combinatorial potential into the lexical description of an item by means of a valence feature. The single list-valued valence feature SUBCAT, proposed by Pollard (1984) and Pollard & Sag (1987) thus can be seen as the equivalent of a type constructor as used in Categorial Grammar. As in Categorial Grammar, the elements of a SUBCAT list directly reflect the combinatorial potential of the word or phrase in question. For that reason, early HPSG exhibits a close similarity to formalisms that combine the combinatorial engine of a categorial grammar with the features of a phrase structure grammar (for instance, Karttunen 1989, Zeevat 1988).

A number of linguistic problems have since been explored in HPSG and solutions have been developed that have significantly refined the original ideas and provided new insights into the nature of valence.

2.1 Argument composition

Since GPSG was designed to be faithful to the formalism of context-free grammars,[1] the kinds of syntactic dependencies that can be expressed in the syntactic rules are very restricted.

Moving subcategorization information into lexical properties at first blush appears to simply redistribute the division of labor between syntax and lexicon. However, it turns out that the HPSG approach affords a much wider perspective on the kind of relationships that are lexically encoded. In particular, the lexicalization of valence makes it possible to consider second-order dependencies, i.e., the valence of valence elements etc. This makes it possible to incorporate a lexicalized version of functional composition into HPSG grammars. Functional composition in categorial grammar is a mode of combination whereby the combinatorial properties of one category (here: `B/C`) are, as it were, "transmitted" to a functor category (here: `A/B`). As a result, we obtain a category that will be of type `A` provided it can combine with an element of type `C`, notated as `A/C`.

(1) $$\frac{\mathrm{A/B + B/C}}{\mathrm{A/C}}$$

The HPSG analysis of controlled complements can be seen as a variant this basic idea, in that the subject requirement of the selected VP is identified with the subject requirement of a predicate selecting that VP (see Green):

(2) $$\left[\text{SUBCAT}\left\langle \boxed{1}, \left[\text{V}\left[\text{SUBCAT}\ \langle \boxed{1}\ \textit{synsem} \rangle\right]\right]\right\rangle\right]$$

[1]The one notable exception in this regard are proposals for the *liberation* of phrase structure, see §3.2 below.

main verb's valence requirements are now mediated by the highest verbal governor (here: *wird*).

Suggestive evidence for such an analysis comes from the fact that the object of the main verb is subject to the same range of order variation as if the main verb itself had been the sole predicator in the clause. Thus, in (6a) the pronominal object *es* occurs before the subject *Peter*, which is precisely parallel to the simple case in (6b):

(6) a. daß **es** Peter gelesen haben wird.
that it Peter read-PSP have-INF will-FIN
'that Peter will have read the book.'

b. daß **es** Peter las.
that it Peter read
'that Peter read it.'

Transformational analyses have usually assumed that such cases are the result of a scrambling transformation that dislocates the object (*es*) from the phrase that it forms with the main verb.[2] From an HPSG perspective, a dislocation analysis is undesirable and instead order variation of this kind has been analyzed in terms of permissive linear precedence conditions within a local syntactic domain (typically, a local phrase structure tree). If both subject and object end up as arguments of the highest predicator *wird* via argument composition, the "scrambled" order in (6a) can be explained in terms of order variations among daughters within the same local tree, just as in (6b).

Further evidence against the constituent status of the main verb together with its notional object comes from the failure to occur as a unit in contexts such as relative clauses:

(7) *ein Buch [[das gelesen] Peter haben wird]
a book that read Peter have will

As has been pointed out by Kathol (2000:180–183), linking the valence requirements of verbal material by means of argument composition does not, in fact, determine the phrase structural relations among the participating verbs. Thus, for typical head-final cases as in (5), there have been proposals that assume no subconstituents among the verbal elements at all (Baker 1994, 1999; Bouma & van Noord 1998; van Noord & Bouma 1997), a constituent with right-branching structure (Kiss 1994; 1995), or a constituent

[2]Notable exceptions are the analyses of Haider (1993) and Bierwisch (1990) who assume base-generated verbal complexes similar to the ones proposed by Hinrichs and Nakazawa.

of just passing the valence requirements of the embedded verb, a passive auxiliary can be thought of as actively manipulating the set of valence elements that they inherit from the governed dependents. As a result, passives on the clausal level can be analyzed as a form of object-to-subject raising. Such an approach has a number of desirable consequences over the more standard manipulation of the verb's valence in terms of lexical rules, such as the fact that the morphologically spurious distinction between passive and past participles is no longer needed.

Other areas of German grammar for which argument composition analyses have been proposed include derivational morphology (Gerdemann 1994) and the problem of preposed complements of nouns (De Kuthy & Meurers 1998). In addition, Abeillé & Godard (1994) have argued that tense auxiliaries in French should be analyzed as inheriting the arguments of their main verbs via argument composition, albeit with a flat constituent structure. Abeillé *et al.* (1998) show how this idea can be extended to certain causative constructions with *faire*. Another language for which argument composition has yielded insightful analysis is Korean, both for auxiliaries (Chung 1993) and control verb constructions (Chung 1998a, cf. also Bratt 1996). Finally, Grover (1995) proposes to analyze English *tough*-constructions by means of argument composition, as an alternative to the more standard approach that attributes missing objects inside the VP complements of *tough*-adjectives to an extraction effect.

2.2 Valence and argument structure

Another development that has generated considerable work in recent years is the separation of valence and argument structure.

The previous section assumes that a single uniform valence attribute (SUBCAT) is responsible for defining the combinatorial potential of lexical and phrasal heads. This reflects a view of complementation assumed in early HPSG ("HPSG1", Pollard & Sag 1987) through the state of the theory represented in the first eight chapters of Pollard & Sag 1994 ("HPSG2"). The crucial assumption underlying this approach to valence is that grammatical relations are derivative of valence. For instance, the notion of subject, as it plays a role in agreement, binding theory, and other phenomena, can be recovered as the least oblique ("leftmost") among the valence elements of some predicator. Despite its conceptual simplicity, later versions of HPSG ("HPSG3"), beginning with chapter 9 of Pollard & Sag 1994, have adopted an approach that singles out subjects from other syntactic arguments by means of a separate valence feature SUBJ (as opposed to COMPS, see also Green forthcoming). This idea was first proposed by Borsley (1987), who points out a number of inadequacies saturation for each higher phrase in the tree, ARG-ST is a static representation of the dependents of the lexical head that does not project to higher nodes in the structure. By default, the elements of the ARG-ST list are identical with the concatenation of SUBJ and COMPS at the lexical level, i.e., if no valence requirement has been saturated yet. However, the lists in question do not always line up in this fashion and the possiblity of mismatches has given rise to a number of analyses of otherwise puzzling phenomena. We will briefly discuss two here, *pro*-drop and argument realignments in Austronesian languages.

The standard approach to missing subjects in finite environments has been to posit a null pronoun (*pro*) that instantiates the syntactic subject position. In keeping with HPSG's general avoidance of unpronounced syntactic material, we can instead analyze the unexpressed subject as an ARG-ST element that does not have a corresponding valence expression. The following example from Italian (12a) and the corresponding lexical description of the verb *mangia* illustrate this idea:

(12) a. Mangia un gelato.
eat.3SG a icecream
'S/he is eating an icecream.'

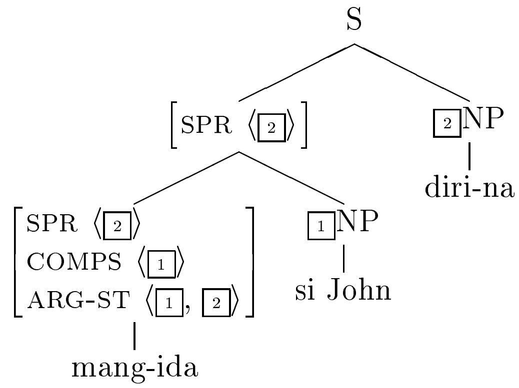
b. $\begin{bmatrix} \text{ARG-ST } \langle \text{NP[3SG], NP} \rangle \\ \text{SUBJ } \langle\ \rangle \\ \text{COMPS } \langle \text{NP} \rangle \end{bmatrix}$

Dependencies in which the subject participates, such as binding or agreement, can be accommodated straightforwardly if we assume that their description references the least oblique ARG-ST element, rather than the value of SUBJ.

A more radical mismatch between valence and argument structure has been proposed by Manning & Sag (1999) for the realization of arguments in Western Austronesian languages such as Toba Batak. In this language clause-initial verbs form a VP with the immediately following argument NP. In the case of active voice (AV) morphology, that NP has the status of nonsubject as evidenced by the fact that a reflexive in that position has to be bound by a later ("higher") NP. Thus, in these cases, valence and argument structure are aligned along the lines familiar from English, despite the difference in word order, cf. (13c):

(13) a. [Mang-ida diri-na] si John.
AV-saw self-his PM John
'John saw himself$_i$.'

c.



Separating information about valence (i.e., syntactic combinatorial potential) from argument structure (i.e., for the most part, semantic roles with syntactic relevance) it becomes possible to treat a number of phenomena as lexical in nature which otherwise would have to be handled in syntactic terms. In turn this keeps at a minimun the structural complexity in terms of genuine syntactic elements. The issue of structual complexity will also be of concern in the next subsection as well as in §4.

2.3 Dependents and Lexical Amalgamation

The following subsections deal with two issues in the area of argument structure which at first appear to be independent of each other but turn out to be closely linked in recent HPSG work. First, is there a fundamental distinction between complements and adjucts and, second, what is the role of the syntactic head in licensing information about missing dependents?

2.3.1 Complements and Adjuncts

It is a common and generally unquestioned assumption in much of contemporary linguistics that there is a syntactic distinction between complements and adjuncts, and that these two classes of dependents occupy different tree-configurational positions. This was also the position of early HPSG work.

