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HPSG for Slavicists*

1 Why Formal Grammar?

Head-driven Phrase Structure Grammar (HPSG) can be briefly and preliminarily characterized as a comprehensive, eclectic and generative linguistic formalism. Why should a Slavicist care about a linguistic formalism (how many have we seen before?), one that is not even the most dominant in the field? Why do we need any formalism, for that matter?

The single most important reason is probably that we want our linguistic theories to have some predictive power, i.e., we want them to be able to predict which linguistic expressions (or linguistic structures) belong to the language, and which do not. In other words, we want a theory that, minimally, *describes* the language, whether it also has other, more profound aims (like *explaining* the language), or not. While, theoretically, it is possible to state such a predictive theory *of* a language or a phenomenon *in* a natural language, in practice, it often turns out that natural languages are too vague and imprecise for this task. According to Pollard and Sag (1994, p. 6):

> An informal theory is one that talks... in natural language... But as theories become more complicated and their empirical consequences less straightforwardly apparent, the need for formalization arises.

In this sense, HPSG, with its emphasis on precision, is a Chomskyan theory. As Ivan Sag put it:[1]

> [T]rying to articulate precise hypotheses about the nature of syntax, or morphology, or the lexicon... is what I would regard as Chomsky's most

*The previous version of this paper circulated as Przepiórkowski (2000d).

[1] In an interview for *Ta!*, the Dutch students' magazine for computational linguistics, volume 2, number 2, Summer 1993; cf. http://www.let.uu.nl/~Anne-Marie.Mineur/personal/Ta/Sag.html.

> important contribution to linguistic science — one that will long outlive the Empty Category Principle, theories of 'government' and 'barriers', and so forth.

But, of course, HPSG is not only a linguistic *formalism*; it is also a cornucopia of novel *linguistic analyses* of a variety of phenomena from a variety of languages stated in this formalism, as well as a certain sociological approach to linguistic inquiry. In sec. 2 below, we briefly characterize Head-driven Phrase Structure Grammar in very general terms, suggesting what it has to offer to the linguistic community, and why it has become the formalism of choice for many linguists with varying backgrounds. Then, in sec. 3–4, we present what we view as main architectural and linguistic ideas of HPSG, and, in sec. 5, move to characterizing the main trends in recent and current HPSG research. Sec. 6 presents recent HPSG work devoted to Slavic languages. Finally, we conclude in sec. 7, and attempt to identify some areas of future HPSG work. Additionally, appendix A contains information on HPSG textbooks, as well as other resources useful for newcomers to HPSG.

2 Some General Features of HPSG

There are two interrelated aspects of HPSG that should be considered separately: HPSG as a *linguistic formalism*, i.e., as a set of formal tools for formalizing linguistic analyses of various phenomena, and HPSG as a *linguistic theory*, i.e., a collection of analyses of various phenomena couched in this formalism. Embracing one does not necessarily entail embracing the other.

For example, it is possible (and has been done) to use the HPSG formalism to encode various insightful analyses of, say, Dependency Grammar and to study their properties and consequences in a more formal way (cf. Rosen (2000) for an account of Czech word order). Conversely, a linguistic analysis isomorphic with an existing HPSG analysis of a linguistic phenomenon can be formulated in a different framework.[2]

[2]See, for example, Hornstein's (1999) Minimalist analysis of raising and control (or 'equi') as

In the following two subsections, we will very briefly characterize HPSG as a linguistic formalism and as a linguistic theory, making on the way occasional brief comparisons with Minimalism (Chomsky, 1995), the dominant linguistic theory at the time of writing this paper. We will look at both aspects in a little more detail in sections 3 and 4, respectively.

2.1 HPSG *qua* Linguistic Formalism

HPSG was developed as a **comprehensive** linguistic formalism for work on syntax, morphology and semantics, as well as phonology and pragmatics. In fact, HPSG preaches what might be called **radical nonautonomy** (Pollard, 1996): no level of grammatical knowledge is privileged with respect to others, and no level is derived from any other. This should be contrasted with the *autonomy of syntax* of Chomskyan transformational theories, including Minimalism. As is emphasized in sec. 4–6 below, much of HPSG work is devoted to grammatical interfaces, where various grammatical levels mutually constrain each other, without any of them being dominant or more important than the others.

Another important difference between HPSG and transformational theories is that HPSG is a **monostratal** theory of language: there are no derivations transforming one grammatical structure into another. Instead, a grammatical structure is well-formed by virtue of simultaneously satisfying all constraints that the grammar imposes. Further, all **constraints are local**, limited to one structure at a time. Thus, HPSG has no equivalent of Minimalism's *global constraints*, consisting in comparison of alternative derivations.[3]

We already mentioned above that HPSG puts emphasis on **explicitness and precision**. HPSG linguistic analyses are couched in a mathematical formalism with well-defined syntax and model-theoretic semantics. In this sense, HPSG is a proto-

involving essentially the same constituent structures, contra the view long dominant in Chomskyan linguistics, but similarly to the standard HPSG analysis of raising and equi (cf. sec. 4.3).

[3]Johnson and Lappin (1997, 1998) argue at length that such global constraints, including their more constrained versions proposed in Collins (1997), pose serious conceptual and computational problems.

typical representative of **generative grammars**.[4] Moreover, HPSG practitioners are usually familiar with **mathematical concepts and methods** (especially, those of logic, set theory, algebra), and "are willing to acquire a wide range of technical tools, and use them in the interest of clarifying their theoretical analyses and proposals" (Pollard, 2001b). These solid formal foundations of HPSG should be contrasted with the essentially programmatic character of Minimalism, where the properties of such important constructs as, e.g., *features* are never formally specified, and where it is not clear what the properties of the all-important interface levels LF and PF are.[5]

Because of this explicitness and formality, HPSG has become one of the most popular linguistic formalisms in **computational linguistic applications**: according to one high-profile computational linguist, "there are more people working on and with implemented head-driven phrase structure grammars than with any other linguistic grammar model" (Uszkoreit, 1996). The popularity of the framework has been also confirmed at a recent workshop on Large-scale Grammar Development and Grammar Engineering (July 2006[6]), as half of the presented systems were based on HPSG, used for parsing and generation (for English, German, Greek, French) as well as applied, among others, to machine translation (Wahlster, 2000; Loenning *et al.*, 2004) or question answering (Bouma *et al.*, 2005) tasks.

2.2 HPSG *qua* Linguistic Theory

Head-driven Phrase Structure Grammar is an **eclectic** linguistic theory. It evolved from Generalized Phrase Structure Grammar (GPSG; Gazdar *et al.* 1985), although

[4] "If the grammar is... perfectly explicit... we may... call it a generative grammar" (Chomsky, 1965, p. 4), "I have always understood a generative grammar to be nothing more than an explicit grammar" (Chomsky, 1995, p. 162, fn. 1). Note that some linguists wrongly use the term *generative* as only referring to whatever the current approach advocated by Chomsky happens to be. See relevant entries in dictionaries of linguistic terms (e.g., Trask (1993) and Crystal (1997)), as well as Borsley (2000) for a lucid discussion.

[5] This last point is made in Jackendoff (1997, p. 21). On essentially programmatic character of Minimalism see, e.g., Freidin (1997, p. 580) and Lappin *et al.* (2000), as well as the following quote from Chomsky (1998, p. 5): "One should bear in mind that it is a **program**, not a theory, even less so than the [Principles and Parameters] approach. There are minimalist questions, but no minimalist answers..."

[6] `http://cl.haifa.ac.il/workshop/abstracts.shtml`

it clearly departs from GPSG both in terms of formal foundations and in terms of linguistic analyses, and it has been freely borrowing from Categorial Grammar (CG; Wood 1993; Morrill 1994), Lexical-Functional Grammar (LFG; Bresnan 1982), the Government and Binding theory (GB; Chomsky 1981, 1986a,b) and, more recently, from the Construction Grammar (Kay, 1995; Goldberg, 1995; Fillmore, 1999). Semantic representations assumed in HPSG are usually based on Situation Semantics (Barwise and Perry, 1983; Devlin, 1991) and Discourse Representation Theory (DRT; Kamp 1981; Kamp and Reyle 1993; Reyle 1993). Due to this eclecticism, it is more customary to cite works representing other schools of linguistic thought in HPSG than in many other frameworks.

Like in many other current linguistic theories, including LFG and GB / Minimalism, much of work within HPSG avoids the rule-based approach, upon which each construction must be listed separately in the grammar, and assumes instead that grammars consist of an **interacting collection of simple and general constraints**, which conspire in accounting for often very complex phenomena. However, there is also another thread of HPSG work, inspired by Construction Grammar, which assumes the existence of a rich hierarchy of grammatical constructions, where more specific constructions inherit the general properties of the less specific constructions but also contribute their own idiosyncratic properties, cf. Fillmore *et al.* (2003).

Also similarly to various other theories, HPSG is highly **lexicalist**: lexical entries are very rich in information and often assumed to be organized in lexical hierarchies which allow encoding lexical information in a non-redundant way (i.e., without having to repeat similar information in many lexical entries).

Moreover, again just like in GB / Minimalism, since the ultimate goal of HPSG is to characterize human linguistic competence, HPSG practitioners are interested in developing **explanatory** analyses of natural language phenomena. But, as observed by Webelhuth *et al.* (1999a, p. 3):

> HPSG's methodology insists upon accepting linguistic analyses as explanatory only when they can be shown to be compatible with a broad and representative database of facts from a given language. This is sometimes

> misunderstood as a lack of interest in linguistic explanation and a mere focus of the theory on description. But HPSG is as much interested in finding explanations for linguistic facts and the human language as other grammatical frameworks. What sets HPSG... apart from [GB / Minimalism] is that its methodological underpinnings require a considerably more careful and complete demonstration of analytical success before one is entitled to the claim of having provided an explanatory analysis.

Unlike in GB and Minimalism, however, no strong claims are made with respect to the **psychological reality** of the grammars that are developed, although the grounds for such claims seem to be stronger than in GB / Minimalism (Sag and Wasow, 1999, sec. 9.4–9.6). In particular, HPSG, just as other constraint-based grammars, is fully *reversible*, i.e., it is well-suited as a model of linguistic competence accessed both at production and comprehension (contrast this with the inherent directionality of transformational grammars). HPSG is also compatible with the fact that sentences are *interpreted incrementally* (Trueswell *et al.*, 1994; Tanenhaus and Trueswell, 1995); this is because, in HPSG, words have similar structure to whole sentences, i.e., they contain both phonological and semantic information, which can be interpreted before the sentence is completely processed. This, again, should be contrasted with Minimalism, where words can apparently be interpreted only at the LF interface level, after the whole sentence has been constructed. Moreover, HPSG *avoids empty constituents* because there seems to be no evidence for the presence of empty constituents in syntactic structures and—in fact—there are reasons to doubt their existence (Pickering and Barry, 1991; Pickering, 1993; Fodor, 1993; Sag and Fodor, 1994; Sag, 1999).[7] Finally, HPSG has been shown to be compatible with what we know about *L1 acquisition* (Wacholder, 1995; Green, 1998).

[7]See also Sekerina (2000) on inconclusiveness of various experiments trying to establish the existence of empty constituents.

