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On the parallel organization of linguistic components

Harry van der Hulst*

Department of Linguistics, University of Connecticut, CT, USA

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Abstract

This article is concerned with the question as to whether the components of grammar (syntax, semantics and phonology) have a similar architecture. I provide a modest historical background to the recurrent discussion about the parallelisms between syntax and phonology within Generative Grammar and mention some 'meta-patterns', i.e., shared properties of linguistic structures in different modules that are quite general and most likely not even specifically linguistic. I also discuss Anderson's [Anderson, J., 1992. Linguistic Representation: Structural Analogy and Stratification. Mouton de Gruyter, Berlin] idea of Structural Analogy, the idea that, all things being equal, linguistic components and levels have similar structural properties. I argue in favor of a division between a word and a sentence subsystem for each of the three parallel grammatical components. Finally, I offer a general discussion of the place of phonology in the grammar and its relationship to phonetics. This section also sums up the main points of this article.

Keywords: Dependency Phonology; Government Phonology; Declarative Phonology; Structural Analogy; Syntactico-centrism; Headedness; Perceptible form (PF)

1. Introduction

In this article, I will be concerned with the organization of grammar, and more specifically with the question as to whether the components of grammar (syntax, semantics and phonology) have a similar architecture, and how these cognitive components relate to each

* Tel.: +1 860 486 4229; fax: +1 860 486 0197.
E-mail address: vdhulst@uconnvm.uconn.edu.

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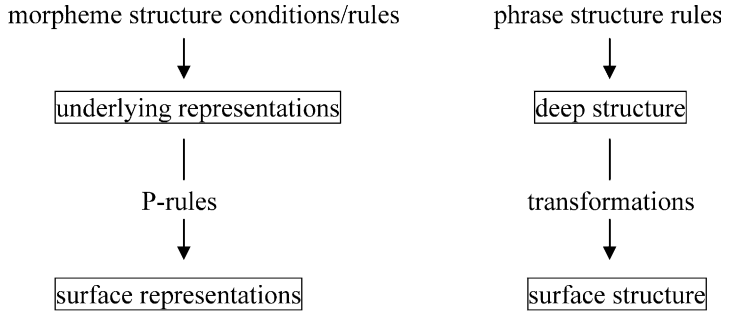
other as well as to the 'outside world'. In Section 2, I provide a modest historical background to the recurrent discussion about the parallelisms between syntax and phonology within Generative Grammar. In Section 3, I mention some 'meta-patterns', i.e., shared properties of linguistic structures in different modules that are quite general and most likely not even specifically linguistic. In Section 4, I discuss Jackendoff's (2002) claim that the grammar has three parallel systems (syntax, phonology and semantics), concluding that we ought to include semantics in discussions on parallelisms between components. In Section 5, I argue in favor of a division between a word and a sentence subsystem for each of the three parallel grammatical components. Section 6 discusses Anderson's (1992, 2006) idea of Structural Analogy, the idea that, all things being equal, linguistic components and levels have similar structural properties. I argue that this is largely true, although certain important differences (for example, involving the notion of recursion) can also be found. In Section 7, I offer a general discussion of the place of phonology in the grammar and its relationship to phonetics. This section also sums up the main points of this article.

2. Historical background

From the outset we must ask whether 'semantics' is included in the discussion on parallelisms between the components of the grammar. There may be two good reasons for limiting the discussion to syntax and phonology. The first reason is that the discussion with respect to parallels has mostly addressed these two components; this reason is enhanced by the choice of the theme and title of this special issue. The second, more personal reason, is that I know far too little about semantics to get involved in a thorough comparison between the organization of the semantic component and the other two components. (Being a phonologist, I should perhaps make a similar reservation concerning my remarks about syntax, or any other non-phonological subject touched upon in this article.) However, despite these two handicaps, I will venture to make some remarks concerning semantics in order to gain a fuller understanding of the issues that are involved.

Let us start out, then, with discussing the various ways in which phonology and syntax, and the relationship between them, has been viewed within Generative Grammar, taking a starting point with the 'Aspects model' (Chomsky, 1965); cf. Anderson (1992) for a broader perspective, and compare Bermúdez-Otero and Honeybone (2006). Until the early seventies it was widely understood that phonology and syntax are organized in a very similar fashion:

(1)



In (1), I have used the familiar terminology, but it is obvious that the terminological differences between phonology and syntax are entirely superficial. For example, P-rules could be (and, of course, have been) called phonological *transformations*, and it was indeed generally recognized that the rules by which the two levels of representation are linked in both components are formally equivalent rule types. Also, in both cases, the rules were (partially) extrinsically ordered. In fact, rumor has it that Chomsky used his ideas about phonology as a model for the development of his ideas on syntax.

The least obvious correspondence lies perhaps at the starting point, the base (cf. Sampson, 1970). I say 'least obvious' because whereas deep structures were 'produced' rather than being stored, the underlying phonological structures of morphemes were assumed to be stored in the lexicon. However, from the viewpoint of their function in the grammar, phrase structure rules and morpheme structure rules played the same role, viz. that of characterizing the wellformedness of an (infinite) array of strings in terms of a finite set of building blocks and a finite set of combination rules (as McCawley, 1968 makes clear when he replaces phrase structure rules by node admissibility conditions, which, like morpheme structure rules, function as wellformedness statements). An actual set of phonological strings (i.e., morphemes) *had* to be listed in the lexicon because of the non-compositional, arbitrary linkage between such strings and their meaning. The meaning of phrases and sentences on the other hand is compositional and there is therefore no need to list them, except in the case of idiomatic expressions. Another discrepancy between the two cases was that, whereas phrase structure rules characterize *syntactic* units, phrases and sentences, morpheme structure rules do not characterize *phonological* units since morphemes by their nature are morphological units. As we will see shortly, this point was later 'clarified' when morpheme structure rules were replaced by rules that characterize phonological units such as syllables, feet and phonological words.