However, the evidence for this syntactically understood complement/adjunct dichotomy has recently been re-examined within HPSG. For example, Hukari & Levine (1994, 1995) show that there are no clear differences between complement extraction and adjunct extraction, and Bouma *et al.* (2000) build on these observations and propose a unified theory of extraction based on the assumption that there is no tree-configurational distinction between complements and (at least a class of) adjuncts. Earlier, eliminating

VALENCE attributes, which are responsible for syntactic realization of constituents. This means that, according to this approach, there are no *wh*-traces (and, more generally, no empty elements) anywhere in the constituent tree.

Second, and perhaps more importantly, the configurational distinction between complements and adjuncts (sister of X^0 vs. X') is lost here: all elements of the extended argument structure DEPS are uniformly mapped into VALENCE attributes, regardless of their complement/adjunct status.

As we will in the next section, various grammatical processes are assumed to operate at the level of such an extended argument structure.

2.3.2 Extended Argument Structure

Bouma *et al.* (2000) propose a theory of extraction which makes crucial use of the extended argument structure encoded as the value of DEPS. They argue that extraction does not distinguish between various kinds of dependents and propose the following principle of SLASH amalgamation which encodes this observation.

(17) SLASH Amalgamation:

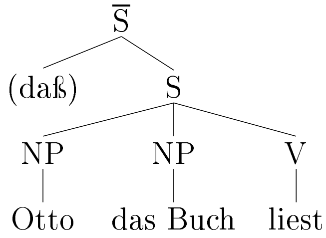
$$\textit{word} \rightarrow \begin{bmatrix} \text{SYNSEM} & \begin{bmatrix} \text{LOC}|\text{CAT} & \begin{bmatrix} \text{DEPS} & \langle[\text{SLASH } \boxed{1}], \ldots, [\text{SLASH } \boxed{n}]\rangle \\ \text{BIND} & \boxed{0} \end{bmatrix} \\ \text{SLASH} & (\boxed{1} \cup \ldots \cup \boxed{n}) - \boxed{0} \end{bmatrix} \end{bmatrix}$$

This principle is responsible for collecting SLASH values from all dependents of a *word*, perhaps lexically binding some of them (this happens in case of words such as *tough* or *easy*, which are lexical SLASH-binders), and collecting all other elements of these SLASH sets into its own SLASH value. This SLASH value is then shared along the head projection of the *word*, in accordance with the principle of SLASH inheritance:

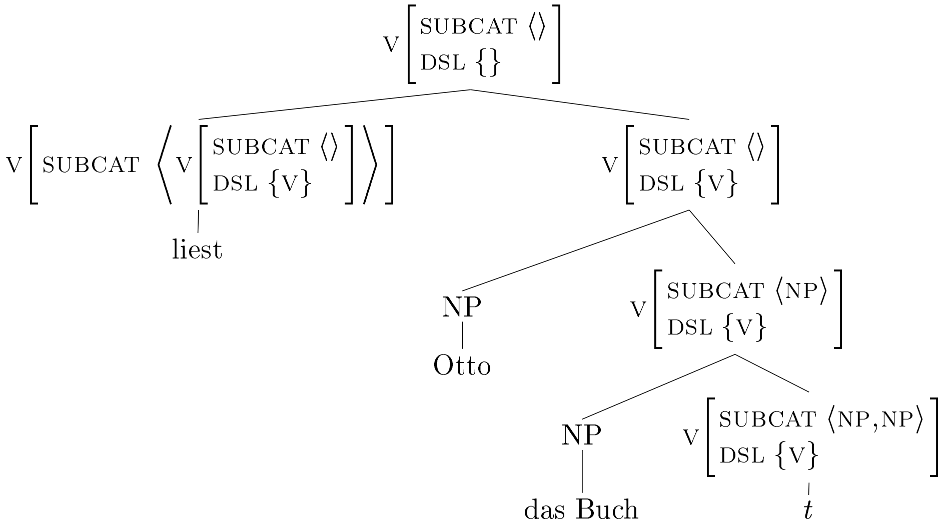
(18) SLASH Inheritance (schematic):

$$\textit{hd-val-ph} \rightarrow \begin{bmatrix} \text{SLASH } \boxed{1} \\ \text{HD-DTR}|\text{SLASH } \boxed{1} \end{bmatrix}$$

This approach differs from earlier HPSG approaches to extraction not only in treating dependent extraction on part with argument extraction, but also in different division of labor between different parts of the grammar. On the analysis sketched above, the amalgamation of SLASH values takes place at the level of *word*s, never at the level of *phrase*s — *phrase*s only pass SLASH values to the head-filler phrase, where extracted elements are overtly realized.

b. 

Analyses of this kind clearly differ sharply from the standard transformational approach in terms of movement of the finite verb from its clause-final base position to a clause-initial position (Comp) via head-movement. The underlying intuition that verb placement is dependent on constituent structure is in fact shared by various HPSG-based proposals that offer a number of different ways in which verb movement may be implemented in HPSG, cf. Kiss & Wesche 1991, Kiss 1995, Netter 1992, Frank 1994. The representation given in (20) illustrates how to capture the dependency between the finite verb (*liest*) and its putative base position in terms of the additional nonlocal feature DSL (for "double slash"):[6]

(20) 

Accounts of verb placement in terms of nonlocal dependencies of this kind are discussed by Kathol (1998) and Kathol (2000), who points out that none of the putative evidence for a dislocation-based analysis in fact holds up under closer scrutiny.[7] In addition, he notes a number of technical and conceptual

[6] A feature with this name and function was first suggested by Jacobson (1987).

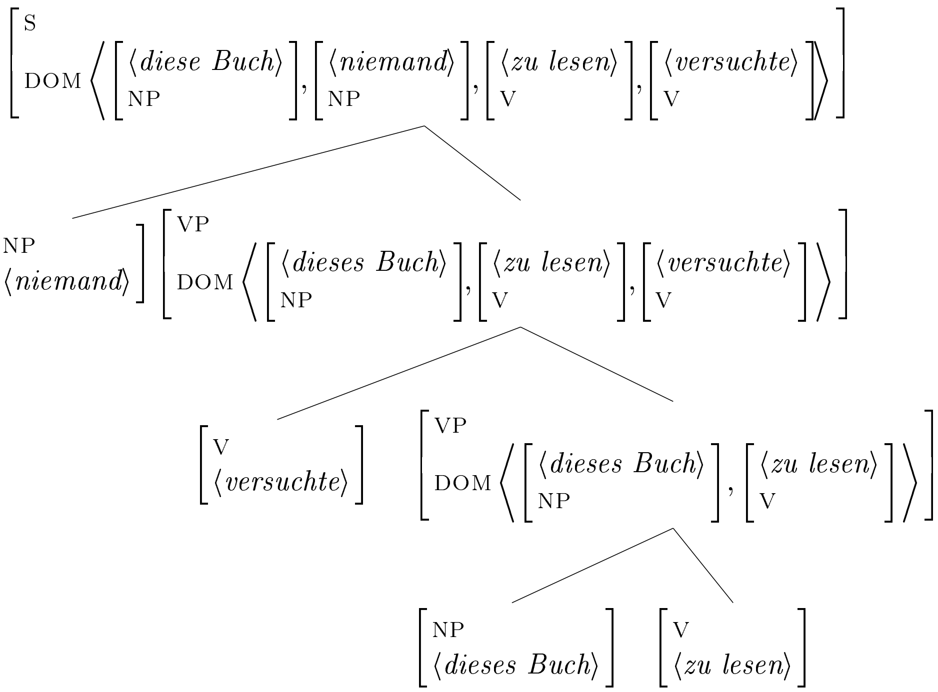
[7] Cf. also Wechsler 1986 for an earlier critique of movement-type analyses of verb placement in Swedish.

the English counterpart (21b).

(21) a. daß **dieses Buch** niemand **zu lesen** versuchte.
that this book.ACC no one.NOM to read tried
'that no one tried to read this book.'

b. No one tried to **read this book**.

The argument composition approach sketched above in §2 attributes this discontinuity to the formation of a complex predicate (*zu lesen versuchte*). Reape instead proposes to analyze the German and English constructions in terms of the same basic constituent types (in particular VPs), yet realized in a discontinuous fashion in the case of German. This is illustrated in (22), where each sign now is augmented with a list-valued feature representing that sign's (WORD) ORDER DOMAIN. Linear order is determined by mapping the phonology of the domain elements onto the phonology of the phrase, rather as the terminal yield of the constituent structure. While in standard phrase structure grammar, the region of (potential) order variation is the local tree, order domains expand that region to include elements that are not immediate constituents of the sign in question. For instance, in (22), the NP *dieses Buch* as a complement of *zu lesen* is not an immediate constituent of the clause; nevertheless it occurs together with the verbal head *versuchte* within the clause's order domain.

(22)


never be 'visible' to the valence change that accompanies the passivization of *versuchen*.[8] Thus, Reape's approach wrongly predicts that such constructions should not exist. In contrast, any argument composition approach can easily accommodate such cases because the syntactic arguments of the most embedded verbal predicate become also the syntactic dependents of the governing predicates.

Even though facts such as these cast doubt on the appropriateness of order domains in description of the particular phenomena that they were originally developed for, there nevertheless appear to be other discontinuous constituency phenomena for which order domains represent an elegant descriptive tool. For instance, Kathol (1998) points out that argument composition of the kind proposed by Hinrichs and Nakazawa fails to correctly account for certain orderings within Dutch verb clusters. In Dutch we typically find head-first ordering between the governing verb and the governed subcomplex. For example, in (24a), *moet* as the highest governing verb precedes *hebben gelezen*. Combinations of tense auxiliaries and their dependent verbs can generally occur in either order; when they occur in head-final order, as in (24b), the preferred occurrence of the governing verb *moet* (in standard Dutch) turns out to be between *gelezen* and *hebben*. This kind of ordering cannot be described assuming only argument composition and binary branching verbal complexes of the kind initially proposed by Hinrichs and Nakazawa.