3 Main Architectural Ideas

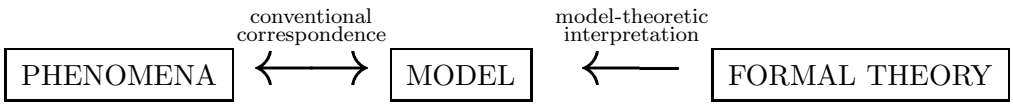
3.1 The Nature of Linguistic Theory

HPSG practitioners consider linguistics to be a formal and, at the same time, empirical science, just like mathematical physics (Pollard and Sag, 1994; Pollard, 1996). Thus, just as there are certain phenomena in physics that need to be accounted for, e.g., movement of planets in the solar system, so in linguistics there is the empirical domain, namely, the language. Moreover, just as in physics there is a formal theory that predicts the positions and velocities of objects in the physical space, so in linguistics there should be a theory predicting the behavior of linguistic objects, whatever they are. Most linguists would agree with that much.

However, in HPSG the analogy is taken further. In physics, the theory does not describe the empirical domain directly, but rather via a model.

> For example, in one kind of standard model of celestial mechanics, the positions and velocities of bodies subject to mutual gravitation are represented by vectors in a higher-dimensional Euclidean space ('phase space'), the masses of the bodies by positive real numbers, and their motions by paths along certain smooth vector fields ('flows') on the space. Of course such a model is not the same thing as what it models (e.g. the solar system), but certain formal properties of such a model may represent aspects of the solar system of interest to a physicist.
>
> (Pollard and Sag, 1994, p. 6)

Thus, the predictive power of a theory is mediated by formal models:

(1) 

In other words, a formal theory explicitly describes (is interpreted by) a model, i.e., a formal construct understood to reflect (be in some way isomorphic with) a fragment of the world around us. This general picture is also adopted in HPSG.

3.2 Formal HPSG Theory

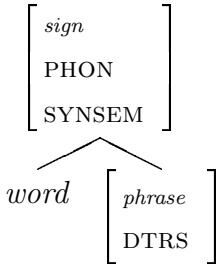
In HPSG, formal theories, i.e., HPSG grammars, are assumed to consist of a *signature* and a *theory* proper. The *theory* is simply a set of constraints that all objects in the model must simultaneously satisfy. Thus, HPSG belongs to the family of constraint-based declarative formalisms (together with Arc-Pair Grammar, GPSG, LFG, and other formalisms). The *signature*, on the other hand, makes ontological assumptions explicit, i.e., it says what types of objects there are (e.g., verbs, nouns, etc.; cases, persons, genders, etc.; etc.) and what features they may have (e.g., verbs have person but not case, nouns have case, genders are atomic objects, i.e., do not have any features, etc.). More formally, a signature is a partial order of types which specifies what types of objects are allowed by the grammar and what attributes might be borne by objects of particular types.

This is probably getting incomprehensible to anybody not already exposed to HPSG, so let us illustrate this with an example; more examples are given in the next subsection, and the sections below.

HPSG assumes that all linguistic expressions are *signs*, understood roughly in the Saussurean sense. Accordingly, the signature contains the type *sign* and the information that all objects of this type must have at least two attributes, PHONOLOGY (abbreviated to PHON), whose values represent the phonological makeup of the sign, and SYNSEM (SYNtax-SEMantics), whose values correspond to the syntax and the semantics of that *sign*. However, *sign* objects which are phrases contain certain components that words lack, namely, constituent structure. Thus, two subtypes of *sign* are assumed, *word* and *phrase*, and only the latter is specified for the attribute DAUGHTERS (abbreviated to DTRS), whose value represents the constituent structure of the phrase. All this information (and much more!) is contained in the signature, and it is summarized below.[8]

[8]Attributes are also called *features*, but since they behave in a rather different manner than the kinds of features assumed in GB / Minimalism, we avoid using this latter term here.

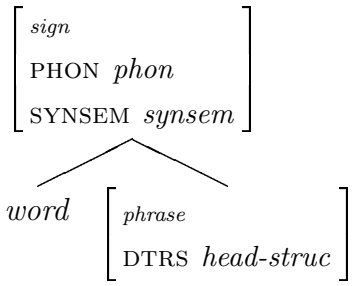
(2)



This bit of the signature should be interpreted in the following way: all objects of type *sign* must be either of type *word* or of type *phrase* (but not both at the same time). All objects of type *sign* (thus, both *word*s and *phrase*s) have the attributes PHON and SYNSEM, and objects of type *phrase* additionally have the attribute DTRS.

In fact, values of attributes are also objects of particular types, and these value types are also specified in the signature; for example, (2) should actually be (3), where *phon* is the type of phonological objects, *synsem* is the type of objects which represent the syntax (excluding constituent structure) and semantics, while *head-struc* is the type of objects representing (headed) constituent structures.[9] Of course, all these types, and the attributes that they bear, must be separately introduced in the signature.

(3)



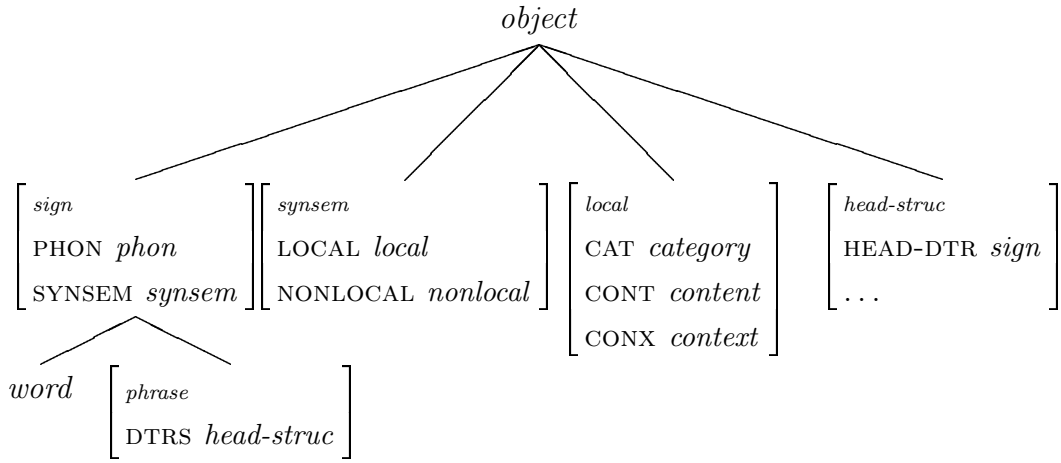
The example above involved just the signature, and not the theory proper (i.e., constraints) itself. Sec. 3.3 slightly extends the signature in (3), and sec. 3.4 introduces some constraints.

[9]Pollard and Sag (1994) actually assume a more general type for values of DTRS, which encompasses also non-headed structures, such as—putatively—coordinate structures. For reasons of exposition, we are making similar simplifications throughout the paper.

3.3 A More Comprehensive Signature

(3) is only a small part of much larger signatures assumed in HPSG; (4) is a slightly more comprehensive part.

(4)



The type *object* is assumed to be the most general type: everything is an object. What (4) says is that each linguistic *object* is either a *sign*, or a *synsem* object, or a *local* object, etc. Additionally, it says what attributes are borne by objects of each type, as well as, what possible values these attributes have.

The part of the signature illustrated in (4) mentions only some of the immediate subtypes of *object*; among the subtypes not shown here are *phon*, *nonlocal*, *category*, etc. Nevertheless, this bit of the signature already shows that the objects assumed in HPSG have a rather complex structure: each *sign* object contains the attribute SYNSEM with values of type *synsem*. But objects of type *synsem* have, in turn, their own attributes, LOCAL and NONLOCAL. Further, LOCAL values have, again, the attributes CAT (for category), CONT (for content) and CONX (for context). Thus, each *sign* object must minimally have the following structure:

(5)
$$\begin{bmatrix} \textit{sign} \\ \text{PHON } \textit{phon} \\ \text{SYNSEM} \begin{bmatrix} \textit{synsem} \\ \text{LOCAL} \begin{bmatrix} \textit{local} \\ \text{CAT } \textit{category} \\ \text{CONT } \textit{content} \\ \text{CONX } \textit{context} \end{bmatrix} \\ \text{NONLOCAL } \textit{nonlocal} \end{bmatrix} \end{bmatrix}$$

As we mentioned above, *synsem* objects represent the broadly understood syntax (minus the constituent structure) and semantics of a *sign*. The two attributes of *synsem* correspond to nonlocal information, i.e., information that a sign contains an unbounded dependency gap, and to local information. Further, *local* objects have three attributes, corresponding to morphosyntax (CAT), semantics (CONT) and (aspects of) pragmatics (CONX).

Moreover, each of *phon*, *category*, *content*, *context* and *nonlocal* has its own structure. For example, *category* objects have attributes summarized in (6), where HEAD values represent strictly morphosyntactic features of the *sign*, VALENCE represents combinatory potential of the *sign* (its subcategorization properties), while ARG-ST values represent the syntactic argument structure of the *sign* (and are usually supposed to be relevant for word *sign*s only).

(6)
$$\begin{bmatrix} \textit{category} \\ \text{HEAD } \textit{head} \\ \text{VALENCE} \begin{bmatrix} \textit{valence} \\ \text{SUBJ } \textit{list(synsem)} \\ \text{COMPS } \textit{list(synsem)} \end{bmatrix} \\ \text{ARG-ST } \textit{list(synsem)} \end{bmatrix}$$

The type *head*, a rough analogue of the traditional notion 'part of speech', additionally has various subtypes corresponding to various morphosyntactic categories (e.g., *verb*, *noun*, etc.), and each of these subtypes may introduce its own attributes (e.g., *verb* introduces VFORM (for verbal form), *noun* introduces CASE, etc.).

3.4 Some Constraints

We said above that HPSG grammars consist of a signature (type hierarchy and attribute specifications) and a theory (a set of constraints). The subsections above illustrate parts of signatures usually assumed in HPSG, and we are now in a position to look at some constraints.

The most famous HPSG constraint is the Head Feature Principle, a version of which is given in (7).

(7) $$\textit{phrase} \rightarrow \begin{bmatrix} \text{SYNSEM|LOCAL|CAT|HEAD } \boxed{1} \\ \text{DTRS|HEAD-DTR|SYNSEM|LOCAL|CAT|HEAD } \boxed{1} \end{bmatrix}$$

The right-hand side of '$\rightarrow$' in (7) is really an abbreviation for (8):

(8) $$\begin{bmatrix} \textit{sign} \\ \text{SYNSEM} \begin{bmatrix} \textit{synsem} \\ \text{LOCAL} \begin{bmatrix} \textit{local} \\ \text{CAT} \begin{bmatrix} \textit{category} \\ \text{HEAD } \boxed{1} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{DTRS} \begin{bmatrix} \textit{head-struc} \\ \text{HEAD-DTR} \begin{bmatrix} \textit{sign} \\ \text{SYNSEM} \begin{bmatrix} \textit{synsem} \\ \text{LOCAL} \begin{bmatrix} \textit{local} \\ \text{CAT} \begin{bmatrix} \textit{category} \\ \text{HEAD } \boxed{1} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Head Feature Principle (7) is an implicational constraint: every object that is characterized by the left-hand side of '$\rightarrow$' must also be characterized by the right-hand side. In this particular case, every object of type *phrase* must be such that the value of its SYNSEM|LOCAL|CAT|HEAD attribute is also the value of the SYNSEM|LOCAL|CAT|HEAD attribute of its head daughter.[10] In prose, each phrase must share its morphosyntactic features with its head daughter.

[10]The tag '$\boxed{1}$' is just a variable used for indicating equality between paths (the number is meaningless). *Paths* are sequences of attributes, like SYNSEM|LOCAL|CAT|HEAD. The value of SYNSEM|LOCAL|CAT|HEAD is simply the SYNSEM value's LOC value's CAT value's HEAD value.