Syntax and phonology then developed in the hands and minds of different linguists, who were not necessarily in agreement with the idea, let alone, with the necessity of there being a close correspondence between phonology and syntax. In addition, rather different varieties of generative syntax emerged, some being closer to the way phonology was developing than others. For example, in the early eighties, a major development in phonology was based on the idea of splitting up the derivation into a 'lexical' and a 'post-lexical' section. These proposals, due to the arguments in Kiparsky (1982), emerged from a growing dissatisfaction with the holistic approach in Chomsky and Halle's ''SPE-model'' (*Sound Pattern of English*; Chomsky and Halle, 1968). In so-called 'natural' approaches to phonology (Vennemann, 1971, 1974; Stampe, 1973; Koutsoudas et al., 1974; Hooper, 1976; Ringen, 1977), it had been argued that the traditional distinction between 'automatic', phonetically motivated rules dealing with allophonic facts and rules accounting for segmental alternations that are dependent on idiosyncratic, lexical and morphological information should be restored.

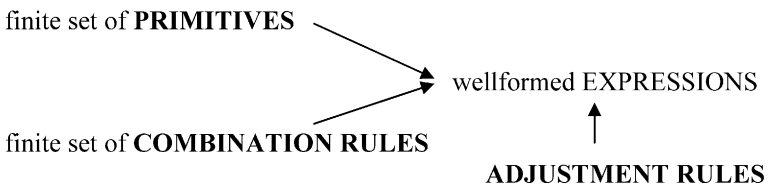
Around the same time, we also saw the rise of a similar theoretical movement in syntax, leading to 'lexical syntax' (dealing with base-generated structures, including structure preserving alternations) as opposed to 'post-lexical' syntax, dealing with unbounded dependencies (cf. Hoekstra et al., 1981 for an extensive discussion of this movement). Kiparsky noted the parallelism between the two developments as well as between the criteria that were developed to distinguish lexical from post-lexical rules in both phonology

and syntax (Kiparsky, 1978). However, the division between lexical and post-lexical syntax was 'rejected' at MIT, while, at the same time, the division between lexical and post-lexical phonology was fully embraced in these quarters. From that point on, it looked as if phonology and syntax (in their 'mainstream' versions) were no longer very similar. The lack of parallelism was enhanced by the spectacular reduction of the transformational component in syntax (leaving no room for construction-specific rules, let alone rule ordering). In phonology, meanwhile, extrinsic ordering of construction-specific rules remained the norm, at least in 'mainstream' phonology, until the rise of Optimality Theory (Prince and Smolensky, 1993). Thus, Bromberger and Halle (1989) conclude that phonology is fundamentally different from syntax.

In the mid-seventies, phonology underwent major changes that made the parallelism between morpheme structure conditions and phrase structure rules more obvious. As mentioned above, the former, it turned out, were really rules characterizing a phonological unit, i.e., syllable. This change in perspective sparked the insight that there is a phonological 'base' that characterizes wellformed phonological constituents, just like the syntactic 'base' characterizes wellformed syntactic constituents. The phonological base was soon extended to include not only syllable structure, but also foot structure and higher levels of organization. These developments brought phonology and syntax closer together again in their representational aspects, although the difference in the derivational aspect of both components was still very much present.

To summarize, at this point in the development, phonology and syntax were perceived to be similar in comprising a combinatorial system (i.e., a finite set of basic units and a finite set of rules for combinations), while they appeared to be different in terms of the subsystem that maps initial (underlying, deep) structures onto final (surface) structures. The architecture of both phonology and syntax, then, can be represented schematically as follows:

(2) The general design of syntax and phonology



The category of 'adjustment rules' differs in both components. In syntax, adjustment involves the rule 'move α', controlled by a set of output constraints, whereas in phonology we encounter an extrinsically ordered set of language-specific rules. In one respect, the syntactic model prefigured the method of Optimality Theory (Prince and Smolensky, 1993). The general rule 'move α' resembles the working of the OT-'generator' that produces an unlimited number of output representations for any given input. The correct output is the one that violates no output-filters or constraints, or, as OT would have it, the one that violates the constraints the least. This parallelism is disturbed by the fact that, in OT, no intermediate levels are assumed, whereas this cannot be said of (non-OT) syntax. Of course, in OT-versions of syntax this difference is removed. However, as in the case of the

notion of lexicalism, it would appear that mainstream syntax and phonology for some reason again decided to go their own ways when it comes to OT. OT seems to have totally conquered phonology, while there is no general acceptance of it in syntactic circles. Given the noted resemblance between OT-phonology and 'move α' syntax, this may come as a surprise. However, rather than attributing this split to different preferences of leading figures in the field (as in the case of the different receptions of lexicalism), in this case the resemblance is probably overshadowed by an important difference, viz. the notion of extrinsic, language-specific ranking of constraints, a feature that is arguably the hallmark of OT, while absent from mainstream non-OT syntax.