(24)	a.	dat	Jan	dit boek	moet$_1$	hebben$_2$	gelezen$_3$.
		that	Jan	this book	must-FIN	have-INF	read-INF
		'that Jan must have read the book.'					
	b.	dat	Jan	dit boek	gelezen$_3$	moet$_1$	hebben$_2$.
		that	Jan	this book	read-PSP	must-FIN	have-INF

Kathol (2000) shows how facts such as these can be given an elegant solution if argument composition is combined with order domains that permit the discontinuous linearization of certain governed subcomplexes such as *gelezen hebben* in (24). Such an analysis goes a long way toward a uniform account of the ordering possibilities in a number of variants of German and Dutch by factoring out dialect-independent constituency and dialect-dependent linearization constraints.

[8] This argument of course pressuposes a lexicalist approach to passives in terms of variation in argument structure or valence rather than manipulation of tree configuration.

While much of the work employing order domains has concentrated on German (see also Richter 1997a and Müller 1999:ch. 11), there have been numerous adaptations of Reape's proposals for a variety of other languages as well, including Japanese (Calcagno 1993 and Yatabe 1996) Danish (Hentze 1996 and Jensen & Skadhauge 1998), Breton (Borsley & Kathol 1999), English (Kathol & Levine 1992), Warlpiri (Donahue & Sag 1999), Ojibwe (Kathol & Rhodes 1999), and Serbo–Croatian (Penn 1999b and Penn 1999a). One of the ongoing issues in the literature on nonconcatenative approaches to linearization is the precise informational content of the inhabitants of order domains. Reape's original suggestion consider order domains as populated by HPSG *signs*. This would allow for the formulation of many linear precedence constraints for which there is little or no empirical evidence. As a result, there have been proposals (cf. Kathol 1995) to limit the informational content of domain elements so as to make certain aspects of linguistic information (such as internal phrase structure) inaccessible to linear precedence relations. This can be seen as closely related other proposals to have the feature architecture express linguistically contentful constraints ("geometric prediction").

4 Syntactic abstractness and reductionism

In this section we survey some developments in HPSG that primarily seem to pertain to methodological issues and closer inspection also have empirical remifications. These have to do with the reality of phonologically empty syntactic constituents and the division of labor between the lexicon and the combinatorial apparatus in expressing syntactic generalizations. The overriding concern in both is the question of how abstract we should assume syntactic representations to be.

4.1 The (non-)reality of syntactic traces

With the reduction of the inventory of transformations in the seventies to those that comply with structure preservation, the notion of a "trace" as the residue of movement operations has become a core ingredient of transformational theories of grammar. The presence of inaudible copies of dislocated elements within the syntactic representation has been of crucial importance for the formulation of many principles in theories of the transformational ilk, including binding, scope of quantificational expressions, distribution of case-marked elements, constraints on extraction etc.

The definition of a trace in HPSG is quite straightforward. One can simply there are phenomena that can be explained more straightfowardly if no traces are assumed.

As an example of arguments of the first kind, consider *wanna*-contraction, one of the most celebrated pieces of evidence in favor of traces. The basic idea is that *wh*-traces disallow the phonological contraction of *want* and *to*. The relative clause in (30a) is ambiguous between a subject or object control reading for the understood subject of *succeed*. In contrast, the variant in (30b) only permits the subject control reading which is supposedly explained by the lack of contractabily across a *wh*-trace.

(30) a. This is the man I want to succeed.

b. This is the man I wanna succeed.

However, as has been pointed out by Pullum (1997), there are numerous technical and conceptual problems with this assumption. Instead a fully lexical, traceless analysis of the above contrast is available if *wanna* is thought of as a morphosyntactically underived subject-control verb which does not license an object.

Turning to positive evidence against traces, consider the following extraction facts:

(31) a.*Who$_i$ did you see [__$_i$ and a picture of __$_i$]?

b.*Which student$_i$ did you find a picture of [a teacher of __$_i$ and __$_i$]?

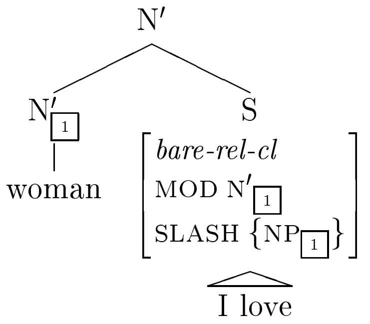
c.*Who did you compare [__$_i$ and __$_i$]?

The operative constraint at work here is that no conjunct must itself consist only of an extraction site. However, this fact is not predicted by the constraints on extraction from coordination constructions which only require each conjunct to be affected in an "Across-the-Board" fashion. Thus, additional stipulations are necessary to capture the ungrammaticality of (31). In contrast, if licensing of extracted phrases is handled entirely by lexical amalgamation of gap information the facts in (31) fall out for free. This is because lexical amalgamation only applies to lexical heads. In order to license the extraction of an entire conjunct, there would have to be a lexical head that could serve as the locus for the gap amalgamation. But no such lexical head arguable exists in coordination constructions, hence there is no way to license the ungrammatical examples in (31).

Together with the elimination of such inaudibilia as *pro* (or empty relativizers as discussed in the next subsection), the abolishment of traces from commitment to avoiding syntactic inaudibilia whenever possible. In particular, Pollard & Sag (1994) propose a functional head analysis in which a phonologically empty relativizer takes a clausal complement with a gap. As the head of the whole relative clause, the relativizer contributes its MOD specification to the entire clause, which in turn licenses the combination with a modified noun.

A rather different approach to relative clauses is pursued by Sag (1997). Instead of reducing the internal and external properties of relative clauses to lexical elements, Sag instead treats relative clauses as grammatical entities in their own right. Thus, relative clauses are considered to be CONSTRUCTIONS in the sense of Construction Grammar (Fillmore *et al.* forthcoming; Zwicky 1994; Goldberg 1995), that is, pairings of meaning and formal syntactic properties that cannot be reduced to any other components of the grammar. From such a construction-based perspective, the example in (32) receives an analysis of the kind sketched in (33):

(33)



Here *bare-rel-cl* is a particular kind of relative clause with properties that set it apart from other kinds of relative clauses, in particular the absence of any initial *wh*-filler.

The constructional perspective has led to a reevaluation of the division of labor between the lexicon and the supra-lexical units recognized by the grammar. Thus, instead of allowing lexical descriptions to become arbitrarily complex by, in effect, incorporating aspects of the constructional context in which the lexical elements are to be embedded, it is now possible to keep the lexicon relatively simple but allow for more complexity in the phrase system. In addition to relative clauses two areas in which a construction-based approach has led to significant advances are English interrogative constructions (Ginzburg & Sag forthcoming, see also §5.1.2) and German clause types (Kathol 1997; Kathol 2000). The latter combines the construction-based perspective with the linearization framework outlined in §3.2. As a result, German clausal

Thus once membership in these and other classes has been established for a given lexeme, only the lexically indiosyncratic properties need to be listed for it.

Since HPSG does not assume any ontological distinction between words other linguistic units (all are assumed to be instances of *sign*), it is straightforward to extend multiple inheritance hierarchies to phrasal constructions as well. For instance, the phrasal type *bare-rel-cl* in (33) above is simultaneously an instance of the phrase types *non-wh-rel-cl* and *fin-hd-subj-ph*. The first classifies the construction as a particular subinstance of non-*wh* relative clauses, which in turn are one way in which the "clausality" of a phrase are specified, that is its combinatorial and semantic properties.[11] The second accounts for its internal composition as a subject-predicate construction (and, for instance, not as a filler-head construction as in the case of *wh*-relative clauses). While there is often a residue of properties that cannot be accounted for by stating what larger constructional classes a given entity inherits from, it turns out that bare relative clauses are defined in their entirety by their supertypes. Thus, far from simply providing a list of available constructions, the construction grammatical approach is very much concerned with stating all available generalizations at all applicable levels. As a result, as Kathol (2000:***) points out, the equivalent of the representational complexity inherent in the abstract structures posited in transformational analyses lies in the various inheritance relationships that tie the constructions of a language into a complex web of dependencies of different kinds, sometimes referred to as the "constructicon".

5 Meaning in HPSG

As Halvorsen (1995), Nerbonne (1992, 1995) argue at length, LFG- or HPSG-style constraint-based semantics has several advantages over, e.g., Montagovian kind of semantics in that the latter but not the former assumes a homomorphism between syntax and semantics. In contrast, constraint-based semantics allows for a much greater freedom in stating analyses at the syntax/semantics interface, and also makes it easy to formulate phonological and pragmatic constraints on meanings (cf. §5.2). In addition, constraint-based semantics seems to be particularly well-suited for expressing semantic underspecification (cf. §5.1) and it allows to formulate theories of combinatorial semantics which go beyond compositionality, a notion recently argued to be vacuous at worst and dispensable at best (Zadrożny 1994;

[11] Other ways of instantiating "clausality" include imperative, declarative, or interrogative clauses.

This analysis rests on the following assumptions: First, in order to treat raising examples such as (36), QSTORE must be present not at the level of *signs*, as in Pollard & Sag 1994, but at least at the level of *synsem*. For example, once QSTORE is appropriate to *synsem*, the quantifier corresponding to *a unicorn* in (36a) is present on the QSTORE within the *synsem* of *a unicorn*, i.e., within the *synsem* of the subject of *appears*. But since *appears* is a raising verb, this QSTORE value is also present on the subject of *approaching* and may be retrieved within the scope of *appears*. In fact, on the basis of extraction examples such as (37), Pollard & Yoo (1998) argue that QSTORE should be appropriate at least to *local*.

(37) Five books, I believe John read.