Note that, although the signature given in (4)–(6) above specifies that, on one hand, *phrase* objects have the SYNSEM attribute, whose values have the LOCAL attribute, whose values have the CAT attribute, whose values have the HEAD attribute, whose values are of type *head*, and that, on the other hand, *phrase* objects have the DTRS attribute, whose values..., whose values are of type *head*, the signature does not say anything about the relationship between these two HEAD values. It is only the constraint (7) that says that these two values must be equal (token-identical or structure-shared, in the HPSG parlance).

Note also that, although *all* linguistic objects are supposed to satisfy constraint (7), those which are not phrases do that in a trivial way: since they do not satisfy the antecedent of the implication, they do satisfy the whole implication (cf. the truth of both '*false* → *true*' and '*false* → *false*' in propositional logic).

Another simple constraint is concerned with the relationship between ARG-ST and VALENCE (cf. (6) above). Simplifying, elements of the VALENCE attributes SUBJ and COMPS of a word add up to the elements of ARG-ST of this word:[11]

(9) $$word \rightarrow \left[\text{SYNSEM|LOCAL|CAT} \left[\begin{array}{l} category \\ \text{VALENCE} \left[\begin{array}{l} \text{SUBJ } \boxed{1} \\ \text{COMPS } \boxed{2} \end{array} \right] \\ \text{ARG-ST } \boxed{1} \oplus \boxed{2} \end{array} \right] \right]$$

In prose: for every *word* object, the list being the value of this object's SYNSEM|LOCAL|CAT|ARG-ST is the concatenation of the list values of SYNSEM|...|SUBJ and SYNSEM|...|COMPS, in that order. With this constraint in hand, the lexicon may specify just the ARG-ST value of any word, and the values of SUBJ and COMPS will be derived (in the logical, not transformational sense!) from it in a non-redundant way.

[11] See Manning and Sag (1998, 1999) and Bouma *et al.* (1998b, 2001) for more realistic versions of this principle. There is also an independent principle which says that SUBJ values have at most one element.

4 Some Linguistic Issues

In this subsection, based mainly on Pollard and Sag (1994), we point out just some areas where HPSG provided successful analyses and often new linguistic insights. What we personally find most impressive about Pollard and Sag's (1994) analyses of these, and other, phenomena is not that each of them extends the empirical domain of previous analyses within other frameworks, but that they correctly interact and explain very complex sets of data. In order to appreciate that, the reader is strongly encouraged to read source texts, especially Pollard and Sag (1994).

4.1 Agreement

HPSG seems to devote rather more attention to agreement phenomena across languages than other theories do. HPSG does not attempt to reduce agreement within natural languages to pure syntax or pure semantics; instead, according to the widely assumed analysis of Pollard and Sag (1994, ch.2), with modifications by Kathol (1999), syntactic, semantic and, indeed, pragmatic factors play a rôle in various agreement phenomena.

Following Kathol (1999), one of the *head* attributes (i.e., morphosyntactic attributes) is AGR, whose values correspond to morphosyntactic agreement features. For example, nominals are typically assumed to have the following attributes within AGR values: CASE, GENDER, NUMBER (but no PERSON!), while verbs are assumed to have the attributes PERSON, NUMBER and, in some languages, GENDER (but no CASE!):

(10) nouns, adjectives, etc.:

$$\begin{bmatrix} \textit{category} & & \\ \text{HEAD} & \begin{bmatrix} \textit{head} & \\ \text{AGR} & \begin{bmatrix} \text{CASE} & \textit{case} \\ \text{GENDER} & \textit{gender} \\ \text{NUMBER} & \textit{number} \end{bmatrix} \end{bmatrix} \\ \ldots & \ldots \end{bmatrix}$$

(11) verbs:
$$\begin{bmatrix} \textit{category} & \\ \textsc{head} & \begin{bmatrix} \textit{head} & \\ \textsc{agr} & \begin{bmatrix} \textsc{person} & \textit{person} \\ \textsc{gender} & \textit{gender} \\ \textsc{number} & \textit{number} \end{bmatrix} \end{bmatrix} \\ \ldots & \ldots \end{bmatrix}$$

Now, NP-internal agreement (between the noun and its adjectival modifiers) is assumed to be a purely (morpho)syntactic phenomenon, i.e., identity of AGR values of elements within the NP (nouns, adjectives, etc.):[12]

(12)

ten	duży	chłopiec
$\text{this}_{nom,sg,masc}$	$\text{big}_{nom,sg,masc}$	$\text{boy}_{nom,sg,masc}$
$\left[\ldots\middle\vert\textsc{agr}\ \boxed{1}\right]$	$\left[\ldots\middle\vert\textsc{agr}\ \boxed{1}\right]$	$\left[\ldots\middle\vert\textsc{agr}\ \boxed{1}\begin{bmatrix} \textit{index} & \\ \textsc{case} & \textit{nom} \\ \textsc{gender} & \textit{masc} \\ \textsc{number} & \textit{sg} \end{bmatrix}\right]$

Note that no directionality is assumed here: agreement is viewed as the equality (or structure-sharing) of values of certain attributes, rather than as copying of values from the 'source' of agreement to its 'target'.

Apart from AGR, nominal elements also have the semantic/pragmatic attribute INDEX:

(13) nouns, adjectives, etc.:
$$\begin{bmatrix} \textit{content} & \\ \textsc{index} & \begin{bmatrix} \textit{index} & \\ \textsc{person} & \textit{person} \\ \textsc{number} & \textit{number} \\ \textsc{gender} & \textit{gender} \end{bmatrix} \end{bmatrix}$$

Values of INDEX should be thought of as 'discourse referents': they keep track of entities referred to in a discourse. Note that the attributes PERSON, NUMBER and GENDER are not morphosyntactic attributes here; for example, attributive adjectives

[12] Examples (12) and (14) are from Polish.

are assumed to share their INDEX value with the noun they modify and, hence, are assumed to be specified for INDEX|PERSON, even though they do not show that value in their morphology.

Now, subject–verb agreement (or, more generally, subject–predicate agreement), unlike NP-internal agreement, is understood as normally involving agreement between the subject's INDEX values (i.e., a semantic entity), and the verb's AGR value (i.e., a morphosyntactic entity):

(14)

Ten duży chłopiec	spał.
this big $\text{boy}_{nom,sg,masc}$	$\text{slept}_{3rd,sg,masc}$
$\left[\ldots\middle\vert\textsc{index}\ \boxed{2}\right]$	$\left[\ldots\middle\vert\textsc{agr}\ \boxed{2}\left[\begin{array}{l}\textsc{person}\ \ 3rd\\ \textsc{gender}\ \ masc\\ \textsc{number}\ \ sg\end{array}\right]\right]$

Although, normally, a noun's AGR value matches its INDEX value (compare [1] in (12) with [2] in (14)), Kathol's (1999) theory allows for exceptions to this rule, i.e., it predicts possibilities of mismatches between the subject-internal agreement and the subject–verb agreement, such as that in (15) from Polish.

(15) Wasza wspaniałomyślna wysokość przyszedł rozdrażniony.
your_{fem} $\text{magnanimous}_{sg,fem}$ $\text{highness}_{sg,fem}$ $\text{came}_{3rd,sg,masc}$ $\text{irritated}_{sg,masc}$
'Your magnanimous highness has arrived irritated.'

On the assumption that the noun *wysokość* is exceptional in that it is morphosyntactically feminine (i.e., its AGR|GENDER value is feminine), while having masculine semantic gender (i.e., INDEX|GENDER), (15) is predicted.

A similar mismatch is found in well-known French examples such as (16):

(16) Vous êtes belle.
$\text{you}_{pl?/sg?}$ are_{pl} $\text{beautiful}_{sg,fem}$
'You are beautiful.'

Here, the assumption that both the verb *êtes* and the predicative adjective *belle* agree with the subject *vous* would normally lead to a contradiction because the verb is in

plural and the adjective in singular. However, on the approach advocated in HPSG, there is a mismatch between the AGR|NUMBER value of *vous*, and its INDEX|NUMBER, and the verb agrees with one while the adjective agrees with the other (Kathol, 1999; Wechsler, 1999a).

In addition to these two kinds of agreement, HPSG recognizes purely pragmatic agreement, i.e., agreement resulting from the requirement of pragmatic consistency, as in, e.g., honorific agreement in Korean. See Pollard and Sag (1994, ch.2) for discussion.

4.2 Binding

Despite superficial similarities, the HPSG binding theory differs from those proposed within GB in that it is largely non-configurational: whether two NPs (proper names, pronouns, anaphors) are coindexed or not is not decided on the basis of tree-configurational positions of these NPs, but rather on the basis of their position in the obliqueness hierarchy (i.e., hierarchy of grammatical functions), as expressed by values of the ARG-ST attribute.

For example, Principle A of the HPSG binding theory for English says that:

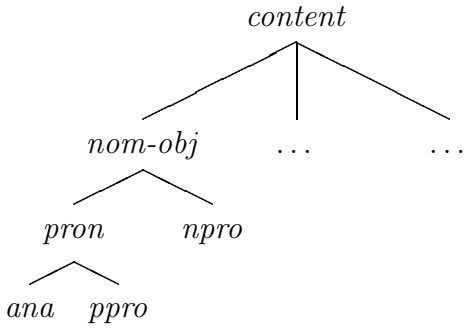
(17) HPSG Binding Theory, Principle A:

A locally o-commanded anaphor must be locally o-bound.

In order to understand the content of this principle, one must understand what *locally o-command*, *locally o-bind* and *anaphor* mean in HPSG.

In HPSG, being an anaphor means having CONT value of type *ana*. So far, we have assumed that CONT values are of type *content* (cf. (5) and (13) above) but, in fact, there is a rich type hierarchy of CONT values. One of the subtypes of *content* is *nom-obj*, the type of CONT values of nominal objects. In turn, *nom-obj* is partitioned into *pron* (pronominal objects in a broad sense) and *npro* (non-pronominal objects, corresponding roughly to GB's R-expressions). Further, *pron* is split into *ppro* (personal pronouns, subject to Principle B of the Binding Theory) and *ana* (anaphors, subject to Principle A). This is summarized below:

(18)



The notions *locally o-command* and *locally o-bind* are very simple: an element α *locally o-commands* an element β iff there is an argument structure (i.e., ARG-ST value) such that α is to the left of β on this argument structure:

(19) $$\left[\begin{array}{l} \textit{category} \\ \text{ARG-ST } \langle \ldots, \alpha, \ldots, \beta \ldots \rangle \end{array}\right]$$

In other words, α locally o-commands β iff α is less oblique than β. Moreover, α *locally o-binds* β iff it locally o-commands β and, additionally, α and β share INDEX values (i.e., are co-indexed; INDEX values are marked via subscripts, cf. $\boxed{1}$ in (20)).[13]

(20) $$\left[\begin{array}{l} \textit{category} \\ \text{ARG-ST } \langle \ldots, \alpha_{\boxed{1}}, \ldots, \beta_{\boxed{1}} \ldots \rangle \end{array}\right]$$

Now, what Principle A (17) says is that, if there is an anaphor on an argument structure, then it must be co-indexed with an element to the left on this argument structure (if there is such an element). Note that if an anaphor is the first ARG-ST element, then this principle does not say anything about it.

Consider a simple example:[14]

(21) John$_i$ admires himself$_i$ / *herself / them / Mary.

admires: $\left[\text{ARG-ST } \langle \text{John}_{\boxed{1}}, \beta_{\boxed{1}/\boxed{2}} \rangle\right]$

[13] As in many other places, we slightly oversimplify here; see Pollard and Sag (1994, ch.6) for details.