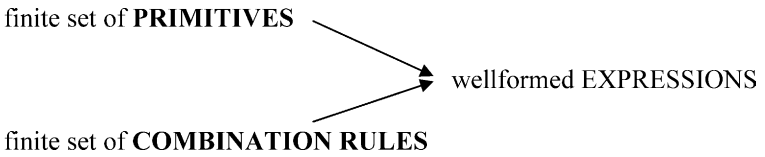
In the preceding discussion, I have referred to *mainstream* movements in syntax and phonology. As we know, the notion 'mainstream' is not necessarily linked to notions such as 'theoretical superiority' or 'empirical coverage'. It seems obvious (at least to me) that theoretical movements are 'mainstream' for reasons that do not always seem to be transparently linked to rational scientific criteria, at least in linguistics. I have shown that mainstream phonology and mainstream syntax appear to differ in their derivational aspect. Phonology adopts the mechanism of extrinsic ordering, whereas syntax does not. This, by the way, is true for traditional generative phonology and Optimality Theory, which both adopt the notion of extrinsic ordering. Outside the mainstream, however, there have been also other syntactic and phonological theories that have entirely done away with extrinsic ordering. In syntax, non-transformational models have capitalized on representing syntactic structure in terms of a system of phrase structure rules, while relocating the explanation of certain types of phenomena to other components. Such models, making no appeal to different (or intermediate) levels of structure mediated by transformational mechanisms, effectively characterize wellformed structures in terms of a set of constraints (i.e., mechanisms that can be thought of as admitting only wellformed structures); e.g., Gazdar et al. (1985) and Pollard and Sag (1994). In phonology, similar constraint-based models have been developed, in some cases with reference to the just-mentioned syntactic models (e.g., Declarative Phonology; Scobbie, 1991; Bird, 1995). Declarative Phonology, in fact, largely restates, in specific formal terms, the kind of model that was advocated by Natural Generative Phonology (cf. especially Hooper, 1976) in which phonological rules had to be 'true generalizations' over surface forms. This model, which got my vote at the time (cf. van der Hulst, 1978), like Declarative Phonology, does away with extrinsic ordering.

Another development that has been of particular interest to me is that of Government Phonology (Kaye et al., 1985, 1990; Ritter, 1995), a model (in many ways largely inspired by, or at least very similar to Dependency Phonology; Anderson and Ewen, 1987) that also views phonology as completely non-derivational, while allowing a somewhat more abstract view of phonological representations than envisaged in Natural Generative Phonology. Thus, it seems clear that an answer to the question of whether phonology and syntax differ depends a great deal on 'who you ask'.

An overall consensus, though, is that both phonology and syntax are (or at least contain) a combinatorial system, characterizing an infinite array of structure using finite means. It has become the custom to refer to rules *qua* admitting mechanisms as *constraints*, reserving the term 'rule' for instructions to 'build' structures. However, the difference between admitting and producing is one of psychological perspective, and does not regard

the task of characterizing wellformed expressions. The real difference lies between having or not having mechanisms that *change* structures, thus necessitating different levels and extrinsic ordering. Structure changing rules (and their extrinsic ordering) introduce the crucial difference between derivational and non-derivational theories. In the absence of a derivational aspect, we can use terms like 'rule' or 'constraint' interchangeably (cf. Mohanan, 2000). We then end up with the general design in (3), which differs from (2) in lacking the structure changing 'adjustment rules'.

(3) The general design of syntax and phonology (revised)



To conclude this brief historical account, I would like to reassess the need for adjustment rules (P-rules, transformations) in phonology. In phonology, it has been common to limit the wellformed expressions to those consisting of phonemes and thus contrastive feature values. Phonemes, when placed in different contexts, can have different realizations, called allophones. One task of P-rules (in models as in (1)) was to account for allophonic variation of phonemes (allowing for both neutralizing and non-neutralizing effects). In addition, in such models P-rules would change phonemes into phonemes due to non-transparent (lexical, idiosyncratic or morphological) factors. These contextual neutralization rules (like 'velar softening' and trisyllabic laxing in English or 'learned backing' in French; cf. Dell and Selkirk, 1978) were the ones that necessitated extrinsic rule-ordering in the SPE-model (in addition to the *absolute neutralization rules* that converted 'abstract underlying segments' into their surface manifestations). However, theories were developed that did away with non-transparent P-rules, building their apparent effect into the expressions that are 'base-generated' (i.e., the underlying, lexical form), such as Natural (Generative) Grammar (Stampe, 1973; Vennemann, 1971, 1974; Hooper, 1976; Ringen, 1977), and/or making them part of morphology ('if you add *-ity* change /k/ into /s/'; cf. Strauss, 1982). Hence, the class of adjustment rules could now be limited to *allophonic rules*, which are 'surface true' (so that extrinsic ordering is not required) and which can be modeled as structure-adding rather than structure-changing (cf. Ringen, 1977). Clearly, though, these rules seem different in function from the combination rules that account for the wellformed phonotactic structures of languages which deal with features that are effectively contrastive (or 'phonemic') in the language. By having both 'base rules' and 'adjustment rules' the model still seems inherently derivational, even though no extrinsic ordering is involved. Thus, the question arises as to whether one can truly get rid of this distinction such that the resulting model is fully non-derivational. There are two ways to proceed from here. Firstly, the limitation of phonological 'base' rules to phonemic structure could be seen as a mistake. In that case, for example, aspiration in English is accounted for in the base rules that characterize the wellformed presence of both contrastive and non-contrastive (distinctive) features. In some sense, this approach boils down to simply denying a difference

between the two rule types, seeing both as statements over wellformed expressions. Both Declarative and Government Phonology have followed this course (Harris, 1994; Scobbie, 1991). Another option would be to relegate allophonic rules to the 'phonetics', seeing them as the result of *phonetic implementation*. This surely seems the way to go for allophonic effects that cannot be accounted for in terms of distinctive features. However, with respect to properties that are potentially contrastive, the jury is still out, and controversy remains. In any event, in either alternative, it seems improper to invoke adjustment rules as separate phonological mechanisms: the allophonic effects are either accounted for in the phonological base, or outside phonology proper.