Przepiórkowski 1997, 1998 goes further and argues that QSTORE should be part of a sign's *content*:

(38)
$$\begin{array}{c}\begin{bmatrix}\textit{cont}\\ \textsc{qstore}\ \ \textit{set(quant)}\end{bmatrix}\\ \\ \textit{psoa}\quad \textit{nom-obj}\quad \textit{quant}\end{array}$$

Second, there is a new set-valued attribute appropriate to *word*s only, namely, NEW-QS. If a word introduces a quantifier, the value of this attribute contains this quntifier; otherwise it is the empty set. For example, a partial specification the indefinite detminer *a*, assumed to be a quantifier, is:

(39)
$$\begin{bmatrix}\textit{word}\\ \textsc{phon}\ \langle\ a\ \rangle\\ \textsc{synsem}|\textsc{loc}\ \begin{bmatrix}\textsc{cat}|\textsc{head}\ \begin{bmatrix}\textit{det}\\ \textsc{spec}\ \mathrm{N}':\boxed{1}\end{bmatrix}\\ \textsc{cont}\ \boxed{2}\begin{bmatrix}\textit{quant}\\ \textsc{determiner}\ \textit{exists}\\ \textsc{restind}\ \boxed{1}\end{bmatrix}\end{bmatrix}\\ \textsc{arg-st}\ \langle\ \rangle\\ \textsc{new-qs}\ \{\boxed{2}\}\end{bmatrix}$$

Third, quantifier retrieval is only allowed at the lexical level, as proposed in Manning *et al.* 1999. The new theory of quantification can schematically be represented as the implicational constraint in (40), where Desc_1 and Desc_2 are given in (41) and (42), respectively.

(40) $\textit{word} \rightarrow \mathrm{Desc}_1 \vee \mathrm{Desc}_2$

(43) would be assigned the meaning in which the simple example is apparent, and not the actual reading in which the example is apparently simple.

On the basis of this and other considerations, Kasper (1997) proposes to distinguish between inherent and combinatorial semantics, with CONTENT values reflecting now only inherent semantics of a sign. For example, the adjective *controversial*, is assumed to always have CONTENT value as indicated in (44), whether it is used attributively or predicatively.

(44) $$\begin{bmatrix}\text{CONTENT} & \begin{bmatrix}\text{RELN} & \textit{controversial}\\ \text{INST} & \boxed{1}\end{bmatrix}\end{bmatrix}$$

This differs from the position of Pollard & Sag 1994, where *controversial* has CONTENT of type *nom-obj* when used attributively, and of type *psoa* when used predicatively.

Now, in order to deal with recursive modification, Kasper (1997) enriches values of MOD as in (45) and revises the Semantics Principle as in (46).

(45) $$\begin{bmatrix}\textit{head} & \\ \text{MOD} & \begin{bmatrix}\textit{mod} & \\ \text{ARG} & \textit{synsem}\\ \text{ICONT} & \textit{content}\\ \text{ECONT} & \textit{content}\end{bmatrix}\end{bmatrix}$$

(46) Semantics Principle (ignoring quantification)

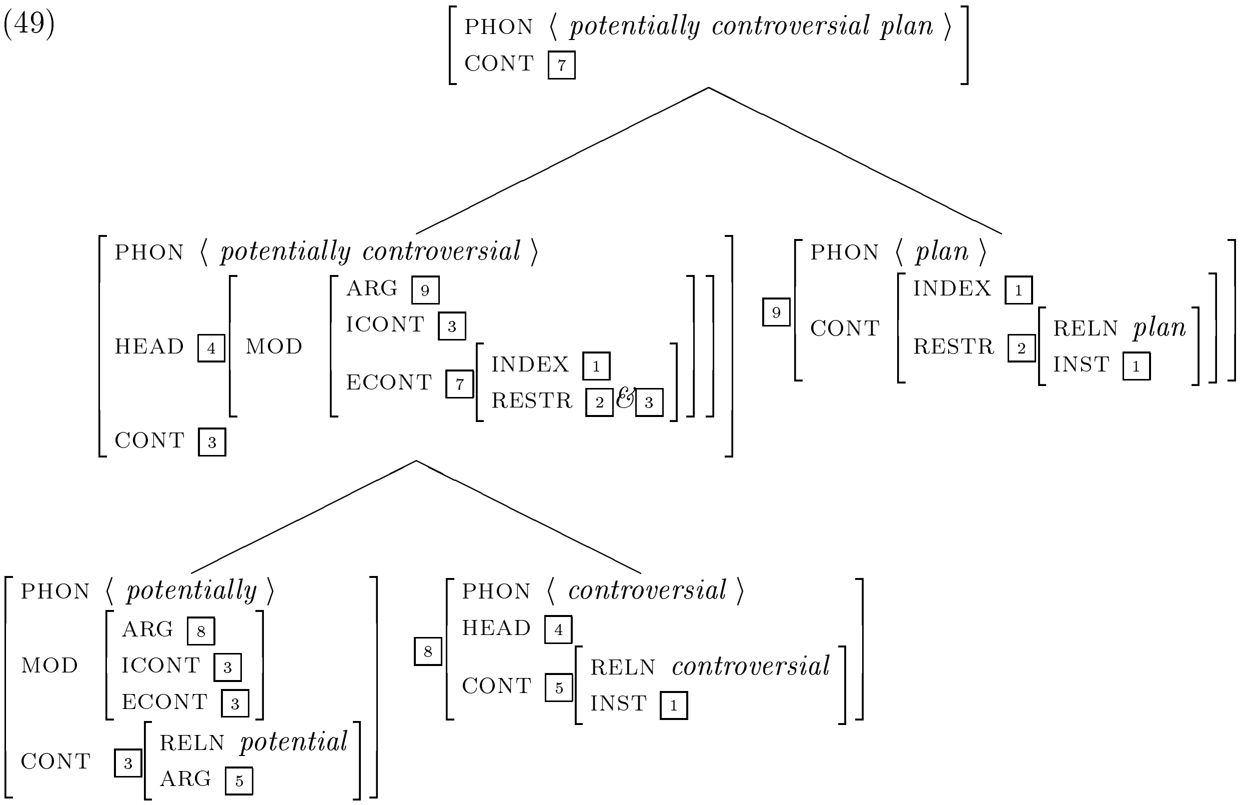
a. For a head-adjunct phrase, the semantic content (CONTENT) is token-identical with the MOD|ECONT value of the adjunct daughter, and the MOD|ICONT value of the adjunct daughter is token-identical withthe adjunct daughter's CONTENT.

b. For all other types of headed phrase the CONTENT is token-identical with the CONTENT of the head daughter.

The value of MOD|ARG corresponds to the value of MOD in Pollard & Sag 1994—it is the *synsem* of the modified element; the value of MOD|ICONT is equal to the CONTENT value of the maximal projection of the modifier (it is different from the modifier's CONTENT if the modifier is itself modified); and the value of MOD|ECONT specifies the combinatorial meaning of the modifier, i.e., the CONTENT value of the phrase resulting from the combination of the modifier phrase with the modified, i.e., ECONT is a function of ICONT and ARG.

Assuming lexical specifications of *potentially* and *controversial* as in (47) and (48), respectively, this analysis leads to the structure of the phrase *potentially controversial plan* schematically described in (49).

(49)



Thus, this analysis correctly assigns the following meaning to the phrase *potentially controversial plan* (cf. $\boxed{7}$ above): 'x : $\mathsf{plan}'(x)$ & $\mathsf{potential}'(\mathsf{controversial}'(x))$'. See Kasper 1997 for further details and applications.

5.1.2 Propositions, Facts, Outcomes and Questions

Ginzburg & Sag (2000) extend previous HPSG approaches to semantics by considering contents of illocutionary acts other than just assertions. They propose that semantic content of clauses be *message*, with two immediate subtypes *propositional* and *question*.

Ginzburg & Sag (2000) distinguish between three types of *propositional* objects: *proposition*, *fact* and *outcome*. Propositions are semantic types of complements of predicates such as *believe*, *assert*, *assume*, *deny* or *prove*, so called *true/false* predicates (TF predicates). Such predicates, unlike factive predicates, e.g., *know* or *discover*, may only occur with nominal complements of which truth can be predicated:

c.#The claim/hypothesis/proposition that Tony was ruthless made the flight against her difficult.

On the other hand, truth is predictable only of propositions, not of facts (or possibilities):

(54) a.#The fact that Tony was ruthless is true.

b. The claim/hypothesis/proposition that Tony was ruthless is true/false.

Apart from complements of factive verbs, facts are the content of the illocutionary acts of reminding and exclaiming, e.g.:

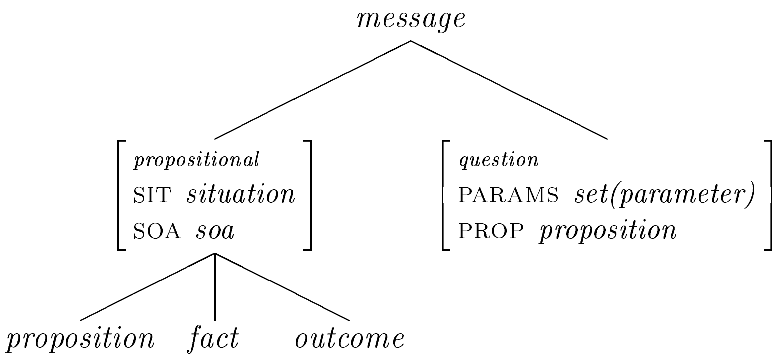
(55) a. Laurie: Why don't the vendors here speak Straits Salish?
Bo: We're in New York City for Pete's sake.

b. Bo reminded Laurie (of the fact) that they were in New York City.

It is considerations like these that lead Ginzburg & Sag (2000) to introduce *proposition* and *fact* as different subtypes of *propositional*. Another subtype of *propositional* which they distinguish is *outcome*, the type of imperative clauses, *inter alia*. What all these *propositional* contents have in common is their internal structure, which involves a situation (the value of the attribute SIT) and a state of affairs (SOA; the value of the attribute SOA), the latter corresponding to Pollard & Sag's (1994) parametrized state of affairs (*psoa*).