[14] We do not give a Slavic example here because a binding theory for Slavic languages, infamous for their middle-distance reflexives, would have to be different from that proposed by Pollard and Sag (1992, 1994) for English.

There are two elements on the ARG-ST of *admires*, the first of which corresponds to *John*. If the second element is an anaphor, it must be co-indexed with the first element, according the Principle A. But in HPSG this co-indexing is taken rather literally, as sharing the INDEX value. Now, since INDEX specifies gender, number and person (see (13) on p. 15 above), these must also be shared between *John* and the anaphor. Thus, only the anaphor that is specified as masculine, singular and 3rd person (these are the respective values for *John*) will be grammatical. Hence the grammaticality of *John admires himself* and the ungrammaticality of **John admires herself*.

On the other hand, if the second element of this ARG-ST does not have CONT value of type *ana*, but, e.g., of type *ppro* (e.g., *them*) or *npro* (e.g., *Mary*), then Principle A does not apply (although Principles B and C do).

Of course, this does not yet make the HPSG binding theory a success story. Where it fares better than other theories is in recognizing that only some anaphors are subject to the syntactic/semantic binding theory, while others are subject to pragmatic constraints. Some examples of such pragmatically-governed anaphors, or logophors, are given in (22) below.

(22) a. [John and Mary]$_i$ knew that the journal had rejected [each other's]$_i$ papers.

b. Iran$_i$ agreed with Iraq$_j$ that [each other's]$_{i+j}$ shipping rights must be respected.

c. John$_i$ asked Mary$_j$ to send reminders about the meeting to everybody on the distribution list except themselves$_{i+j}$.

Many more examples of this kind may be found in Pollard and Sag (1994, ch.6). What they all have in common is that the anaphor does *not* occur as a non-initial element on some ARG-ST, a condition for Principle A to be applicable. For example, in (22a), *each other's* is the initial (and only) element of the ARG-ST of *papers*, and does not occur on any other ARG-ST. This means that the Binding Theory does not have anything to say about such anaphors, and that they are, instead, subject

to other constraints, probably of pragmatic or processing nature (Zribi-Hertz, 1989; Golde, 1999). The analysis of Pollard and Sag (1992, 1994) was apparently the first proposal of limiting the scope of syntactic (or syntactico-semantic) binding theory this way. A similar approach within GB was developed by Reinhart and Reuland (1993).

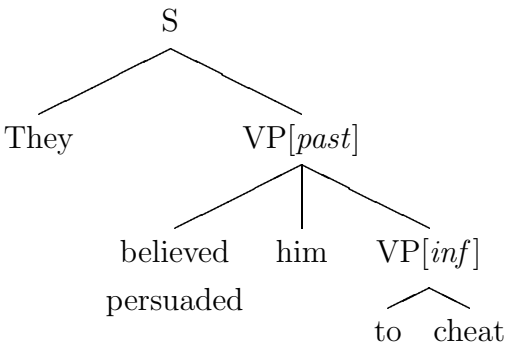
4.3 Raising and Control

In HPSG, there is no constituent structure difference between raising constructions and equi (or control) constructions. The raising/equi controller is realized as an argument of the higher verb:

(23) a. They believed him to cheat. (raising)

b. They persuaded him to cheat. (equi)

(24)



What, then, is the difference between raising predicates, such as *tend* or *believe*, and equi predicates, such as *try* or *persuade*?

The essential difference is semantic: the 'controller' arguments of equi predicates are assigned a semantic role by the equi verb, while the 'controller' arguments of raising predicates are not assigned such a role by the raising verb. Thus, CONTENT values of, e.g., *believe* and *persuade* differ in the following way:[15]

[15]These structures presuppose, of course, that *believe* and *persuade* are subtypes of *content*, along with the subtypes shown in (18).

(25) *believe*:
$$\begin{bmatrix} \textit{local} \\ \text{CAT } \ldots \\ \text{CONT} \begin{bmatrix} \textit{believe} \\ \text{BELIEVER } \boxed{1} \\ \text{PROPOSITION } \boxed{3} \end{bmatrix} \end{bmatrix}$$

(26) *persuade*:
$$\begin{bmatrix} \textit{local} \\ \text{CAT } \ldots \\ \text{CONT} \begin{bmatrix} \textit{persuade} \\ \text{PERSUADER } \boxed{1} \\ \text{PERSUADEE } \boxed{2} \\ \text{PROPOSITION } \boxed{3} \end{bmatrix} \end{bmatrix}$$

In (25)–(26) above, the tags $\boxed{1}$ and $\boxed{2}$ are INDEX values of the appropriate arguments, while $\boxed{3}$ is the CONT value of the VP[*inf*] argument; more fleshed-out descriptions are given below.

(27) *believe*:
$$\begin{bmatrix} \textit{local} \\ \text{CAT}|\text{ARG-ST } \langle \text{NP}_{\boxed{1}}, \text{NP}_{\boxed{2}}, \text{VP} \begin{bmatrix} \ldots|\text{HEAD}|\text{VFORM } \textit{inf} \\ \ldots|\text{CONT } \boxed{3} \end{bmatrix} \rangle \\ \text{CONT} \begin{bmatrix} \textit{believe} \\ \text{BELIEVER } \boxed{1} \\ \text{PROPOSITION } \boxed{3} \end{bmatrix} \end{bmatrix}$$

(28) *persuade*:
$$\begin{bmatrix} \textit{local} \\ \text{CAT}|\text{ARG-ST } \langle \text{NP}_{\boxed{1}}, \text{NP}_{\boxed{2}}, \text{VP} \begin{bmatrix} \ldots|\text{HEAD}|\text{VFORM } \textit{inf} \\ \ldots|\text{CONT } \boxed{3} \end{bmatrix} \rangle \\ \text{CONT} \begin{bmatrix} \textit{persuade} \\ \text{PERSUADER } \boxed{1} \\ \text{PERSUADEE } \boxed{2} \\ \text{PROPOSITION } \boxed{3} \end{bmatrix} \end{bmatrix}$$

However, how does HPSG express the intuition that the argument of *believe* is really the same thing as the subject of the embedded verb? It is not through movement,

as in GB / Minimalism, but through identity: raising predicates lexically specify that the unrealized subject of the VP[*inf*] complement is equal to their own argument:

(29) *believe*: $\left[\begin{array}{l} \textit{category} \\ \textsc{arg-st}\ \langle \mathrm{NP}, \boxed{1}, \mathrm{VP}\left[\begin{array}{l} \ldots|\textsc{head}|\textsc{vform}\ \textit{inf} \\ \ldots|\textsc{subj}\ \langle \boxed{1} \rangle \end{array}\right] \rangle \end{array}\right]$

On the other hand, in case of equi predicates, there is structure sharing not of whole arguments, but only of their INDEX values (note the subscripts below):[16]

(30) *persuade*: $\left[\begin{array}{l} \textit{category} \\ \textsc{arg-st}\ \langle \mathrm{NP}, \mathrm{NP}_{\boxed{1}}, \mathrm{VP}\left[\begin{array}{l} \ldots|\textsc{head}|\textsc{vform}\ \textit{inf} \\ \ldots|\textsc{subj}\ \langle \mathrm{NP}_{\boxed{1}} \rangle \end{array}\right] \rangle \end{array}\right]$

There are a number of consequences that follow from this modeling of the difference between raising and equi. First, assuming that the semantics (CONT value) of an active sentence is the same as that of its passive counterpart, there is no difference between (31a–b).

(31) a. Kim believed the doctor to have examined Sandy.

b. Kim believed Sandy to have been examined by the doctor.

This is because the CONT value of *believe* is the same in both (31a–b): the value of BELIEVER is the INDEX of *Kim*, and the value of PROPOSITION is the CONT value of the lower VP, which—by assumption—is the same for passive and for active.

However, in case of equi, there is a clear difference in meaning:

(32) a. Kim persuaded the doctor to examine Sandy.

b. Kim persuaded Sandy to be examined by the doctor.

[16]Note that, in HPSG, the tags 1, 2, etc., may represent different kinds of objects in different descriptions (e.g., (29) vs. (30)), just as variables x, y, etc., mean different things in different logical formulae. In other words, identities indicated by tags hold only within one description, not across descriptions.

This is predicted by the analysis because now CONT values of *persuaded* in (32a–b) are different: in (32a), the value of PERSUADEE is the INDEX of *the doctor*, while in (32b), it is the INDEX of *Sandy*.

The second consequence of this analysis of raising and equi stems from the assumption that semantic roles may be assigned only to referential indices, not to, say, expletives. This in particular means that equi controllers (e.g., the PERSUADEE) may not be expletive:

(33) *Kim persuaded *there* to be some misunderstanding about these issues.

(34) *Lee persuaded *it* to bother Kim that Sandy snores.

However, since raising controllers are not assigned semantic roles (there is no BELIEVEE), there is no similar restriction imposed on them:

(35) Kim believed *there* to be some misunderstanding about these issues.

(36) Lee believes *it* to bother Kim that Sandy snores.

Third, since in the case of raising the whole 'controller' and 'controllee' are identical, not just their indices, as in case of equi (cf. [1] in (29)–(30) above), syntactic information is also predicted to be shared between the 'controller' and the 'controllee' in raising. Well known quirky case assignment data from Icelandic seem to corroborate this prediction: whenever the lower verb subcategorizes for a quirky (lexically assigned) case on the subject, that quirky case is realized on the 'controller':[17]

(37) Hann telur *mig* vanta peninga.
he$_{nom}$ believes me$_{acc}$ lack$_{inf}$ money
'He believes that I lack money.'

(38) Hann telur *barninu* hafa batna veikin.
he believes the-child$_{dat}$ have$_{inf}$ recovered-from the-disease
'He believes the child to have recovered from the disease.'

[17]See, however, Hudson (1998) and Przepiórkowski (1999a, ch.5) for some dissent.

(39) Hann telur *verkjanna* ekki gæta.
he believes the-pains$_{gen}$ not be-noticeable$_{inf}$
'He believes the pains to be not noticeable.'

4.4 Summary

What this rather sketchy presentation of just a couple of basic HPSG analyses shows is, first of all, that HPSG is not just a syntactic theory, but rather a comprehensive theory of language willing to acknowledge the place of semantics, pragmatics and other grammatical levels in grammatical theory. Thus, only some instances of agreement are analyzed in purely syntactic terms, while others are assumed to be of syntactico-semantic (subject–verb agreement) or even purely pragmatic (honorific agreement) nature. Similarly, binding is assumed to be a phenomenon on the syntax-semantics interface, with some instances (i.e., those of logophoric binding) belonging rather to pragmatics. And also raising and equi (control) are assumed to be syntactico-semantic phenomena. This distinguishes HPSG from theories such as GB / Minimalism, which arguably take all of these phenomena (with the exception of logophoricity and, possibly, honorific agreement) to belong to the domain of syntax.

The next section briefly presents some areas of ongoing HPSG research.

5 Recent and Current Research

Recent and current HPSG research is versatile and extends far beyond syntax. In this section we try to identify those areas of research which attract most attention within the HPSG community, or are otherwise interesting. Note that many of these areas are concerned with interfaces between grammatical levels.

Word Order Most theories do not assume any particular level of representation devoted to the linear order of words or morphemes; word order is often assumed to be read from the usual constituent tree structures. If theories do assume such a level, as, e.g., PF in GB / Minimalism, it is not always clear what mechanisms apply at

such a level. This is also true of much of HPSG work.