What does all this imply for the treatment of allomorphic *alternations* that cannot be dealt with as part of the morphology? Clearly, the output of productive morphology must be checked by the phonology and, if necessary 'adjusted' or 'repaired'. What needs to be done in any model is to provide the sequences of morphemes that form a complex word with an overall phonological 'metrical' structure that integrates all the phonological content of all morphemes. Let us say that this overall structure arises automatically and in full conformity with the wellformedness constraints for the relevant domain. Alternatively, one might say that out of all possible alternatives, only one is compatible with the constraint on phonological structure. If then anything needs to be done to the phonological *content* of morphemes, the question is *how* this will be done. For example, if (as is frequently attested in languages) a stem-final vowel fails to show up before a vowel-initial suffix (because two abutting vowels are not wellformed), is it not the case that we need an adjustment rule that deletes the first vowel? Or, if morpheme final voiced obstruents (postulated because they occur before vowel-initial suffixes) need to be devoiced word- or syllable finally, do we not need a rule for that? Note that such adjustment rules (being *repair rules*) can never be seen as part of the phonological base because they do not characterize wellformedness contrary to allophonic peaks. In some models (e.g., Singh, 1987; Paradis, 1988; Calabrese, 1988, in press) repair rules are indeed adopted, separated from the wellformedness constraints. In OT, the 'generator' will produce all possible repairs and the ranking between anti-repair (faithfulness) constraints will then determine which repair wins. Thus, the repair rules show up as anti-repair constraints effectively causing OT to have two types of constraints (well-formedness constraints and faithfulness constraints), as well as introducing the main reason for OT needing extrinsic ordering (cf. van der Hulst and Ritter, 2000b, 2002). In Government Phonology the relevant effects are attributed to what is called 'the phonetic interpretation' (which is not necessarily the same as the 'phonetic implementation' described above). Phonetic interpretation indicates how phonological structures are pronounced, without adding or deleting phonological content. A morpheme-final vowel or final voicing that does not surface is said not to be interpreted phonetically. In other cases such as vowel harmony, a phonological element is said to be interpreted over an extended domain, under circumstances that are fully characterized in the phonological representation. A discussion of the treatment of 'opacity effects' within Government Phonology is offered in van der Hulst and Ritter (2000a). In my opinion, Declarative Phonology, unwilling to follow the course taken by Government Phonology, has not managed to deal with repair-like statements in a satisfactory manner because, indeed, such statements are not wellformedness conditions at all.

In conclusion, we can say that the model in (3), without 'adjustment' or 'repair' rules may be sufficient for phonology if the course proposed by Government Phonology is taken.

3. Properties of grammatical systems as metapatterns

I now return to the issues of parallelism between grammatical components, making the point that some such properties may, in fact, be even more general. I will also discuss the consequences of the latter point with respect to claims that said properties are due to an innate, specifically linguistic faculty.

Abler (1989) describes *particulate systems* (i.e., systems based on the 'particulate principle') as systems in which a finite set of discrete units are combined into hierarchical structures. Those structures themselves can be combined further, such that the primitive units, as well as their combinations, remain discrete (rather than being blended) while all combinations have properties that go beyond the sum total of properties of their components because of the presence of structure including, possibly, linear order. Abler also refers to such systems as 'self-diversifying systems' or 'Von Humboldt systems', after the latter's famous characterization of language as a system that makes infinite use of finite means.

The 'particulate principle', according to Abler, characterizes not only language, but all physical systems, including chemistry/physics and genetics. In all these systems, we start out with a finite set of primitives (elements, DNA-bases) which are combined in increasingly complex structures. In language, so it seems, the particulate principle applies twice, both at the level of phonology and at the level of syntax. Indeed linguists, especially those linguists who accept the conclusion of Section 2, have long taken this point for granted. Particular, hierarchical organization, in fact, is more common than Abler suggests. Simon (1996) discusses the application of 'hierarchy' not only in biological and physical systems, and (human) symbolic systems, but also in social systems.

The realization that the basic architecture of grammatical components is far from a unique property of language, does not preclude the possibility of there being differences among particulate systems in general, nor among phonology and syntax more specifically. The 'syntax' of genetic expressions at the lowest level dictates units of three bases (so-called 'codons'), while any systematicity in the higher structure, especially that of whole genes, is largely unknown at this point. It is not obvious that chemical compounds share significant properties with syntactic phrases (like being headed or binary), while arguably such properties are shared with phonological expressions (cf. below). Differences between systems that share a fundamental architecture raise the question of how the specific characteristics of systems arise out of the combination of general principles and apparent domain-specific properties. Note, incidentally, that even domain-specific properties may be due to general principles that happen not to apply in every domain that involves hierarchy. For example, I mentioned binarity and headedness as characteristic properties of linguistic structures. However, following the spirit of Volk (1995), these properties might be seen as instantiations of 'metapatterns' ('binaries' and 'centers', respectively), 'hierarchies' being mentioned as a metapattern itself.

Thus, important design properties of syntax and phonology may be due to the fact that these systems belong to a family of systems that typically, or even by necessity have these

properties. This finding reduces claims about parallelism between syntax and phonology to a claim about a much more general form of parallelism. It seems obvious that the discovery of such general design properties and metapatterns could be used to undermine far-reaching claims about a highly specific, innate design of linguistic components. However, it must also be realized that it is entirely consistent with establishing a general design of particulate systems to argue that such properties have over (evolutionary) time found their way into the hard-wired structure of *cognitive* particulate systems. After all, when it comes to language, the 'particulate' design property, as well as additional general properties, exist *as cognitive structures* (states of the brain). The fact that (some of) these design properties may be a logical necessity for systems that characterizes an infinite array of structures with finite means does not invalidate the idea that the human mind is genetically predisposed to 'grasp' these properties, nor that a specialized form of this predisposition characterizes an innate language-acquisition faculty (cf. Ritter, 2003). However, it would seem that especially the latter point is controversial either with specific reference to a language module, or with reference to modularity in general. Anderson (2006) argues that all properties of language that have been attributed to language-specific innate 'stipulations' may very well be shown to derive from more general cognitive principles, a view that also characterizes the broad linguistic school of 'cognitive linguistics' based on the work of linguists like Langacker (1987) and Lakoff (1987). Proponents of the latter view must still attribute human language to properties that are specific to the human mind, given that human language is specific to the species, but they claim that there is no language-module, or perhaps no modularity at all.