On the other hand, *questions*, which correspond to the denotata of clausal complements of such predicates as *wonder* and *ask*, are represented as propositional abstracts, with the relevant notion of abstraction being **(Aczel and Lunnon's 1992)** *simultaneous abstraction*. In terms of HPSG feature geometry, *questions* are *messages* with two new attributes, PARAMS, whose value is the set of (abstracted) parameters, and PROP, with values of type *proposition*. This is summarized below. AP

(56)



analysis of English interrogatives.[12]

5.1.3 Beyond Situation Semantics

The extensions of HPSG approach to semantics presented in the two subsections above are exactly that: extensions of the standard (Pollard & Sag 1994) HPSG semantic theory, which was inspired by Situation Semantics. The last decade has also witnessed numerous proposals aiming at dethroning Situation Semantics as the provider of semantic resources for HPSG. These proposals can be classified into two overlapping categories: the first category comprises of analyses replacing the standard HPSG approach to semantics with a version of predicate logic, the second contains HPSG analyses of underspecified meanings. We will present these two classes of approaches in turn below.

Predicate Logics To the best of our knowledge, the first proposal to use a predicate logic as the semantic language of HPSG is that of Nerbonne 1992, 1993: it shows how to encode the language of generalized quantifiers in typed feature structures and it provides a treatment of scopal ambiguities (see below) within this encoding.

A more recent proposal of this type is adduced in Richter & Sailer 1999a, 1999b, which show in technical detail how a higher order type theoretic language Ty2 can be used as the semantic object language of HPSG. According to that proposal, values of CONTENT are of type *me* (*meaningful expression*), which introduces the attribute TYPE with values of type *type*, and which has the following subtypes: *variable*, *constant* (with a number of subtypes), *application*, *abstraction*, *equation*, *negation*, *logical-constant* and *quantifier*. Many of these types have their own attributes and further subtypes; thus, *application* has two *me*-valued attributes, FUNCTOR and ARGUMENT, *abstraction* has *variable*-valued VAR and *me*-valued ARG, both *equation* and *logical-constant* have two *me*-valued attributes, ARG1 and ARG2, and *logical-constant* also has subtypes such as *disjunction*, etc., *negation* has a *me*-valued attribute ARG, and, finally, *quantifier* introduces *variable*-valued VAR and *me*-valued SCOPE, and is further partitioned into *universal* and *existential*. Moreover, the type *type* is partitioned into *atomic-type*s (*entity*, *truth*, *w-index*) and *complex-type*s (with two *type*-valued attributes, i.e., IN and OUT). Given these assumptions, the formula (59a) can be represented by (59b).

(59) a. $\lambda x_e.\mathsf{professor}'_{\langle e,t\rangle}(x_e)$

[12] See also Przepiórkowski 1999b and Przepiórkowski & Kupść 1999 for a related approach to Negative Concord in Italian and in Polish.

(62)

$$\forall y \exists x.\mathsf{love}'(x,y)$$

- $\lambda Q \exists x.Q(x)$ — *someone*
- $\lambda X \forall y.X(\lambda x.\mathsf{love}'(x,y))$
  - $\lambda Y \lambda X.Y(\lambda y.X(\lambda x.\mathsf{love}'(x,y)))$ — *loves*
  - $\lambda P \forall y.P(y)$ — *everyone*

Note that, on this approach, scope ambiguities as in *someone loves everyone* result from different placements of the new variable introduced by the Quantifier Raising lexical rule (60): were λY placed after λX in (61c), the opposite scoping would result (i.e., $\exists x \forall y.\mathsf{love}'(x,y)$).

Richter & Sailer 1999a, 1999b extensively illustrate this approach to HPSG semantics by utilizing it in their analyses of Negative Concord in French and Polish.

Underspecification One of the first discussions of the proper representation of semantic underspecification in HPSG is Nerbonne 1992, 1993, which shows how underspecified *descriptions* of meanings may correctly denote semantic *objects* corresponding to fully specified meanings. For example, although the grammar leaves open which quantifier outscopes the other in, say, *everybody loves somebody*, each object corresponding to this phrase is disambiguated one way or the other. This is, in fact, also the approach adopted in Pollard & Sag 1994, Pollard & Yoo 1998, and other works mentioned above. According to all these works, although *descriptions* of (semantic) objects are underspecified with respect to meaning, the *objects* themselves correspond to fully resolved semantic representations.

Recent years have witnessed a number of proposals of truly underspecified semantics for HPSG, i.e., semantics in which both descriptions *and objects* correspond to underspecified meanings. According to such approaches, the semantic object described (generated) by an HPSG grammar and corresponding to, say, *everybody loves somebody* does not resolve the relative scope of the two quantifiers. It is only an extragrammatical resolution step which provides such disambiguated readings, if they are necessary at all — some logics, such as Underspecified Discourse Representation Theory (UDRT; Reyle 1993), define truth conditions for underspecified semantic representations and provide a proof theory which makes it possible to draw inferences from such partial semantic structures. In fact, the first (to the best of our knowledge) proposal for underspecified semantics for HPSG simply embeds UDRT into HPSG — Frank & Reyle (1992, 1995, 1996) use this formalism in their analysis of interactions between word order and quantifier scope, and of the collective /

(64)
$$\begin{bmatrix} \textit{mrs} \\ \text{LTOP} \ \boxed{0} \\ \text{RELS} \ \left\{ \begin{bmatrix} \textit{every} \\ \text{HNDL} \ \boxed{1} \\ \text{BV} \ \boxed{x} \\ \text{RESTR} \ \boxed{l} \\ \text{SCOPE} \ \boxed{m} \end{bmatrix}, \begin{bmatrix} \textit{dog} \\ \text{HNDL} \ \boxed{2} \\ \text{INST} \ \boxed{x} \end{bmatrix}, \begin{bmatrix} \textit{some} \\ \text{HNDL} \ \boxed{3} \\ \text{BV} \ \boxed{y} \\ \text{RESTR} \ \boxed{n} \\ \text{SCOPE} \ \boxed{p} \end{bmatrix}, \begin{bmatrix} \textit{cat} \\ \text{HNDL} \ \boxed{4} \\ \text{INST} \ \boxed{y} \end{bmatrix}, \begin{bmatrix} \textit{chase} \\ \text{HNDL} \ \boxed{5} \\ \text{ACT} \ \boxed{x} \\ \text{UND} \ \boxed{y} \end{bmatrix} \right\} \end{bmatrix}$$

(65)
$$\begin{bmatrix} \textit{mrs} \\ \text{LTOP} \ \boxed{0} \\ \text{RELS} \ \left\{ \begin{bmatrix} \textit{some} \\ \text{HNDL} \ \boxed{3} \\ \text{BV} \ \boxed{y} \\ \text{RESTR} \ \boxed{n} \\ \text{SCOPE} \ \boxed{p} \end{bmatrix}, \begin{bmatrix} \textit{cat} \\ \text{HNDL} \ \boxed{4} \\ \text{INST} \ \boxed{y} \end{bmatrix}, \begin{bmatrix} \textit{every} \\ \text{HNDL} \ \boxed{1} \\ \text{BV} \ \boxed{x} \\ \text{RESTR} \ \boxed{l} \\ \text{SCOPE} \ \boxed{m} \end{bmatrix}, \begin{bmatrix} \textit{dog} \\ \text{HNDL} \ \boxed{2} \\ \text{INST} \ \boxed{x} \end{bmatrix}, \begin{bmatrix} \textit{chase} \\ \text{HNDL} \ \boxed{5} \\ \text{ACT} \ \boxed{x} \\ \text{UND} \ \boxed{y} \end{bmatrix} \right\} \end{bmatrix}$$

(64′) $\forall x(\mathsf{dog}'(x) \rightarrow \exists y(\mathsf{cat}'(y) \wedge \mathsf{chase}'(x,y)))$

(65′) $\exists y(\mathsf{cat}'(y) \wedge \forall x(\mathsf{dog}'(x) \rightarrow \mathsf{chase}'(x,y)))$

Of course, not all identifications of values of RESTR and SCOPE with HNDLs of particular relations lead to well-formed formulae. For example, there is no well-formed formula consistent with the identification of $\boxed{m}$ with $\boxed{1}$: such identity would mean that the quantifier *every* is in scope of itself.

It should be clear by now that the function of the LTOP attribute is to single out the (HNDL value of the) relation with outermost scope. Apart from LTOP and RELS, all *mrs*s have two more attributes, namely, KEY and H-CONS. The role of the attribute KEY is to single out the 'head' relation of a phrase, i.e., the relation introduced by the syntactic head of the phrase. In the example above, the value of KEY would be $\boxed{5}$, the HNDL of *chase*. Finally, the attribute HCONS (for *handle conditions*) collects other, linguistic, constraints on possible identifications of arguments and handles. For example, in case of a sentence like *Kim thinks that Sue did not make it*, *not* cannot outscope *thinks*, even though such a reading would be allowed by considerations of well-formedness alone. The unavailability of this interpretation is ensured by adding to HCONS a constraint—to be taken into account during the post-grammatical disambiguation process—to the effect that negation cannot scope outside its clause. See Copestake *et al.* 1997 and Pollard 1998 for the format of such constraints and for further details.