However, there is a growing body of HPSG work which argues for or assumes a distinction between a *tectogrammatical level* and a *phenogrammatical level*, the former responsible for the composition of meaning, the latter for word order.[18] For example, Penn (1999b,a) argues that, in Serbo-Croatian (40), *u koji* is a constituent at the phenogrammatical level, although it is not a constituent at the tectogrammatical level (*koji grad* and *u koji grad* are).

(40) U koji si znao da je stigao grad?
in which $\text{Aux}_{cl,2nd,sg}$ knew Comp $\text{Aux}_{cl,3rd,sg}$ arrived city
'Into which city did you know he has arrived?'

This example shows that phenogrammatical constituents (e.g., *u koji*) do not necessarily correspond to semantic entities, while tectogrammatical constituents (e.g., *koji grad*) are not necessarily linearly contiguous.

This line of HPSG research was started by Reape (1990, 1992, 1994, 1996) and extended by Kathol (1995, 2000). An even greater dissociation between tectogrammatical and phenogrammatical levels has been proposed in Penn (1999b,c,a) and Crysmann (2002). Some other works assuming this so-called *linearization* approach to word order are: Kathol and Levine (1992), Müller (1999a, 2004), Yatabe (1996), Chung (1998b), Borsley (1999b), Kupść (1999d), Przepiórkowski (1999b), Bonami *et al.* (1999), Donohue and Sag (1999), Kuthy (2002), Jaeger (2003).[19]

Representation of Semantics Although, in HPSG, semantics is treated seriously and assigned its own grammatical level, the original treatment of semantics in Pollard and Sag (1994) has often been perceived as flawed in various ways and a number of subsequent publications, including Pollard and Yoo (1998), Kasper (1997), Przepiórkowski (1998), seek to remove these flaws and extend the account.

[18] This distinction was introduced by Curry (1961); a similar dichotomy is present in much of the Prague School's work; see also Dowty (1996).

[19] See also Richter and Sailer (1995) for a different formalization of word order in HPSG.

Despite these improvements and extensions, many HPSG practitioners have been dissatisfied with the kind of semantics proposed in Pollard and Sag (1994), which is sometimes viewed as a diluted version of Situation Semantics with occasional patches, and more radical changes have been proposed in the literature. One of them, i.e., that in Ginzburg and Sag (1999), is relatively conservative in still being based on a version of Situation Semantics, but others have departed from the original proposals much further. Thus, Nerbonne (1992) proposes a version of predicate logic with generalized quantifiers as the semantic representation for HPSG, Richter and Sailer (1999b,a) and Sailer (2000) show in technical detail how an Intensional Logic-like language Ty2 (Gallin, 1975) can be embedded into HPSG, Frank and Reyle (1995) use Reyle's (1993) Underspecified DRT, and Copestake *et al.* (2005) introduce the Minimal Recursion Semantics, an UDRT-like underspecified formalism. Moreover, Richter and Sailer (1997, 1999c) show how, for any logical language (i.e., in practice, any semantic formalism), a semantic underspecified version of this language can be defined as the semantic representation for HPSG.

In short, a number of proposals for doing semantics in HPSG have been made and it is not clear which of them, if any, will become dominant in the future.

Information Structure Since the HPSG framework is well-suited for studying interactions between various grammatical levels, it is only natural that there is some HPSG work on information structure (also called *topic-focus*, *theme-rheme*, *new-given*, *topic-ground*), which is known to interact with syntax and prosody in interesting ways. The most influential approach is based on Vallduví's (1992) account of information structure, and it includes Engdahl and Vallduví (1994, 1996), Vallduví and Engdahl (1996) and Engdahl (1999). We will illustrate this approach with a simple example, from Engdahl and Vallduví (1996).

Consider the mini-dialogue in (41), where **bold face** corresponds to so-called B-accent (L+H*), while SMALL CAPITALS correspond to so-called A-accent (H*).

(41) A:. In the Netherlands I got a big Delft china tray that matches the set in the living room. Was that a good idea?

B:. (Maybe.) The **president** [$_{\text{F}}$ HATES] the Delft china set. (But the **first lady** LIKES it.)

Vallduví (1992) assumes a 3-way partition of information structure of sentences: first, the information conveyed by a sentence is split into new information (*focus*) and information already present in the discourse (*ground*). Second, *ground* is further subdivided into *link* (what the sentence is about, sometimes called *topic*) and *tail*. Under the assumption that every utterance contains new information, this leads to a four-way classification of utterances: *all-focus* (no ground), *link-focus* (no tail), *focus-tail* (no link) and *link-focus-tail*. The sentence in (41B) represents the *link-focus-tail* type.

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

(42)
$$\left[\begin{array}{l} \textit{context} \\ \text{INFO-STR} \left[\begin{array}{l} \textit{info-struc} \\ \text{FOCUS } \textit{set(content)} \\ \text{GROUND} \left[\begin{array}{l} \textit{ground} \\ \text{LINK } \textit{set(content)} \\ \text{TAIL } \textit{set(content)} \end{array}\right] \end{array}\right] \end{array}\right]$$

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:

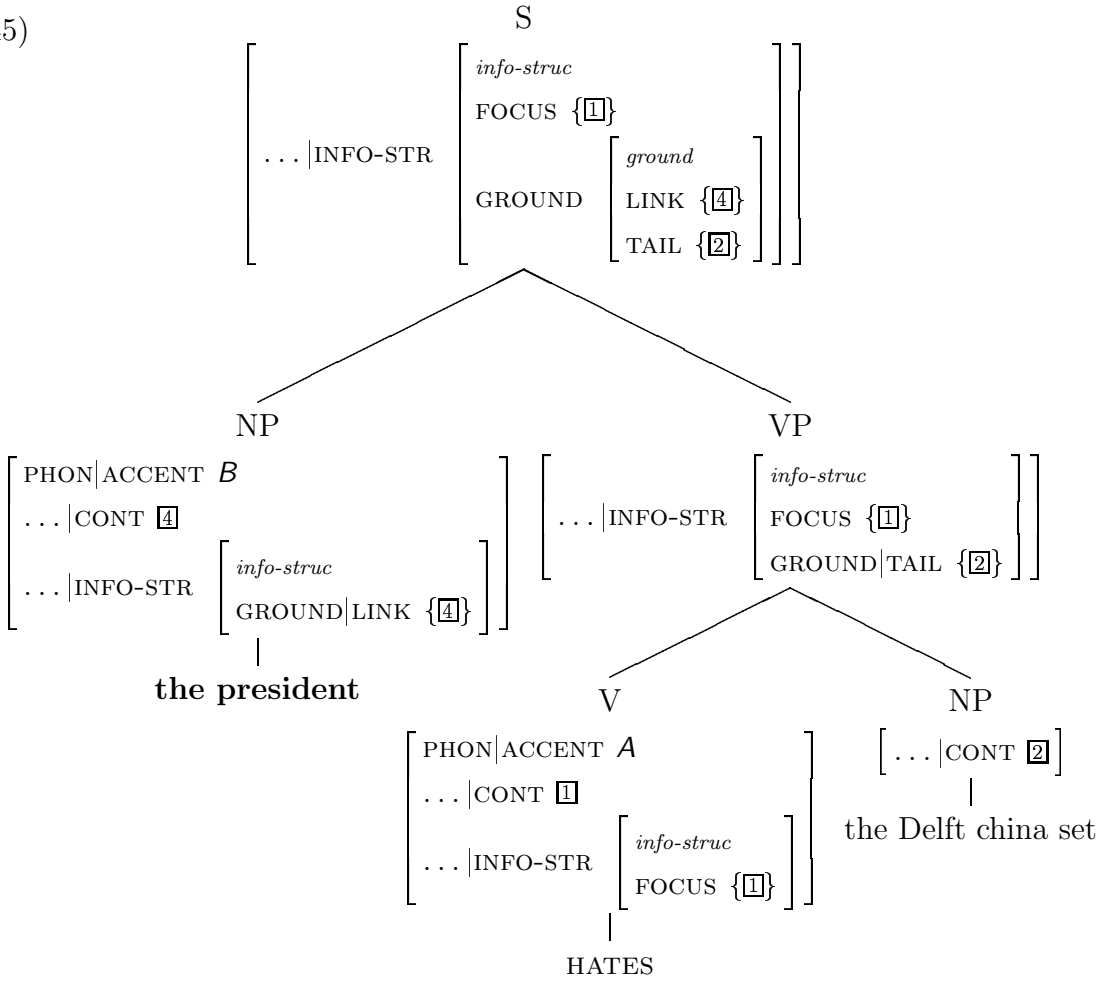
(43) $$\textit{word} \rightarrow \left(\left[\text{PHON}|\text{ACCENT } A\right] \leftrightarrow \left[\ldots|\text{LOC} \left[\begin{array}{l} \textit{local} \\ \text{CONT } \boxed{1} \\ \text{CONX}|\text{INFO-STR}|\text{FOCUS } \{\boxed{1}\} \end{array}\right]\right)$$

(44) $$\textit{word} \rightarrow \left(\left[\text{PHON}|\text{ACCENT } B\right] \leftrightarrow \left[\ldots|\text{LOC} \left[\begin{array}{l} \textit{local} \\ \text{CONT } \boxed{1} \\ \text{CONX}|\text{INFO-STR}|\text{GROUND}|\text{LINK } \{\boxed{1}\} \end{array}\right]\right)$$

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

This leads to the following (much simplified) structure of (41B), in which values of the DTRS attribute are presented in the familiar constituent tree notation.

(45)



Note that this analysis simultaneously accesses and constrains various grammatical levels: prosody (PHON values) and pragmatics (CONX|INFO-STR values), but also semantics (CONT values) and constituent structure (DTRS values; not shown explicitly here). This account clearly illustrates the advantages of constraint-based theories, such as HPSG, over derivational theories, like Minimalism, where it is not clear how

such an analysis, making simultaneous use of various levels of grammatical knowledge, could be stated.[20]

Among recent HPSG analyses concerned with information structure in various languages are: Avgustinova (1997c), Kolliakou (1998, 1999), Alexopolou (1998), Kuthy (2002), Haji-Abdolhosseini (2003), Paggio (2005).

Complex Predicates As in other frameworks, complex predicates (broadly understood) have recently come to the forefront of HPSG research; see Ackerman and Webelhuth (1998) for a book-length HPSG account of complex predication in a variety of languages. The languages under most scrutiny so far have been: German[21] (Hinrichs and Nakazawa, 1990, 1994, 1998, 1999; Pollard, 1996; Nerbonne, 1994; Kathol, 1997; Ackerman and Webelhuth, 1998; Kathol, 1998; Bouma and van Noord, 1998; Meurers, 1999; De Kuthy and Meurers, 1999; Baker, 1999; Müller, 2002), French (Abeillé *et al.*, 1998; Godard *et al.*, 1998; Calcagno and Pollard, 1999), Italian (Monachesi, 1998b, 2005; Grover, 1998), Japanese (Uda, 1992; Manning *et al.*, 1999; Gunji, 1999; Kubota, 2005), Korean (Bratt, 1996; Chung, 1998a; Sells, 1998) and Bulgarian (Avgustinova, 1997c). Most of these works are, however, concerned with purely syntactic aspects of complex predicates.

Complements vs. Adjuncts It is a common and generally unquestioned assumption in 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 has also been 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 and Levine (1994, 1995) show that there are no hard differences between complement extraction and adjunct extraction, and Bouma *et al.* (1998b, 2001) build on these observations and propose a unified theory of extraction based on the assumption that

[20] See Engdahl (1999) for some discussion on how information packaging could be represented in Minimalism and in HPSG.