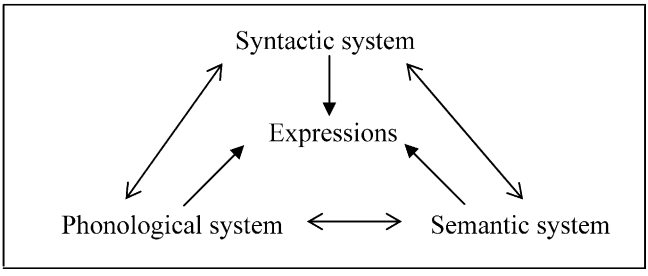
My own view on these admittedly very complicated issues is this. I share general views (based on the result of evolutionary psychology as well as the study of brain defects) that the human mind has a genetically determined modular design, and I refer to Pinker (2002) for a survey of the evidence and counter-arguments. Thus, it strikes me as entirely plausible that some properties of language are due to language-specific, genetically programmed states of the mind. For the reason stated above, this could even include properties of language that can be seen to operate in non-cognitive domains. However, there seems little motivation for believing or assuming that every property of language is specific to the language faculty. Whether or not this is so is dependent, it seems to me, on the results of findings in sciences that study other faculties of the mind. If a certain principle is shown to operate elsewhere (e.g., in the vision 'system'), there are two possibilities. The first is that there is a general cognitive pool of principles that govern what is going on in domain-specific faculties, and the principle in question belongs there, or, secondly (putting aside whether or not there is such a general pool), several faculties have incorporated the same principle (for whatever reason). Methodological rules of theory construction dictate, I would say, that an attested principle, given that some form of modularity is accepted, is first exclusively attributed to the faculty that indicated its existence; this is the position that can most easily be falsified, i.e., by showing relevance of the principle in one other domain. (At least, it seems much more difficult to show that a certain domain is *not* subject to that principle, although all this may depend on the nature of the principle or constraint at issue.) Then, if evidence for the same principle shows up elsewhere, it would seem that the principle must be eliminated from the specific faculty, until proven otherwise. This means that 'cognitive linguists' must be able to demonstrate that their principles operate outside the linguistic domain, whereas Chomskyan

linguists must positively show that alleged properties of UG are in fact part of only the language faculty if they wish to maintain that position for properties that have been shown to operate outside language.

4. Syntacto-centrism

Returning to our historical perspective, we must add one important ingredient to the understanding of parallelism between grammatical components. Despite what was said about parallels and differences, one important feature of mainstream models that seems to undermine strong parallelism is, what Jackendoff (2002) calls, their 'syntacto-centrism'. In the notorious T-model, the syntactic component is responsible for coming up with expressions, which then can be interpreted semantically and phonologically (or 'phonetically'). The usual 'sloppy' use of terminology (phonology, phonetics) is, of course, indicative of the lack of appreciation for the interpretative components. The interpretative view of phonology does not in itself seem incompatible with viewing this component as a combinatorial system. This depends on how much autonomy is granted to phonological organization above the level of simplex words. The views following Selkirk (1978) and Nespor and Vogel (1986) recognize an autonomous syntax of phonological structures, while, at the same time, building them with reference to a pre-given syntactic structure. The more fundamental point that Jackendoff makes, however, is that there is no reason to view syntax as central. Various kinds of objections could, and have been made. The psychological objection (in, e.g., Seuren, 2001) is that speakers first know what they want to say (meaning) before they put it in a certain form (phonology, syntax). Without the necessary psychological perspective (which ignores that we also have listeners who necessarily start out with the form and then arrive at the meaning), the movement of generative semantics also favors semantico-centrism. Jackendoff (2002) objects to syntacto-centrism without replacing it with the wish to make another component central. Rather, he argues for strict parallelism between all three components. All three components, then, are in his view combinatorial systems and the grammar as a whole includes a set of correspondence rules which state how specific syntactic, phonological and semantic structure can co-occur. In this view, the grammar is essentially a checking device.

(4) The grammar as a checking device



A linguistic expression is wellformed on this model if it is wellformed according to all three components and if the particular combinations of these wellformedness structures is in accordance with the correspondence rules (indicated by the bidirectional arrows).

The question 'where do the expressions come from' is not relevant unless we are concerned with the actual act of speaking (cf. Levelt, 1989). So there is no need, if the characterization of wellformedness is at issue, to add a 'generator' to the diagram in (4).

In the preceding discussion, I have brought the semantic component into the picture (following Jackendoff, 2002), and have given it a status that is equal to that of the syntactic and phonological system. All things being equal, we might expect the semantic system to be a 'particulate' system of the type in (2). The primitives of the semantic system would be comparable to the primitives of the phonological system in being cognitive symbolic objects (categories) that receive an interpretation in some domain. Phonological objects receive a phonetic interpretation (articulatory movement and acoustic speech event), whereas the semantic primitives receive a cognitive interpretation (corresponding to an event in a 'possible world'). (Jackendoff, 2002 makes no distinction between the semantic primitives, as linguistic units, and their cognitive interpretation. In his view, the semantic primitives *are* cognitive units, as such the end station of semantics.) I will return to this issue in Section 7.

If Jackendoff's view of the grammar is accepted, a discussion of parallels ought to be concerned with all three components. However, in this article I will not go beyond the suggestions made above, viz. that the parallelism holds at least in as far as all components display the general architecture in (2), and in as far as all three systems have the same status as checking devices.

Jackendoff also raises the point that each of the grammatical systems is presumably complex in containing various subsystems. In the case of phonology, for example, he anticipates different systems dealing with syllabic, metrical, and autosegmental representations. The different subsystems partly characterize different levels within a single hierarchy, and partly, different planes.

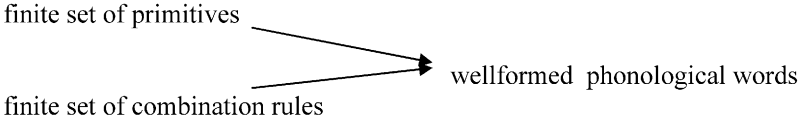
5. Word versus sentence (or utterance) grammar

In this section, I would like to discuss the possibility or desirability of making a distinction between a word and a sentence (or utterance) grammar in each of the three grammatical subsystems.

