the treatment of VSO clauses in other languages, such as German, Japanese and Korean, cf. Pollard (1990) on German. For English, it implies that one no longer needs a separate phrase type for the inverted clauses: instead, they are now straightforward instances of the *head-complements* phrase type; furthermore, given the correlation between surface order and degrees of obliqueness, it follows –without further stipulation– that the inverted subject precedes the other complements.[13]

[12] In Warner's terminology, [+FIN,–BSE] stands for the nonimperative finite forms.

[13] This treatment is also adopted in Sag (1997; p.439).

(27)



(28) *verb* →

$$\begin{bmatrix} \text{SYNSEM} \begin{bmatrix} \text{LOC} \begin{bmatrix} \text{CAT} \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SUBJ} & \boxed{1} \\ \text{SPR} & \langle\,\rangle \\ \text{COMPS} & \boxed{2} \\ \text{ARG-ST} & \boxed{1} \oplus \boxed{2} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

The operator verbs are the inverted auxiliaries.[14] They are finite and have positive values for AUX and INV. Furthermore, since they have an empty SUBJ list, it follows –from constraint (27)– that their subject is treated as a complement, as in Warner's analysis.

(29) *operator* →

$$\begin{bmatrix} \text{SYNSEM} \begin{bmatrix} \text{LOC} \begin{bmatrix} \text{CAT} \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{VFORM } \textit{finite} \\ \text{AUX} + \\ \text{INV} + \end{bmatrix} \\ \text{SUBJ} & \langle\,\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

The ordinary verbs, on the other hand, have a negative value for INV and a SUBJ list of length one, which implies that their subject is VP-external.[15]

(30) *ordinary* →

$$\begin{bmatrix} \text{SYNSEM} \begin{bmatrix} \text{LOC} \begin{bmatrix} \text{CAT} \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{INV} - \end{bmatrix} \\ \text{SUBJ} & \langle [\,] \rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

[14] This term is taken from Quirk et al. (1985).

[15] This does not exclude the possibility of stylistic inversion, for since the subject is clause final in that case, it can be treated as VP-external.

6. CONCLUSIONS

Capturing lexical generalizations adequately is of crucial importance for all lexicalist grammar frameworks. In this paper we have reviewed the situation in HPSG, where inheritance and lexical rules have been used to capture such generalizations.

Lexical rules are traditionally used to account for a wide range of lexical relationships. The status of lexical rules within HPSG has always been somewhat unclear. Many analyses within HPSG presuppose the existence of certain lexical rules, but at the same time most linguists working within a declarative, non-transformational, theory such as HPSG feel uncomfortable if they have to defend analyses which, at least superficially, introduce a procedural and transformational aspect into the theory.

Inheritance is much more appealing from a declarative, constraint-based, perspective. By organizing the lexicon as an inheritance network generalizations can be stated as inheritance relationships, the various dimensions along which a word needs to be classified can be expressed using multiple inheritance, and exceptions can be expressed using nonmonotonic inheritance. Again, certain formal details remain to be resolved, especially with respect to nonmonotonicity.

Interestingly, inheritance is also immediately compatible with attempts to eliminate lexical rules by using underspecification and relational constraints. If the relationship between, say, an active verb and its passive counterpart, or the noninverted and inverted usage of an auxiliary is no longer captured by means of a lexical rule, it must be the case, if they are to be related at all, that both are 'instances' of a general, underspecified, lexical entry. Both plain underspecification (i.e. not assigning a value to certain crucial features) and relational constraints (defining the value of one or more features using a definite relation which typically has more than a single solution) are essential for defining such abstract lexical entries.

By combining relational constraints with inheritance, a lexical organization arises in which generalizations which hold for a class of items (say the information common to all verbs, to all transitive verbs, or to all operator verbs) are expressed using inheritance, whereas generalizations relating different forms of the same abstract lexical entry are expressed using relational constraints.

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