[21] Much of research on German (and Dutch) verb complexes concentrates on partial VP fronting.

there is no tree-configurational distinction between complements and (at least a class of) adjuncts. Earlier, getting rid of the configurational distinction was proposed, on different grounds, by Miller (1992), van Noord and Bouma (1994), and Manning *et al.* (1999). This 'adjuncts-as-complements' approach is further defended on the basis of case assignment facts in Finnish and other languages (Przepiórkowski, 1999c), and on the basis of diachronic considerations (Bender and Flickinger, 1999).

The crux of all these analyses is that (at least a class of) adjuncts are added to the verb's subcategorization frame already in the lexicon and, hence, are indistinguishable from complements in syntax. For example, on the account of Bouma *et al.* (2001), words are specified for the attribute DEPS (dependents), in addition to attributes ARG-ST and VALENCE (see (6)) above. ARG-ST encodes the narrow argument structure, i.e., information about dependents which are more or less idiosyncratically required by the word. As in (9) above, this information is eventually mapped into the word's VALENCE attributes, which are responsible for syntactic realization of these dependents. However, on Bouma *et al.*'s (2001) account there is one more intermediary level between ARG-ST and VALENCE, namely, DEPS, which encodes all dependents of a verb, both subcategorized (elements of ARG-ST) and non-subcategorized (adjuncts). In other words, DEPS extends ARG-ST to adjuncts, as schematically illustrated in (46).

(46) Argument Structure Extension

$$\begin{bmatrix} \textit{word} \\ \ldots|\textsc{head}\ \textit{verb} \end{bmatrix} \rightarrow \begin{bmatrix} \ldots|\textsc{cat} & \begin{bmatrix} \textit{category} \\ \textsc{deps}\ \boxed{1} \oplus \textit{list(adjunct)} \\ \textsc{arg-st}\ \boxed{1} \end{bmatrix} \end{bmatrix}$$

The DEPS list, in turn, is mapped into the VALENCE attributes, according to the following constraint (replacing (9) on p. 13 above).

(47) Argument Realization

$$\textit{word} \rightarrow \begin{bmatrix} \ldots|\textsc{cat} & \begin{bmatrix} \textit{category} \\ \textsc{valence} & \begin{bmatrix} \textsc{subj}\ \boxed{1} \\ \textsc{comps}\ \boxed{2} \ominus \textit{list(gap)} \end{bmatrix} \\ \textsc{deps}\ \boxed{1} \oplus \boxed{2} \end{bmatrix} \end{bmatrix}$$

What this principle says is that all elements of ARG-ST, apart from *gap*s, must be present on VALENCE attributes. Two things to note about (47) are: 1) the distinction between complements and adjuncts is lost here, i.e., all elements of DEPS, regardless of their origin, are uniformly mapped into VALENCE attributes; and 2) *gap*s, i.e., traces of extracted elements, are present on the non-configurational attribute DEPS, but they disappear from the 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. See Bouma *et al.* (2001) for the full analysis and for extensive justification of this approach.

Let us add that much of the first author's own work is devoted to the complement/adjunct dichotomy: apart from Przepiórkowski (1999c) mentioned above, which shows that case assignment does not distinguish between complements and adjuncts, Przepiórkowski (1999d, 2002) refute all previous and various putative arguments for postulating a syntactic distinction between complements and adjuncts in Polish, and Przepiórkowski (1999a) extends the arguments of the previous works, and also shows (in gory empirical detail) that the best known argument for the configurational complement/adjunct distinction, based on the so-called *do so* test, does not stand closer scrutiny.

Formal Foundations Last but not least, the last decade has witnessed the emergence of a full-fledged logical formalism for HPSG. See King (1994, 1999) and Pollard (1999) with important extensions in Richter (1999, 2000), and, especially, Richter *et al.* (1999).[22]

Other Topics Among other themes of recent HPSG research are: **morpho(phono)logy** (Riehemann, 1998; Van Eynde, 1994; Höhle, 1999; Kathol, 1999; Crysmann, 1999b, 2002; Koenig, 1999; Reinhard, 2000; Bonami and Boyé, 2002), **cliticization** in Romance (Miller 1992; Miller and Sag 1997; Monachesi 1995, 1998a,c,

[22]See also Carpenter (1992) for a different logical formalism, often assumed in earlier HPSG works.

1999; Crysmann 1999a; see also sec. 6), **lexical semantics and linking** in English, but also Greek (Wechsler, 1995; Davis, 1997; Verspoor, 1997; Kordoni, 1999a, 2001; Koenig, 1999; Davis and Koenig, 2000), **binding** in a variety of languages (Manning and Sag 1998; Wechsler 1999b; Asudeh 2000; Golde 2001; Aranovich 2003; Branco 2002, 2005; Kiss 001b; Pollard 2005; Runner and Kaiser 2005; see also sec. 6), **relative clauses** in Turkish, English, German, Hebrew, Japanese, Korean and Persian (Güngördü 1996; Sag 1997; Borsley 2004; Müller 1999b; Kiss 2005; Vaillette 2001; Kikuta 2002; Han and Kim 2004; Cha 2005; Taghvaipour 2004, 2005; see also sec. 6.3 below), the syntax and semantics of **negation** in French, Italian, Korean, English, Swedish and Welsh (Abeillé and Godard 1997; De Swart and Sag 2002; Godard and Marandin 2006; Kim 2000; Kim and Sag 2002; Richter and Sailer 2006; Borsley and Jones 2005; Borsley 2006; see also sec. 6.4), as well as **tough movement**, **parasitic gaps**, the structure of **NPs and PPs**, **case assignment**, **auxiliary systems**, **noun incorporation**, **antecedent-contained ellipsis**, **coordination**, **quantification**, the syntax and semantics of **interrogative clauses**, and a variety of other topics.[23] In the next section, we will look a little closer at HPSG work devoted to Slavic languages.

6 Slavic in HPSG

Although HPSG is a relatively young theory, the number of HPSG publications at large seems to increase exponentially each year, HPSG books are published by well-known publishers (Cambridge University Press, Oxford University Press, Blackwell, Academic Press, CSLI Publications, Chicago University Press, Garland), and HPSG articles appear in prestigious refereed journals (*Natural Language and Linguistic Theory*, *Language*, *Linguistic Inquiry*, *Journal of Linguistics*, *Linguistics and Philosophy*, *Lingua*, *Linguistics*). Despite that, HPSG work on Slavic languages can hardly be described as voluminous. Apart from various working papers, reports and proceedings-level articles, there is only one published collection of papers devoted to HPSG analyses of Slavic languages, namely Borsley and Przepiórkowski (1999), just

[23] See Appendix A for recent collections of HPSG papers.

a few HPSG dissertations on Slavic (Avgustinova, 1997c; Zlatić, 1997b; Mykowiecka, 1999; Przepiórkowski, 1999a; Kupść, 2000a; Marciniak, 2001; Trawiński, 2006), a book concerned with an HPSG description of Polish (Przepiórkowski *et al.*, 2002), and a handful of journal papers (Kodrič, 1994; Przepiórkowski, 1997; Avgustinova, 1998; Wechsler and Zlatić, 2000, 2001; Przepiórkowski, 2000a, 2004; Przepiórkowski and Rosen, 2005).

Below, we present only some of the most interesting work on Slavic languages done within HPSG. The accounts mentioned below are not only more explicit and formal than accounts of the same phenomena in other theories, but also extend the empirical scope of previous analyses.

6.1 Agreement

Slavic work on agreement builds on Pollard and Sag (1994, ch.2) and Kathol (1999) and distinguishes between, minimally, purely syntactic agreement, and semantically-driven agreement (cf. sec. 4.1).

For example, Wechsler and Zlatić (2000) follow Kathol (1999) and assume that NPs have two sets of agreement attributes, AGR (syntactic attributes CASE, NUMBER and GENDER)[24] and INDEX (semantic attributes PERSON, NUMBER and GENDER). Normally, syntactic attributes NUMBER and GENDER correspond to their semantic correlates, but there are exceptions; one, from Polish, is (15) above, another one, from Serbo-Croatian, is given in (48) below.

(48) Ta dobra deca dolaze.
that$_{sg,fem}$ good$_{sg,fem}$ children$_{sg,fem}$ come$_{3rd,pl}$
'Those good children came.'

According to Wechsler and Zlatić (2000), *deca* and other collective nouns of this type are exceptional in that they are (morpho)syntactically (i.e., in terms of AGR) singular feminine, but semantically (i.e., in terms of INDEX) plural (and neuter).

[24]Wechsler and Zlatić (2000) rename AGR as CONCORD.

(48) shows that the correspondence between AGR and INDEX may be violated. Wechsler and Zlatić (2000) propose two other types of correspondence relevant to agreement, which may also be violated, namely the correspondence between DECLENSION and AGR, and between INDEX and CONTEXT.[25] (49) summarizes this:

(49) $\boxed{\text{DECLENSION}} \Leftrightarrow \boxed{\text{AGR}} \Leftrightarrow \boxed{\text{INDEX}} \Leftrightarrow \boxed{\text{CONTEXT}}$

The '$\boxed{\text{DECLENSION}} \Leftrightarrow \boxed{\text{AGR}}$' link is severed, e.g., in names such as *Steva* and *Mika*, which are syntactically and semantically masculine, but which show feminine declension. The '$\boxed{\text{INDEX}} \Leftrightarrow \boxed{\text{CONTEXT}}$' link is broken, e.g., in pluralia tantum nouns such as *naočare* 'glasses', *pantalone* 'pants', etc., which refer to singular (non-aggregate) entities, but which nevertheless have plural INDEX (as shown by the subject–verb agreement in (50)), plural AGR (as shown by the NP-internal agreement in (50), from Serbo-Croatian again) and plural declension.

(50) Ove naočare su nove.
these$_{pl}$ glasses are$_{pl}$ new$_{pl}$
'These glasses are new.'

Wechsler and Zlatić (2000) also show how Corbett's (1983) Agreement Hierarchy follows (to a large extent) from that analysis.[26]

6.2 Case Assignment

There is a rich body of literature on case assignment within GB, and Slavic HPSG practitioners usually build on that work, but also aim to extend and improve it in various ways. Much of the main author's own work has been devoted to case assignment, and we apologize for making extensive self-references here.

Empirically, the analysis of Avgustinova *et al.* (1999b) is probably the most ambitious: it outlines an account of case assignment and diathesis, concentrating on ways

[25] This is a slight re-analysis of Wechsler and Zlatić (2000); see their paper for details.

[26] Other work on agreement in Slavic includes Czuba and Przepiórkowski (1995), Czuba (1997) and Przepiórkowski (2003) (on Polish), Zlatić and Wechsler (1997) and Wechsler (1999a) (on Serbo-Croatian, *inter alia*), Hahm (2006) (on Russian) and Avgustinova and Uszkoreit (2003) (a cross Slavic typology).

of accounting for typological similarities and differences between Slavic languages (mainly Bulgarian, Czech, Polish and Russian).

On the other hand, Przepiórkowski (1999a) concentrates on Polish, but attempts to provide an exhaustive account of such phenomena as:

- structural vs. inherent (lexical) case assignment;
- Genitive of Negation;
- case patterns in Numeral Phrases;
- case assignment to predicative phrases.