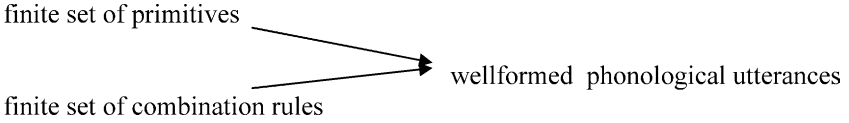
In phonology, this distinction is both traditional and new. Trubetzkoy, the founder of modern phonology, clearly envisaged a distinction between word and sentence level phonology (Trubetzkoy, 2001). In more recent times, the distinction has been seemingly re-erected in Lexical Phonology (Kiparsky, 1982, 1985), given that the label 'lexical' in this framework seems to imply a focus on the phonology of words, as opposed to the post-lexical focus on syntactic constellations of words.

If such a distinction is made, we must have two combinatorial systems for phonology:

(5) a. **PHONOLOGY (word; 'lexical phonology')**



b. **PHONOLOGY (utterance; 'post-lexical phonology')**



An issue that arises here is whether the two systems are built on top of each other, forming different levels within the same plane, such that the primitives of the sentence grammar are the wellformed expressions of the word grammar; or rather whether the two systems represent two different parsings of the phonological string, represented in different *planes*. In the latter case, the internal phonology of words (as constructed in the word-level phonology) would not be accessible to the utterance phonology. Rather, utterance phonology would *ignore* the word phonology and construct its own complete phonological structure. Both planes would share a common interface, which could simply be the linear string of x-slots. Anderson and Ewen (1987) advocate the second view, which is also adopted in van der Hulst (2003a) where I claim that, what I call the 'duality hypothesis', makes sense of many 'structure paradoxes', i.e., cases in which a particular phonological string seems amenable to two different structural analyses, both motivated in terms of different considerations. van der Hulst (2003a) argues that the difference between the two levels may even extend to the issue of whether or not parochial constraint ranking is part of the grammar. At the word level, the answer might be against constraint ranking since differences between languages can be dealt with in a more restricted manner, viz. in terms of parameter settings. At the sentence level, where the 'battle' between perception and production is more 'active', constraint ranking may very well be the appropriate means for dealing with different solutions to meeting conflicting demands.

In order to determine the relevant notion of 'word', we need to discuss the organization of the phonological word grammar in some detail. Here I will follow the ideas of Dependency and Government Phonology (Anderson and Ewen, 1987; Kaye et al., 1990; Kaye, 1995). The smallest units are a small set of elements that occur either alone or in combinations, forming 'phonological expressions' that associate to 'skeletal' X-units. The skeletal positions are organized into syllabic constituents that are maximally binary. Syllabic constituents, notably rhymes, are grouped into foot-like units, which in turn are grouped into 'word-like' units. Here such 'word-like' units are taken to be maximal phonological units that require

no morphological complexity. In Government Phonology this is the so-called *non-analytic* domain, which roughly corresponds to the 'word-level' in Borowsky (1994); in English this includes underived words and words having 'level 1 affixes'. The next level up is the *analytic* level, which is morphologically structured, although I assume that it also accomodates 'the phonological appendix' (cf. Fudge, 1969). In fact, we could refer to the analytic domain as the *clitic* domain, if we take derivational level 2 and inflectional affixes that do not contain a full vowel to be phonological clitics, i.e., independent morphological units that cannot stand alone as phonological word-like units. Other level 2 affixes (sometimes called 'heavy'), which behave just like the right member of compounds, i.e., they *are* independent word-like units, seem to contain more than one word-like unit, and we could refer to them as 'phonological phrases' (cf. van der Hulst and Ritter, 2002 for further discussion on this topic).

The Government Phonology view on O(nset)–R(hyme)-structure is that even though there is no syllable as such, a network of so-called interconstituent licensing relations binds together Os and Rs, while placing restrictions on the occurrence of both empty syllabic constituents and branching constituents (in short, on 'marked' constituents); cf. van der Hulst and Ritter (1999, in preparation) and van der Hulst (in press-a). The network of OR structures and interconstituent licensing relations plays an important role in steering the phonetic interpretation of phonological representations, allowing both for non-interpretation ('deletion') and non-local interpretation ('assimilation', 'spreading') of the elements. Thus, the 'word-plane' contains the following hierarchy of layers:

(6)

Basic units	elements
First level	Segments
Second level	O/R constituents
Third level	feet
Fourth level	non-analytic domain ([X])
Fifth level	clitic group (analytic domain [[X]Y] or [Y[X]]
Sixth level	phrase (analytic domain [[X][Y]])

The three highest levels can occur as independent wellformed expressions, i.e., they are all wellformed words in the phonological sense.

At the utterance plane, we can assume that the primitives of organization are segments which are grouped into syllables with a moraic, rather than onset/rhyme structure. The syllabic units form rhythmic patterns within prosodic domains such as the prosodic word, the prosodic clitic group and the prosodic phrase.

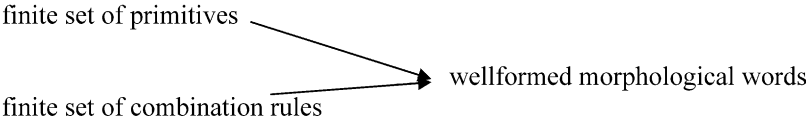
As pointed out in van der Hulst (2003a), mismatches between word- and utterance-plane units can easily exist. Firstly, whereas at the word-level syllables constitute onset/rhyme packages, the utterance level organization may be moraic, cutting up the syllable in two halves ('demi-syllables'). Secondly, with respect to syllable boundaries, it might be argued that ambisyllabicity (overlap of syllabic constituents)

is an utterance phenomenon. At the word-plane, overlap between O and R constituents is not allowed by the word-phonological 'syntax'. At higher utterance levels, one might say that the word-internal analytic structure (comprising 'clitics' and/or words derived with heavy affixes and compounds) is largely ignored. Prosodic words in the utterance plane can be either non-analytic or analytic in the word plane, showing no apparent difference in behavior at the utterance level. This is witnessed by the fact that at the utterance plane, all such word units contribute only their strongest, primary stress. Working out the details of exactly how word structure corresponds to utterance structure must be done elsewhere. I take it that the main point, viz. that both levels are needed and overlapping has been established at this juncture; Rischel (1987) also proposes two different phonological hierarchies or planes.