Minimal Recursion Semantics has been shown to provide a natural solution to the problem of recursive modification discussed above (Copestake *et al.*

Engdahl & Vallduví 1994, 1996 and Engdahl 1999 propose that information structure be represented within *signs*' CONX (context) values in the following way:

(67) $$\begin{bmatrix} \textit{context} & \\ \text{INFO-STR} & \begin{bmatrix} \textit{info-struc} & \\ \text{FOCUS} & \textit{set(content)} \\ \text{GROUND} & \begin{bmatrix} \textit{ground} & \\ \text{LINK} & \textit{set(content)} \\ \text{TAIL} & \textit{set(content)} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

They also posit principles expressing the claims that, for each word, this word's semantic contribution is part of the focus if and only if it bears the A-accent, and it is part of link if and only if it bears the B-accent:

(68) $$\textit{word} \rightarrow \left(\begin{bmatrix} \text{PHON}|\text{ACCENT} & \mathsf{A} \end{bmatrix} \leftrightarrow \begin{bmatrix} \ldots|\text{LOC} & \begin{bmatrix} \textit{local} & \\ \text{CONT} & \boxed{1} \\ \text{CONX}|\text{INFO-STR}|\text{FOCUS} & \{\boxed{1}\} \end{bmatrix} \end{bmatrix} \right)$$

(69) $$\textit{word} \rightarrow \left(\begin{bmatrix} \text{PHON}|\text{ACCENT} & \mathsf{B} \end{bmatrix} \leftrightarrow \begin{bmatrix} \ldots|\text{LOC} & \begin{bmatrix} \textit{local} & \\ \text{CONT} & \boxed{1} \\ \text{CONX}|\text{INFO-STR}|\text{GROUND}|\text{LINK} & \{\boxed{1}\} \end{bmatrix} \end{bmatrix} \right)$$

There are additional principles specifying how a phrases's information structure is constrained by information structures of its daughters.

This leads to the following (much simplified) structure of (66B), in which values of the DTRS attribute are presented in the familiar constituent tree notation.

information does not correspond to the real world directly (as it apparently does, e.g., in Pollard & Sag 1994 and in (57)–(58) in §5.1.2 above), but rather describes speakers' beliefs about the world and their intentions.

Thus, Green 1994 reiterates arguments that "the relevant background propositions are not about objective aspects of any world, but rather are propositions about beliefs which the speaker supposes to be mutual" (p. 5); for example, the sentence (71) is felicitous provided that both the speaker and the hearer believe the presupposition (that french fries are bad for Clinton), even if that presupposition is in fact false.

(71) Clinton realizes french fries are bad for him.

Moreover, Green 1994 argues that restrictions on INDEX values, normally taken to be a part of CONTENT (i.e., values of the attribute RESTRICTION) should rather be treated as beliefs about how referential expressions may be used, i.e., as parts of CONTEXT. This is because "as language users, we are free to use any word to refer to anything at all, subject only to the purely pragmatic constraint that... our intended audience will be able to correctly identify our intended referent from our use of the expression we choose" (p. 7). If, nevertheless, expressions such as *dog* have certain 'standard' or 'normal' meanings it is due to the mutual belief of the speaker and the hearer as to what a normal belief about the referential use of *dog* is within a given language community. According to these considerations, a partial simplified ('naive') version of the lexical entry for *dog* would be (72).

(72)
$$\begin{bmatrix}
\text{PHON} & \langle \textit{ dog } \rangle \\
\text{SS}|\text{LOC} & \begin{bmatrix}
\text{CONT}|\text{INDEX} & \boxed{1} \\
\text{CONX} & \begin{bmatrix}
\text{C-INDS} & \begin{bmatrix} \text{SPEAKER} & \boxed{2} \\ \text{ADDRESSEE} & \boxed{3} \end{bmatrix} \\
\text{BKGRND} & \left\{ \begin{bmatrix} \textit{mutually-believe} & \\ \text{EXPERIENCER} & \boxed{2} \\ \text{STANDARD} & \boxed{3} \\ \text{SOA} & \begin{bmatrix} \textit{normally-believe} & \\ \text{EXPERIENCER} & \textit{English speakers} \\ \text{SOA} & \begin{bmatrix} \textit{canis} & \\ \text{INST} & \boxed{1} \end{bmatrix} \end{bmatrix} \end{bmatrix} \right\}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}$$

This approach to referential expressions is a step towards representation of cases of transferred reference, extensively discussed by Nunberg (1978), such as (73) below.

(73) The milkshake claims you kicked her purse.

6 Issues in morphosyntax

6.1 Romance and Slavic Clitics

Romance clitics. There is a recent body work in HPSG on Romance cliticization, represented by, e.g., Miller 1992, Miller & Sag 1997 (for French), and Monachesi 1993 and Monachesi 1999 (for Italian), which argues that Romance 'clitics' are actually lexical affixes and provides a lexicalist account, contra earlier claims that such a lexicalist approach to Romance cliticization cannot be uniformly executed (Sportiche 1996). We present the main features of this account on the basis of Miller & Sag 1997.

The main idea of this analysis is that French 'clitics' corresponding to arguments of a head are present on this head's ARG-ST, but not on its VALENCE attributes. Thus, 'clitics' do not constitute separately licensed syntactic entities. Instead, there is a morphological constraint which takes the presence of 'clitics' on ARG-ST into consideration when 'calculating' the actual morphological form of the head.

Specifically, *word*s are assumed to have a feature MORPH, whose values introduce three further features, STEM, I-FORM and FORM:

(76)
$$\begin{bmatrix} \textit{word} & \\ \text{MORPH} & \begin{bmatrix} \text{FORM} \ \ldots \\ \text{I-FORM} \ \ldots \\ \text{STEM} \ \ldots \end{bmatrix} \end{bmatrix}$$

The values of STEM correspond to the morphological stem of the head, I-FORM represents the inflected form of the head before 'clitics' are taken into account, while FORM values represent full inflected forms including any 'clitics' realized on the head. For example, the 3rd person singular present tense indicative form of the lexeme LAVER 'wash' with its object realized as an anaphoric affix has the following MORPH value:

(77)
$$\begin{bmatrix} \text{FORM} \ \textit{se-lave} \\ \text{I-FORM} \ \textit{lave} \\ \text{STEM} \ \textit{lav-} \end{bmatrix}$$

Simplifying a little, FORM values are derived from I-FORM values, taking into account HEAD and ARG-ST information, via the following constraint:

(78)
$$\textit{word} \rightarrow \begin{bmatrix} \text{MORPH} & \begin{bmatrix} \text{FORM} \ \mathrm{F}_{\text{PRAF}}(\boxed{0},\boxed{1},\boxed{2}) \\ \text{I-FORM} \ \boxed{0} \end{bmatrix} \\ \text{SYNSEM}|\text{LOC}|\text{CAT} & \begin{bmatrix} \text{HEAD} \ \boxed{1} \\ \text{ARG-ST} \ \boxed{2} \end{bmatrix} \end{bmatrix}$$

(82) Pierre les a lavés.
Pierre 3PL has washed
'Pierre washed them.'

In order to deal with such cases, Miller & Sag (1997) assume the argument composition approach, in which higher verbs in such climbing environments do not subcategorize for a VP, but rather combine with the lexical head of the VP and 'take over' ('attract', 'raise') all arguments of this head to their own ARG-ST. For example, a partial and schematic lexical entry for the auxiliary *avoir* is given in (83):

(83) AVOIR (tense auxiliary):

$$\left[\begin{array}{l} \mathit{word} \\ \mathrm{SS}|\mathrm{LOC}|\mathrm{CAT} \left[\begin{array}{l} \mathrm{HEAD}\ \mathit{verb} \\ \mathrm{ARG\text{-}ST}\ \left\langle \boxed{1}, \left[\begin{array}{l} \mathit{synsem} \\ \mathrm{LOC}|\mathrm{CAT} \left[\begin{array}{l} \mathrm{HEAD} \left[\begin{array}{l} \mathit{verb} \\ \mathrm{VFORM}\ \mathit{past\text{-}p} \\ \mathrm{V\text{-}AUX}\ \mathit{avoir} \end{array}\right] \\ \mathrm{ARG\text{-}ST}\ \langle \boxed{1} \rangle \oplus \boxed{2} \end{array}\right] \end{array}\right] \right\rangle \oplus \boxed{2} \end{array}\right] \end{array}\right]$$

All arguments, including 'clitics', of the past participle (*past-p*) that the verb subcategorizes for are also present on the ARG-ST of *avoir*, where the constraint (78) applies and ensures that any clitics raised from the ARG-ST of the past participle are morphologically realized. Of course, since (78) is a constraint on all *word*s, it nonvacuously applies to the past participle as well. Nevertheless, the $\mathrm{F}_{\mathrm{PRAF}}$ function is defined in such a way that, in case its second argument ($\boxed{2}$ in (78)) is a *past-p* head, it is the identity function on the first argument. The overall result of this is that no 'clitics' are realized on past participles.

Slavic clitics. Another analysis of morphosyntactic aspects of cliticization is that of Borsley (1999), who presents an HPSG analysis of so-called *mobile inflections* in Polish discussed earlier in GB terms in Borsley & Rivero 1994, and argues that the former is more satisfactory in a number of ways. In particular, Borsley (1999) analyzes the enclitic *-ś* in (84b) as a 'weak auxiliary' which subcategorizes for a participial verb, i.e., as a syntactic item. At the same time, he also argues that the similarly looking element *-eś* in (84a) should rather be analyzed as attaching to the verb in the lexicon, that is, within the morphology proper.

(87)
$$\begin{bmatrix} \textit{complex-verb} & \\ \text{PHON} & \boxed{1} + \boxed{2} \\ \text{MORPH-B} & \left\langle \begin{bmatrix} \text{PHON} & \boxed{1} \\ \text{SYNSEM} & \boxed{3} \end{bmatrix}, \begin{bmatrix} \textit{weak-aux} & \\ \text{PHON} & \boxed{2} \\ \text{SYNSEM}|\text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} \\ \text{VFORM } \textit{fin} \end{bmatrix} \\ \text{VALENCE} & \begin{bmatrix} \text{SUBJ} & \boxed{4} \\ \text{COMPS} & \langle \boxed{3} \rangle \oplus \boxed{5} \end{bmatrix} \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{SYNSEM}|\text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} \\ \text{VFORM } \textit{fin} \end{bmatrix} \\ \text{VALENCE} & \begin{bmatrix} \text{SUBJ} & \boxed{4} \\ \text{COMPS} & \boxed{5} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Here, Borsley (1999) follows Riehemann (1998) in assuming that morphologically complex words have the feature MORPH-B (morphological base), whose value is a list of *sign*s. In (87), the same weak auxiliary occurs within the morphological makeup of the complex verb *widziałeś* as described in (85). However, since this finite auxiliary combines with the participle at the lexical level, it may (in fact, *must*, according to the order of elements of MORPH-B in (87)) occur after the verb (the LP constraint (86) does not apply at the level of MORPH-B) and it may participate in various word-level morphophonological processes.