In all these areas, the analysis in Przepiórkowski (1999a) is claimed to have substantially extended previous (mainly GB / Minimalism) analyses, and corrected various flawed observations, e.g., that the Genitive of Negation is always obligatory in Polish (cf. (51) for counterexamples), that adjectival primary predicates must always occur in the nominative (cf. (52)), or that adjectival secondary predicates must always agree with the NP they predicate of (cf. (53)).[27]

(51) a. Głowa już ją / jej nie boli.
head$_{nom}$ already she$_{acc/gen}$ NM aches
'Her head isn't aching any more.'

b. Nie mógłbyś przestać studiować algebrę / algebry?
NM could$_{2nd,sg}$ stop$_{inf}$ study$_{inf}$ algebra$_{acc/gen}$
'Couldn't you stop studying algebra?'

(52) a. Być miłym / *miły to być głupim / *głupi.
be$_{inf}$ nice$_{ins}$ / nice$_{nom}$ is be$_{inf}$ stupid$_{ins}$ / stupid$_{nom}$
'To be nice is to be stupid.'

b. Wiele studentek chce wydawać się ?szczęśliwych / many$_{acc}$ students$_{gen,pl,fem}$ want$_{3rd,sg,neut}$ seem$_{inf}$ RM happy$_{gen}$ / ??szczęśliwe / szczęśliwymi.
happy$_{acc}$ / happy$_{ins}$

[27] See also Przepiórkowski (2000a,b,c, 2001).

'Many students$_{fem}$ want to seem happy.'

(53) a. Pamiętam go miłym / miłego.
remember$_{1st,sg}$ him$_{acc}$ nice$_{ins}$ / nice$_{acc}$
'I remember him as nice.'

b. Zastałem go pijanego / pijanym.
found$_{1st,sg,masc}$ him$_{acc}$ drunk$_{acc}$ / drunk$_{ins}$
'I found him drunk.'

Further, Wechsler and Zlatić (1999) present a challenge to the comfortable view that syntactic case assignment rules do not make reference to purely morphological information. In particular, they argue that in Serbo-Croatian, when nouns or verbs assign dative or instrumental to an NP, this case must be morphologically realized on some element within that NP. Thus, undeclinable names such as *Miki*, *Keti*, etc., may not normally be assigned the dative or the instrumental, unless there is a modifier that shows this dative or instrumental, e.g.:

(54) Divim se *(mojoj) Miki.
admire$_{1st,sg}$ RM my$_{dat}$ Miki
'I admire (my) Miki.'

Wechsler and Zlatić (1999) provide an HPSG analysis of such facts and argue that that analysis automatically accounts for the highly idiosyncratic distribution of quantified NPs in Serbo-Croatian.

Finally, a comprehensive account of case patterns within Serbo-Croatian NPs (as well as of the structure of SC NPs) is presented in Zlatić (1997b).

6.3 Clitics

HPSG work on clitics is mainly concerned with Bulgarian (especially, clitic doubling; Avgustinova 1997a,c, 1998), Serbo-Croatian (Penn, 1999b,c,a) and Polish (Borsley, 1999b; Kupść, 1999d,f,c,b,a, 2000b,c; Kupść and Tseng, 2005; Crysmann, 2006). This subsection briefly presents HPSG work on Polish clitics.

Borsley (1999b) presents an HPSG analysis of so-called *mobile inflections* in past tense forms, discussed earlier in GB terms in Borsley and Rivero (1994), and argues that the former is more satisfactory in a number of ways. In particular, Borsley (1999b) analyses the element *-ś* (2sg marking) in (55b) as a 'weak auxiliary' (an enclitic) which subcategorizes for a participial verb, i.e., as a syntactic item, but—at the same time—he argues that the similarly looking *-eś* in (55a) should rather be analyzed as attaching to the verb already in the lexicon, within the morphology proper.

(55) a. Ty widział*eś* ten film.
you saw-*2sg* that film
'You saw that film.'

b. Ty*ś* widział ten film.
you-*2sg* saw that film

Kupść and Tseng (2005) refute the auxiliary analysis of (55b) and postulate a morphological account of all past tense forms. Their approach builds on two main observations: first, in the third person, the participial alone is used, hence no auxiliary element is ever involved in third person forms; second, in addition to well-known peculiarities of post-vebral markings (lexical stress shift, epenthetic vowel insertion, vowel alternations in the host), there are morphophonological restrictions on non-verbal hosts as well, specific for different markings (phonological "friendliness", cf. Bański (2000)): for example, 1sg marking *-m* cannot follow a word ending in a nasal vowel (i.e., *-ę/-ą*) but all other markings can. Such idiosyncracies are more characteristic of affixes than of syntactic items (clitics) and Kupść and Tseng (2005) propose a morphological analysis.[28] They treat past tense as a simple tense with a quirky agreement pattern: the agreement markings are either attached directly to the agreement trigger (the participle) or realized at a distance. Formally, the presence of the affix is encoded as a non-empty value of attribute AGR(EEMENT)-MARK(ING) (a list containing the corresponding person/number features) whereas the non-empty value of

[28] See Crysmann (2006) for a different account of the same facts.

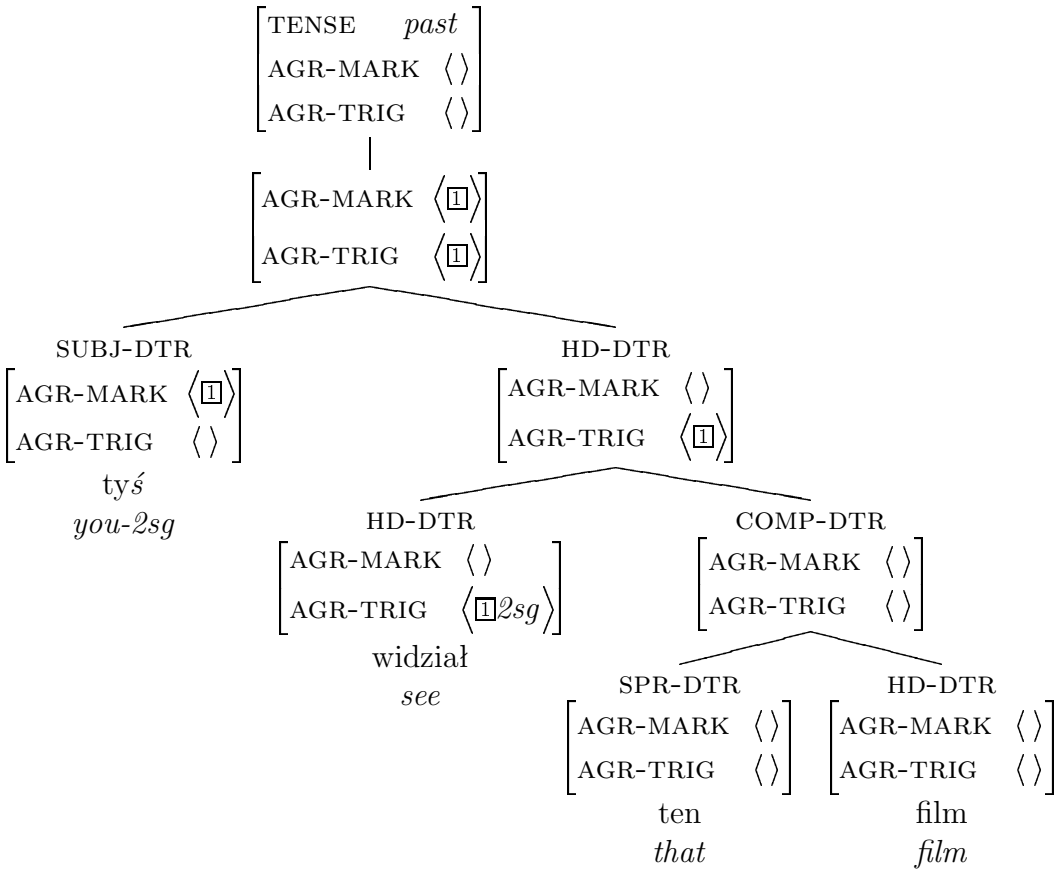


Figure 1: AGR-MARK and AGR-TRIG: Analysis of example (55b)

AGR(EEMENT)-TRIG(GER) indicates that an affix is required by the agreement trigger. All AGR-MARK/AGR-TRIG values are introduced lexically and then a syntactic constraint incorporates them into the syntactic structure: the AGR-MARK is amalgamated from all daughters, while AGR-TRIG is transmitted along the head projection of the trigger. Once the specifications of the two attributes match, the agreement requirement is discharged and both lists are emptied. An analysis of example (55b) is illustrated in Fig. 1. The mechanism has been extended to account for conditional constructions in Polish and has been also applied to past tense and conditional forms across Slavic, cf. Tseng and Kupść (2006).

On the other hand, Kupść (1999d,f,c,b,a, 2000b,c) deals with various aspects of pronominal and reflexive clitics in Polish, which are arguably always syntactic items. For example, Kupść (1999d) provides an HPSG analysis of haplology of the reflexive clitic *się*, illustrated in (56b)–(58b).

(56) a. Jan stara się golić się codziennie rano.
John tries RM shave RM every day morning
'John tries to shave himself every morning.'

b. Jan stara się golić codziennie rano.
'John tries to shave himself/oneself every morning.'

(57) a. Janowi łatwo się myje siebie w ciepłej wodzie.
John$_{dat}$ easily RM wash self in warm water
'John finds it easy to wash himself in warm water.'

b. Janowi łatwo się myje w ciepłej wodzie.
John$_{dat}$ easily RM wash in warm water
'John finds it easy to wash himself/something in warm water.'

(58) a. Siedziało się i się gadało.
sat RM and RM talked
'One would sit and chat.'

b. Siedziało się i gadało.

Moreover, Kupść (1999f,c,b,a, 2000b) analyses the positioning of pronominal clitics, especially, in so-called verb clusters (or 'clause union' environments), applying the linearization approach of Kathol (1995) and others (cf. sec. 5 above).

6.4 Negation

The first systematic investigation of Negative Concord in Polish was carried out within HPSG, by Przepiórkowski and Kupść (1997a,c,b) (cf. also Przepiórkowski and Świdziński (1997) and Kupść (1999e)). Although these initial works were solely concerned

with syntactic aspects of Negative Concord, they uncovered and analyzed various generalizations normally neglected in works on Negative Concord in other languages, e.g., the fact that it is a long-distance phenomenon in the sense that it may operate across any number of NP and PP boundaries, as in (59), where the negative marker *nie* is separated from the *n*-word *żadnego* by 6 NP and 2 PP boundaries.

(59) [Gazety [z [plotkami [o [żonach [władców [państw [*żadnego*
Newspapers with rumours about wives of rulers of countries of none
kontynentu]]]]]]] *(*nie*) są tak interesujące, jak te z plotkami o
continent NM are so interesting as those with rumours about
żonach władców państw afrykańskich.
wives of rulers of countries African
'No newspapers with gossip about wives of rulers of countries of any continent are so interesting, as those containing gossip about wives of rulers of African countries.'

Przepiórkowski and Kupść (1997a,c,b) treat such examples as evidence for the claim that Negative Concord in Polish is really an unbounded dependency construction, just like, say, *wh*-movement in English. Of course, in case of NC, nothing really 'moves' from one position to another (at least, not visibly), but that is not a problem for HPSG because the HPSG treatment of unbounded dependencies does not involve movement at all, but rather structure-sharing of information between the 'bottom' of the unbounded construction (i.e., *wh*-gap or *n*-word) and the 'top' of the construction (i.e., *wh*-filler or verbal negation). In case of *wh*-movement, this information says that a phrase is locally missing and, hence, must be realized somewhere higher in the tree, while in case of NC, this information says that there is an *n*-word, which requires higher verbal negation to license it.