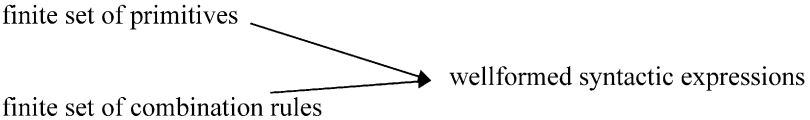
The next question is now whether the other components require the same kind of distinction, somewhat along the following lines:

(7)

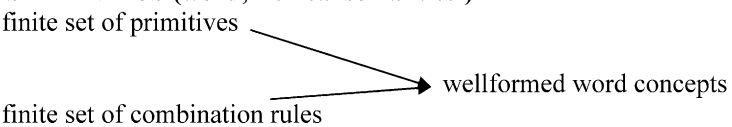
a. **SYNTAX (word; 'morphology')**



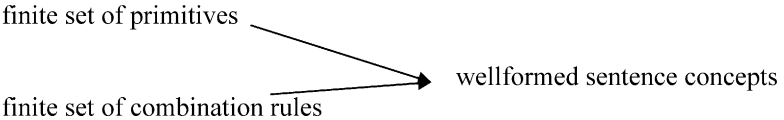
b. **SYNTAX (sentence; 'syntax')**



c. **SEMANTICS (word; 'lexical semantics')**



d. **SEMANTICS (sentence)**



No doubt, specialists in syntax and semantics will find this picture too simplistic. In both components, however, it would seem that the distinction is widely acknowledged in some form or other. The primitives of morphology are morphological categories (word class categories) specified as either free or bound. The syntax of morphology is different from

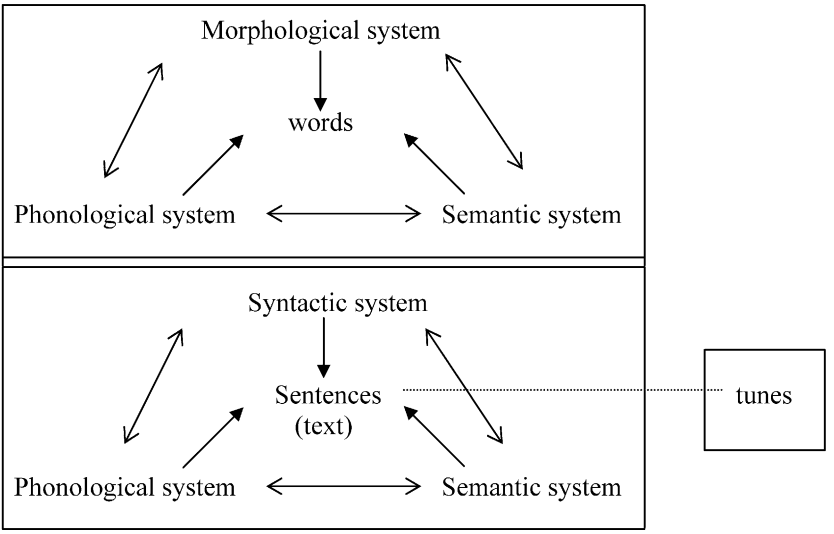
the syntax of sentences in certain respects, although words seem to have binary, headed constituency much like phrasal structure (cf. Hoekstra et al., 1981). As for sentence syntax, one might raise the issue that I raised in the domain of phonology: are the basic units of sentence syntax morphological words, or does sentence syntax have access to smaller units? Note that the picture in (7a,b) does not exclude that 'inflectional' morphology is part of sentence syntax, in which case inflected items wouldn't be 'words' but rather units belonging to the sentence level. I cannot address this issue here. It is, in any event, well known that the boundary between word structure and phrasal and sentential structure is not clear cut. Various kinds of structure paradoxes involving word-internal elements having (semantic) scope over larger-than-word structures have been discussed extensively, giving rise to models that allow conflicting organizations of the same string or morphemes (Sadock, 1991), thus embodying the same kind of 'duality' that I have argued for in the domain of phonology.

As for semantics, at the word level, the nature and number of primitives has been the subject of extensive debate. However, it seems reasonable to postulate that a set of 'semantemes' exists, either as proposed in Jackendoff (2002, and much of his earlier work) and Talmy (2000), or, in a more restricted form in Mohanan and Wee (1999). Like phonological elements, semantic elements can occur alone or in combinations, thus forming expressions that form the semantic side of words or phrases. With respect to the division of labor between word ('lexical') and sentential semantics, similar discussions as were mentioned with respect to phonology and syntax arise, but, as promised, I will not venture into this area.

At this point, we need to scrutinize the term 'morpheme', which I have avoided as the term for morphological primitives. Given the tripartite organization of grammar, we cannot regard morphemes as the primitives of morphology. Rather, the primitives of morphology are class labels like Noun, Verb, etc. Morphemes, on the other hand, are *packages* of phonological form, meaning and morpho-syntactic category. This leads to the following question: is there a unifying notion of 'word' such that it results from a combination of three wellformed expressions, here called a phonological word, a morphological word and a semantic word? Common sense would have it that, in fact, this is exactly what is normally meant by the term 'word'. Thus, both morphemes and words are, as Jackendoff puts it, frozen correspondences between pieces of phonological, syntactic and semantic structure. In the case of morphemes, the pieces are 'whatever they are', while in the case of words it must be the case that the pieces are wellformed expressions. Morphemes (and words) do not necessarily have all three layers of structure, of course. Defective items might miss, for example, a phonological structure as in 'zero affixes' or with syntactic elements like PRO/pro. Morphological roots may lack a word category; interjections may also be characterized in this way. Lack of semantic structure might be attributed to morphological 'binding morphemes' (/+s/ or /+e/ in Dutch, /-o/ in Greek).