(Add references to Kupść, Penn and Avgustinova and Crysmann?) AP

6.2 Mixed Categories

HPSG, with its type hierarchies and the mechanism of multiple inheritance, is particularly well-suited for analyzing mixed categories, i.e., categories which simultaneously share various properties of different major categories such as verb or noun.

Malouf (1998, 2000b) utilizes these mechanisms to provide an HPSG account of verbal gerunds in English (like (88a)–(88b), but not (88c)), well known for their mixed verbal/nominal properties.

(88) a. Everyone was impressed by [Pat's artfully folding the napkins]. (verbal POSS-*ing* gerund)

b. Everyone was impressed by [Pat artfully folding the napkins]. (verbal ACC-*ing* gerund)

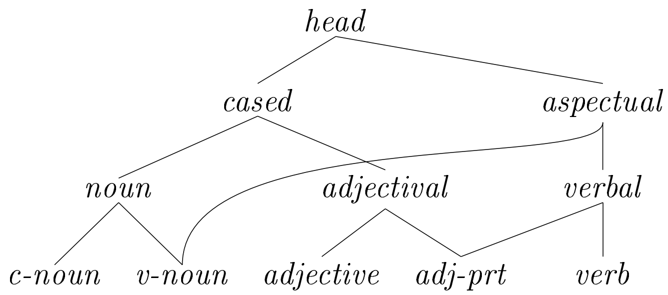
c. Everyone was impressed by [Pat's artful folding of the napkins]. (nominal gerund)

b.*I couldn't figure out [who(m) being late every day] Pat didn't like __.
(verbal ACC-*ing* gerund)

Languages with more morphology than English provide additional evidence for the essential usefulness of this approach to mixed categories. For example, in Polish, there is a number of mixed categories. One of them, called *verbal noun*, is verbal in the sense that the argument structure of a verbal noun is systematically related to that of the corresponding verb and, more importantly, in the sense that verbal nouns show both aspect and negation morphologically, just like Polish verbs do. On the other hand, verbal nouns are nominal in the sense that they occur in positions reserved for NPs, and also have gender (neutral), decline for case and number, and can be modified by adjectives, just like ordinary nouns. Another mixed category in Polish is that of *adjectival participles*, which inflect for case and number, and modify nouns, just like other adjectives, but may inflect for negation and (to some extent) aspect, like verbs, and also pattern with verbs in the way they assign case to their arguments (e.g., they combine with accusative NPs, which undergo the genitive of negation; cf. Przepiórkowski 1999a).

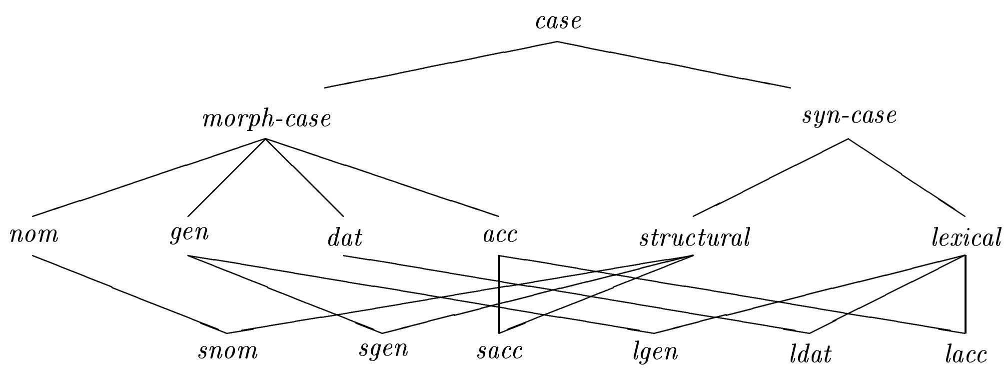
Note that these Polish mixed categories are somewhat more complex that English verbal gerunds in that they combine properties of different major categories *at the same level*; for example, Polish verbal nouns display internal structure and morphology of both nominal (e.g., case) and verbal (e.g., aspect and negation) elements. This makes them ineligible for accounts, often proposed for English verbal gerunds, which posit that such verbal/nominal elements are purely verbal as far as their internal structure is concerned, but they project to nominal phrases, which explains their distribution (cf. Malouf 1998, 2000b for a review of such approaches). On the other hand, the multiple inheritance type hierarchy approach can be applied straightforwardly; e.g., a partial *head* type hierarchy for Polish could be:[18]

(91)



[18]See Przepiórkowski 1999a, appendix, for a more comprehensive *head* type hierarchy for Polish.

(92)



Second, lexical entries of predicates (verbs, nouns, etc.) are assumed to distinguish between *str*uctural arguments and *lex*ical arguments: only the latter, not the former, are morphologically specified in such lexical entries. For example, German verbs *unterstützen* ‘support’ and *helfen* ‘help’ are assumed to have following ARG-ST (originally, SUBCAT) specifications:

(93) a. *unterstützen*: [ARG-ST ⟨NP[*str*], NP[*str*]⟩]
b. *helfen*: [ARG-ST ⟨NP[*str*], NP[*ldat*]⟩]

The criterion for deciding which arguments are structural (i.e., bear a *str*uctural case) and which are lexical is roughly the stability of the morphological case of these arguments across syntactic configurations. For example, the case of the second argument of *unterstützen* (i.e., its object) is unstable because it is accusative in active voice and nominative in passive, cf. (94), while the second argument of *helfen* is stable, because it is dative in both voices, cf. (95).

(94) a. Der Mann unterstützt **den Installateur**.
the.NOM man supports the.ACC plumber
‘The man is supporting the plumber.’

b. **Der Installateur** wird unterstützt.
the.NOM plumber AUX supported
‘The plumber is supported.’

(95) a. Der Mann hilft **dem Installateur**.
the.NOM man helps the.DAT plumber
‘The man is helping the plumber.’

while various case-receiving elements are absent from VALENCE attribute(s) on current approaches to extraction and cliticization.

An approach to case assignment which solves these problems was proposed in Przepiórkowski 1996 and is most fully described and illustrated in Przepiórkowski 1999a. This approach accepts the first two parts of Heinz & Matiasek's (1994), i.e., it assumes the structural/lexical case dichotomy, but it changes the actual case-assigning principles in such a way that case is assigned strictly locally and non-configurationally (without recourse to DTRS) to the elements of ARG-ST, rather than being assigned on VALENCE attribute(s).[21]

Such an approach has long been deemed impossible because of, e.g., the so-called remote passive in German, where correct resolution of the *str*uctural case of an argument seems to crucially depend on the tree-configurational realization of this argument. Przepiórkowski 1999a shows, though, that the only non-local information that is required to correctly assign structural case is binary, roughly, whether a given argument is realized locally or raised to be realized higher up. Once elements of ARG-ST are marked with this binary information, case can be assigned to them strictly locally and non-configurationally. For example, the constraints in (96) above would be restated within this approach as (97) below, where 'NP$^-$' describes an occurrence of an NP which is not raised to a higher ARG-ST.[22]

(97) a. $$\begin{bmatrix} \textit{cat} \\ \text{HEAD } \textit{verb} \\ \text{ARG-ST } \langle \text{NP}^-[\textit{str}] \rangle \oplus \boxed{2} \end{bmatrix} \rightarrow \begin{bmatrix} \text{ARG-ST } \langle \text{NP}[\textit{snom}] \rangle \oplus \boxed{2} \end{bmatrix}$$

b. $$\begin{bmatrix} \textit{cat} \\ \text{HEAD } \textit{verb} \\ \text{ARG-ST } \langle \boxed{1}, \text{NP}^-[\textit{str}] \rangle \oplus \boxed{2} \end{bmatrix} \rightarrow \begin{bmatrix} \text{ARG-ST } \langle \boxed{1}, \text{NP}[\textit{sacc}] \rangle \oplus \boxed{2} \end{bmatrix}$$

This approach, apart from being arguably conceptually cleaner, avoids the technical problems of Heinz & Matiasek's (1994) analysis to do with extraction and cliticization: regardless of which approach to extraction (traced or traceless) or cliticization (syntactic or morphophonological) is adopted, all case-bearing arguments (more generally, dependents) of a predicate are present on this predicate's ARG-ST (or DEPENDENTS, assuming the architecture of Bouma *et al.* 1999b) and may be assigned case in a uniform way. See Przepiórkowski 1999a for details and extensive application to case assignment in Polish and

[21] A similar approach is sometimes assumed in LFG, but has never been substantiated, to the best of our knowledge.

[22] Various ways of representing such information about (not) being raised to a higher ARG-ST are adduced in Przepiórkowski 1999a and Meurers 1999a.

gender. A strictly semantic approach predicts that these conventions can be used independently of each other, and in fact, that is what we find across sentences, cf. (99):

(99) That dog is so stupid, every time I see **it** I want to kick **it**. **He**'s a damn good hunter, though.

However, within certain grammatical domains, the linguistic convention used must be respected in subsequent referrals. This is why the alternations between neuter and masculine pronominals in (100c,d) give rise to illformedness:

(100) a. That dog is so ferocious, it even tried to bite itself.

b. That dog is so ferocious, he even tried to bite himself.

c.*That dog is so ferocious, it even tried to bite himself.

d.*That dog is so ferocious, he even tried to bite itself.