Further analyses, i.e., Richter and Sailer (1999b) and Przepiórkowski and Kupść (1999), recognize that Negative Concord is a complex syntactico-semantic phenomenon and provide more comprehensive accounts at the syntax-semantics interface.

Finally, Kupść and Przepiórkowski (2002) argue at length that the verbal (sentential) negation marker in Polish is really a morphological prefix, attached to the verb in the lexicon, and Kupść (2002) provides a corresponding morphosyntactic analysis of this negative prefix.

6.5 Other Topics

A general approach to **word order**, based on earlier 'linearization' approaches (cf. sec. 5) is proposed by Penn (1999b,c,a) and illustrated with a detailed analysis of extraction and clitic placement in Serbo-Croatian, while Avgustinova (1997c) examines word order in Bulgarian in more traditional terms. An interesting account of Polish past tense mobile inflection, including its placement, is proposed by Crysmann (2006). **Relative constructions** are analyzed in Avgustinova (1996b, 1997b) (for Bulgarian) and in Mykowiecka (1999, 2000, 2001b,a) (for Polish). A comprehensive analysis of **binding** in Polish is presented in Marciniak (1999) (see also Kupść and Marciniak (1997) and Kupść *et al.* (1997) for earlier attempts); an analysis of binding in Czech, which examines differences between binding of reflexives and binding of reciprocals, is proposed in Avgustinova *et al.* (1999a); further, Zlatić (1996, 1997a) contains considerations on binding in Serbo-Croatian, compatible with HPSG's non-configurational approach to binding. A preliminary treatment of Russian **morphology**, executed from a computational perspective, is given in Henschel (1991), while a comprehensive formal model of **morphophonology**, and its application to Russian obstruents, is proffered in Höhle (1999). Finally, Kupść *et al.* (2000) present a preliminary account of **constituent coordination** in Polish, whereas Trawiński (2005) provides an analysis of Polish **comitative constructions**.

There has also been some **computational HPSG work** on Slavic languages, performed mainly at Saarbrücken, Germany, and Warsaw, Poland. The University of Saarland, Saarbrücken, participated (1993–1996) in a European Union project "Language Processing Technologies for Slavic Languages" (LaTeSlav) and implemented HPSG grammars of Bulgarian and Czech. A summary of the project can be found here: `http://www.coli.uni-sb.de/cl/projects/lateslav1.html`, and

Avgustinova (1996a) describes the HPSG grammar of Bulgarian developed within that project. The Institute of Computer Science, Polish Academy of Sciences, Warsaw, held (1996–1998) a Polish Committee for Scientific Research Grant on "Logical Foundations of Linguistic Engineering", whose aim was to develop a small HPSG grammar of Polish (Bolc *et al.*, 1996; Przepiórkowski *et al.*, 2002; Mykowiecka *et al.*, 2003; Mykowiecka and Marciniak, 2005) and it participated (1997–2000) in a European Union CRIT-2 project "An HPSG Treebank for Polish" (Marciniak *et al.*, 2003).

7 Conclusion and Future Work

So What Can HPSG Offer the Slavicist Community? We think the main contribution of HPSG to Slavic linguistics is an explicit framework with well-understood logical foundations and with a description language expressive enough to state the whole range of linguistic intuitions and analyses, whether these intuitions and analyses build on earlier HPSG work, on Dependency Grammar, on Construction Grammar, or on any other linguistic theory, probably not excluding (non-transformational versions of) Chomskyan theories. In other words, HPSG provides precisely constructed models, as advocated by Chomsky (1957), but increasingly often perceived as missing in current Chomskyan theorizing.[29]

> Precisely constructed models for linguistic structure can play an important role, both negative and positive, in the process of discovery itself. By pushing a precise but inadequate formulation to an unacceptable conclusion, we can often expose the exact source of this inadequacy and, consequently, gain a deeper understanding of the linguistic data. More positively, a formalized theory may automatically provide solutions for many problems other than those for which it was explicitly designed. Obscure and intuition-bound notions can neither lead to absurd conclusions nor provide new and correct ones, and hence they fail to be useful in

[29] See, e.g., Pullum (1996), Pollard (1996), Freidin (1997), Johnson and Lappin (1997, 1998), Webelhuth *et al.* (1999a), Borsley (2000) and Lappin *et al.* (2000).

> two important respects. I think that some of those linguists who have questioned the value of precise and technical development of linguistic theory have failed to recognize the productive potential in the method of rigorously stating a proposed theory and applying it strictly to linguistic material with no attempt to avoid unacceptable conclusions by *ad hoc* adjustments or loose formulation.
>
> (Chomsky, 1957, p. 5)

HPSG also offers scientific culture which puts strong emphasis on precision and on modeling all observable language, without limiting oneself to 'core phenomena' only. As Farrell Ackerman and Gert Webelhuth, two then-newcomers to HPSG (but with considerable experience in LFG and GB, respectively) say:

> We were keenly aware that by largely formulating our theory in terms of HPSG our work would be measured against the superior quality standard they [Pollard and Sag] have set for their own work and HPSG in general. We believe that the field of linguistics would be well-served if these quality standards were accepted at large...
>
> (Ackerman and Webelhuth, 1998, p. xii)

To this, Webelhuth *et al.* (1999a) add:

> We conjecture that it is precisely this feature of the HPSG culture that attracts not only linguists but also a considerable number of logicians, mathematicians, and computer scientists to the framework.
>
> (Webelhuth *et al.*, 1999a, p. 3)

Finally, HPSG makes it easy to examine the interaction of various grammatical levels, e.g., the mutual constraints of pragmatics, prosody and constituent structure in articulation of information structure, or the interaction of syntax and morphophonology in various cliticization phenomena. In fact, thanks to its monostratal constraint-based character, HPSG does not make any assumptions as to the primacy of one grammatical level over another and, hence, may serve as a meeting point for,

say, a syntactician and a semanticist working on Negative Concord from differing perspectives.

Future Work As we saw in sec. 6, only a limited number of phenomena in a limited number of Slavic languages has been covered within HPSG. Deplorably, there is hardly any work on Russian, and no work at all on a variety of other Slavic languages, including Ukrainian, Slovak and Sorbian. This is a yawning gap that should be filled. Also synchronic or comparative study on Slavic is very limitted.

Moreover, some grammatical levels have been rather neglected, although, as we try to show *ad nauseam* above, this reflects the sociological factor of who is currently doing HPSG, rather than any theory-internal limitations. Thus, there is currently very little work on phonology, morphology, semantics and pragmatics; indeed, most work is devoted to syntax and to interfaces between syntax and other grammatical levels.

But even within syntax, there are still many phenomena to be dealt with. There is certainly much more work to be done on coordination and on word order, especially on interaction between word order and information structure, and on multiple *wh*-extraction in various languages. There are also no analyses of, e.g., ellipsis, parasitic gaps (if they can be observed in Slavic languages at all), or imperative constructions.

There are also more general limits of present-day HPSG, which will hopefully be alleviated in future research.

Limits of HPSG HPSG, like most current linguistic frameworks, is ill at ease with the notion of *graduality*. In particular, linguistic expressions are predicted to be either well-formed or ill-formed, with nothing in between; the often perceived shades or degrees of grammaticality are implicitly blamed on 'processing complexity'. For example, HPSG, as most frameworks, cannot express the generalization evident in (60) (from Przepiórkowski (1999a)), i.e., that in Polish, the greater the structural distance between the copula and its overtly realized subject, the greater the acceptability of the instrumental marking of the predicative adjectival complement of the copula.

(60) a. Jan jest szczęśliwy / (?)*szczęśliwym.
John$_{nom}$ is happy$_{nom}$ / happy$_{ins}$
'John is happy.'

b. Jan chce być szczęśliwy / ?*szczęśliwym.
John$_{nom}$ wants be$_{inf}$ happy$_{nom}$ / happy$_{ins}$
'John wants to be happy.'

c. Jan chce spróbować być szczęśliwy / ?szczęśliwym.
John$_{nom}$ wants try$_{inf}$ be$_{inf}$ happy$_{nom}$ / happy$_{ins}$
'John wants to try to be happy.'

d. Jan bał się nawet chcieć spróbować być szczęsliwy / szczęśliwym.
John$_{nom}$ feared RM even want$_{inf}$ try$_{inf}$ be$_{inf}$ happy$_{nom}$ / happy$_{ins}$
'John was afraid to even want to try to be happy.'

Abney (1996) argues at length that knowledge about degree of acceptability, preferences of some readings but not others, and knowledge about frequency of various constructions should all be part and parcel of strictly linguistic study.[30] He also argues that such graded, or statistical, kinds of information are necessary to talk about language acquisition, language change (i.e., diachrony) and language variation.

Although there are some initial attempts at bringing statistical information to HPSG, most notably Brew (1995), Riezler (1996) and Abney (1997), they are rather computationally oriented and still need to be integrated with HPSG *qua* linguistic formalism.

A Appendix: Some Resources

The main HPSG publication at the time of writing this paper is still Pollard and Sag (1994), which not only extends, but actually replaces the now outdated Pollard and

[30] See also Manning and Schütze (1999).

Sag (1987). Pollard and Sag (1994) is not a textbook *per se*, but rather a linguistically advanced presentation of the theory, aimed chiefly at the GB audience.

There are two HPSG-related introductory textbooks: Borsley (1996) is an introduction to GPSG and HPSG, which concentrates on linguistic rather than formal issues, while Sag and Wasow (1999) is a very readable introduction to syntax based on HPSG-like mechanisms and assumptions, although it is not an introduction to HPSG as such. Moreover, Borsley (1999a) is an introduction to syntax which simultaneously introduces a transformational and a phrase structure grammar approach to linguistic theorizing. There are also a couple of shorter HPSG introductory texts available via the Internet, e.g., Pollard (2001b, 1996) and `http://hpsg.stanford.edu/ideas.html`.

Various collected volumes are devoted (mainly or chiefly) to HPSG; the most representative are (in roughly chronological order): Nerbonne *et al.* (1994), Grover and Vallduví (1996), Balari and Dini (1998), Webelhuth *et al.* (1999b), Borsley and Przepiórkowski (1999), Kordoni (1999b), Bouma *et al.* (1999), Levine and Green (1999).

There are two main HPSG web sites:

- `http://www.ling.ohio-state.edu/research/hpsg/` (Ohio State University)
- `http://hpsg.stanford.edu/` (Stanford University)

A comprehensive, but by no means complete, HPSG bibliography can be found at the address: `http://www.cl.uni-bremen.de/HPSG-Bib/` (Universität Bremen, Germany).

Proceedings of the last seven HPSG conferences are available on-line:

2006: Varna, Bulgaria, `http://cslipublications.stanford.edu/HPSG/7/`

2005: Lisbon, Porugal, `http://cslipublications.stanford.edu/HPSG/6/`

2004: Leuven, Belgium, `http://cslipublications.stanford.edu/HPSG/5/`

2003: Michigan, USA, `http://cslipublications.stanford.edu/HPSG/4/`

2002: Seoul, Korea, `http://cslipublications.stanford.edu/HPSG/3/hpsg02.htm`

2001: Trondheim, Norway, `http://cslipublications.stanford.edu/HPSG/2/hpsg01.html`

2000: Berkley, USA, `http://cslipublications.stanford.edu/HPSG/1/hpsg00.html`

Finally, there are two main grammar implementation platforms:

- LKB: `http://wiki.delph-in.net/moin/LkbTop` DELPH-IN project
- TRALE: `http://www.cl.uni-bremen.de/Software/Trale/`

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