If we adopt indices as a device which in a sense keeps a record of aspects of the linguistic form that was used to introduce an entity into the discourse then these domain effects can readily be explained simply via structure sharing among indices.

As Pollard & Sag (1994) point out, however, there are cases where properties of the linguistic form need to be distinguished from properties of the referent itself. An illustration from French of such a situation is given in (101):

(101) Vous êtes belle.
you are-PL beautiful-SG.FEM
'You are beautiful.'

Here, the subject *vous* with a single female as the intended referent is involved in two agreement relations. It triggers plural morphology on the verb *êtes*. At the same time, the predicative adjective exhibits feminine singular morphology. Whereas the first can straightforwardly be attributed to the number properties of the index of *vous*, Pollard & Sag (1994) propose that the singular marking of the adjective be seen as a reflection of inherent, semantic properties of the subject's referent. Thus, we need to distinguish between the index per se and the conditions under which an index is referentially linked ("anchored to") an entity of the world. The singular morphology on *belle* can be viewed as a fact about the pragmatics of using morphologically plural *vous* with a nonaggregate referent. The two-way split between syntactic/semantic index-agreement and pragmatic agreement of the latter kind is illustrated in (102):

Data like these indicate that agreement as a relation between syntactic forms needs to be distinguished from morphological form as possible, but not necessary exponent of a dependency among syntactic units. For that reason Kathol (1999b) proposes that all inflecting lexical categories have a description of their morphological form in terms of the head feature MORSYN. Embedded inside the value of MORSYN is the attribute AGR, which groups together all morphosyntactic features that are, in principle, subject to covariation.[23] For example, nominals are typically assumed to have the following attributes within AGR values: CASE, GENDER, NUMBER, while verbs are assumed to have the attributes PERSON, NUMBER and, in some languages, GENDER (but not CASE):

(105) a. nouns, adjectives, etc.:

$$\left[\text{AGR} \left[\begin{array}{l}\text{CASE } \textit{case}\\ \text{GENDER } \textit{gender}\\ \text{NUMBER } \textit{number}\end{array}\right]\right]$$

b. verbs:

$$\left[\text{AGR} \left[\begin{array}{l}\text{PERSON } \textit{person}\\ \text{NUMBER } \textit{number}\\ (\text{GENDER } \textit{gender})\end{array}\right]\right]$$

As a consequence, NP-internal agreement (between the noun and its adjectival modifiers) can be treated as a concord of all agreement-relevant features, not just CASE, as previously assumed by Pollard & Sag (1994). This is illustrated with the following example from Polish where there is NP-internal agreement between demonstratives, adjectives, and nouns involving case, number, and gender:

(106)

ten	duży	chłopiec
this.NOM.SG.MASC	big.NOM.SG.MASC	boy.NOM.SG.MASC
$\left[\text{AGR } \boxed{1}\right]$	$\left[\text{AGR } \boxed{1}\right]$	$\left[\text{AGR } \boxed{1}\left[\begin{array}{l}\textit{index}\\ \text{CASE } \textit{nom}\\ \text{GENDER } \textit{masc}\\ \text{NUMBER } \textit{sg}\end{array}\right]\right]$

The assumption of AGR as a bundle of features that may participate in an agreement relation allows for a greater differentiation in terms of which pieces of lexical information bear a systematic relation with morphology and semantics/pragmatics—and what kinds of mismatches are possible. A detailed

[23]Along similar lines, Wechsler & Zlatić (forthcoming) group locally shared information under CONCORD.

Contrast this now with the situation in which the declension class mismatch has no bearing on the covariance behavior of dependent elements. For instance, *Steva* ('Steve') is also inflected according to declension class II, yet as the example in (110b) illustrates, the determiner and the adjective exhibit masculine agreement:

(110) a. *Stev-a* ('Steve')

declension class	II (typically for fem. nouns)
concord	masculine sing
index	masculine sing

b. Vratio mi je ovaj ludi Steva
returned me AUX this.NOM.M.SG crazy.NOM.M.SG Steve.NOM
violinu koju sam mu pozajmio.
violin which AUX him loaned
'This crazy Steve returned to me the violin which I loaned him.'

If we represent declension, concord, index, and semantics as four parameters of variation the case of totally transparent morphological and covariation properties can be represented as in (111a). Where there is a split between morphology, NP-internal concord and NP-external covariation behavior—as with *deca* in (108, 109), there is a misalignment between concord and index-based properties, as shown in (111b). Finally, the situation where the exceptionality is restricted to morphology, as in (110), can be represented schematically as in (111c).

(111)
a. declension $\Leftrightarrow$ concord $\Leftrightarrow$ index $\Leftrightarrow$ semantics
b. declension $\Leftrightarrow$ concord $||$ index $\Leftrightarrow$ semantics
c. declension $||$ concord $\Leftrightarrow$ index $\Leftrightarrow$ semantics

As Wechsler & Zlatić (forthcoming) show, this conception of agreement as a multi-layer phenomenon based on a number of default alignments between "modules" makes correct predictions with respect to the expected scope of different kinds of covariation as well as possible possible exceptions.

7 Advances in Logical Foundations (RSRL)

Within the last 15 years or so, a number of different formalisms have been proposed for formalizing HPSG-style analyses, e.g., Kasper & Rounds 1986, King 1989 and Carpenter 1992. These different formalisms often reflect the state of the art in HPSG theorizing at the time when they were developed and more stand in the *local o-command* relation if and only if both have LOCAL | CONTENT | INDEX values of type *ref*, their LOCAL values are not token-identical and, moreover, either y and x stand in the *more oblique* relation, or there exists a *synsem* object s such that y is a member of s's LOCAL | CATEGORY | SUBCAT, and s and x stand in the *more oblique* relation. Similar paraphrases can be given for the notions introduced in (113c–d).

These paraphrases already show that there is a great deal of existential quantification hidden in Pollard & Sag's (1994) Binding Theory. The definition of the *more oblique* relation makes reference to *some word*, the definition of *local o-command* refers to *a synsem object*, etc.

Any direct formalization of this Binding Theory must also make use of universal quantification. This is because the logical structure of Principles A–C is actually as follows: *For each x such that x is a locally o-commanded anaphor / a personal pronoun / a nonpronoun, x is locally o-bound / locally o-free / o-free, respectively.* Note that, apart from universal quantification, these principles also make direct use of existential quantification. For example, the more careful paraphrase of Principle A would be:

(114) Principle A of Pollard & Sag's (1994) Binding Theory (paraphrased):

> For each x such that, both, x is an anaphor and there exists y such that y and x stand in the local o-command relation, there exists z such that z and x stand in the local o-binding relation.

Finally, the definition of *(local) o-freeness* in (113d) calls for the presence of logical negation in the underlying formalism: two objects x and y stand in the *(local) o-freeness* relation if and only if they do not stand in the *(local) o-binding* relation.

Although relations, quantification and general logical negation are commonly (even if often implicitly) used in HPSG, for a long time there existed no HPSG formalism providing the logical foundations for these notions. A formalism meeting these desiderata has been proposed in Richter *et al.* 1999 and, more comprehensively, in Richter 2000 under the name "RSRL" (Relational Speciate Re-entrant Language). It is based on Paul King's SRL (Speciate Re-entrant Logic; cf. King 1989, 1994, 1999 and Pollard 1999) but extends SRL by introducing relations and restricted quantification. A formal introduction to RSRL would be well beyond the scope of this survey, so we will only illustrate this formalism here.

Let us look again at Principle A, as paraphrased in (114). Assuming the existence of relation symbols `loc-o-command` and `loc-o-bind` which correspond to *local o-command* and *local o-binding*, respectively, this principle could be rendered in RSRL as follows (Richter 2000:§4.2):

$$(^{s}\begin{bmatrix} \textit{synsem} \\ \text{LOC CAT SUBCAT } \boxed{3} \end{bmatrix} \wedge$$
$$\texttt{more-oblique}(s, x) \ \wedge$$
$$\texttt{member}(y, \boxed{3})))$$

Similar definitions can be given for relations `loc-o-bind` and `o-bind`.

One important aspect of RSRL that should not be overlooked is the restricted character of its quantification mechanism: the range of quantifiers used in an RSRL description is restricted to components of the described object. Let us illustrate this aspect with a generalization regarding Serbo-Croatian case assignment discussed in Wechsler & Zlatić 1999, 2000 and cited in (119) below.

(119) Serbo-Croatian Dative/Instrumental Case Realization Condition.

If a verb or noun assigns dative or instrumental case to an NP, then that case must be morphologically realized by some element within the NP.

The element which 'realizes' the dative/instrumental case on an NP does not have to be the head of this NP: in Serbo-Croatian, there is a class of uninflected female names which do not decline for case at all and, hence, are grammatical in dative and instrumental positions only when accompanied by a determiner or an adjective which is overtly inflected for case, cf. (120).

(120)	Divim	se	*(mojoj)	Miki.
	admire.1ST.SG	REFL	my.DAT.SG	Miki
	'I admire (my) Miki.'			

The generalization in (119) is difficult to state without quantification (cf. Wechsler & Zlatić 1999 for an attempt), but straighforward when quantification is available; (121) is a slightly modified version of the constraint given in Wechsler & Zlatić 2000.

(121)
$$\begin{bmatrix} \textit{phrase} \\ \text{SYNSEM}|\ldots|\text{CASE } \boxed{1}(\textit{dative} \vee \textit{instrumental}) \end{bmatrix} \rightarrow$$
$$\rightarrow \ \exists x \mid x = \begin{bmatrix} \textit{inflected-word} \\ \text{SYNSEM}|\ldots|\text{CASE } \boxed{1} \end{bmatrix}$$

This constraint is already almost an RSRL principle. The RSRL version is given below.

spin-off that relies heavily on HPSG-based ideas (YY Corporation). While the history of linguistics has seen its share of "movements" that fizzled out after only a few productive years, we hope to have conveyed to the reader our confidence that there is still a tremendous amount of unrealized potential in HPSG.

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