In summarizing, if the distinction between word and sentence/utterance is valuable in all three dimensions of language, grammars then consist of two checking devices, one for words and one for sentences:

(8)



Wellformed words are picked from the random collections of morpheme combinations, whereas wellformed sentences are picked from the random collection of word combinations.

Parallel to the sentence-level system, one component has been added in (8) that has not been mentioned before. So far, we have only accounted for the 'text'. Language utterances also have a 'tune'. It is not uncommon to hear that intonation is part of the *phonological* system, but this is not the right view. Intonational tunes (following Pierrehumbert, 1980) are complex expressions built from primes that have their own form and meaning or function. In other words, the intonation system forms a grammar in its own right, as argued explicitly in Gussenhoven (1984). The intonational grammar, then, is a sentence-level system with a phonological, a syntactic and a semantic subcomponent, and correspondences between the wellformed structures that these subcomponents allow. Wellformed intonational expressions ('tunes') are associated to the 'text' in accordance with 'text-to-tune' alignment rules that make reference to the text's three correlated structures. At the word level, there is no 'tune component' as pitch distinctions (in tonal languages) are part and parcel of the phonological system.

In this section, I have argued for a distinction between a word and utterance/sentence grammar in all three subsystems. The distinction between word and sentences/utterances is related but not identical to two other distinctions, viz. *lexicon* versus '*post-lexicon*' and *storage* versus *on-line processing*. The latter distinctions are discussed at length in Jackendoff's 2002 book. With Jackendoff, I take the lexicon to be a stored inventory of linguistic expressions as opposed to those expressions that are constructed on line. The stored items (*lexemes*) could be words (defined as packages of wellformed phonological, semantic and morphological expressions), but we also find stored items that are smaller or larger than words. The smaller items are bound morphemes, while the larger items are idiomatic and 'fixed' expressions. But not all words need to be in the lexicon. Complex

words that are formed by fully productive morphology would not need to be stored. (Whether or not they are is a psycholinguistic issue.)

Jackendoff (2002) specifically discusses idiomatic expressions, showing how such expressions may have irregular syntax, while having regular phonological and semantic structure. He correctly and insightfully points out that phonological combinations can also be idiomatic in that some occurring combinations may be highly unusual in the language (cf. the rare case of initial /fj/ in Dutch or English). Also, many languages may have segments with a very limited distribution (often called 'loan phonemes').

6. How much structural analogy?

The grammar, as sketched in the preceding sections, is modular in the usual sense. It consists of components (modules) that perform their own functions, independent from other components. According to one possible view, modularity allows, or even predicts that different modules have totally different designs. This is not the view that is expressed in the preceding sections. On the contrary, my assumption has been that all components are highly parallel in their organization. In regard to the issue of component design, I have adopted what Anderson (1992, 2006) calls 'the structural analogy assumption': ''crudely, the assumption that the same structural properties recur (ceteris paribus) on different linguistic planes and levels'' (Anderson, 1992: vii). Hence, rather than taking modularity to imply (let alone necessitate) different structural properties, Anderson suggests taking the opposite view as the null hypothesis. The discussion in Section 2 is in line with this view. In fact, in Section 3 I have suggested that the notion of structural analogy extends far beyond the realm of grammatical systems. There, I discussed various suggestions (from Abler, Simon and Volk) that the particular, hierarchical organization is a natural principle of all systems (physical, social and cognitive) that produce infinite (or large) sets of expressions or constellations using finite means.

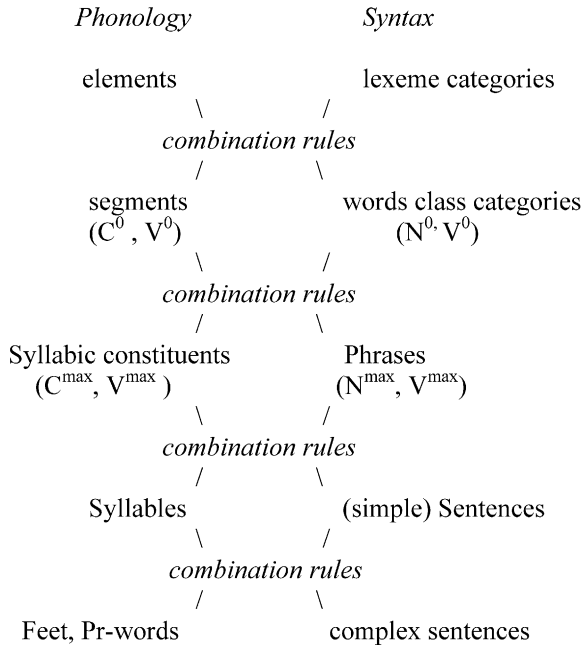
In this section, I will look at some specific claims made by Anderson, materialized in work that came to be known as Dependency Grammar, with specific instantiations in Dependency Phonology (Anderson and Ewen, 1987). Related models in phonology are Government Phonology (Kaye et al., 1985, 1990), Radical cv Phonology (van der Hulst, 2000, in preparation, in press-a) and Head-driven Phonology (van der Hulst and Ritter, 1999, in preparation). A cornerstone idea in Anderson's work is the realization that structure in such areas as morphology, syntax and phonology (he does not extend this to semantics) is characterized by head-dependency relations. In any combination, one member is the head, the other (or the others) the dependent(s). Heads are atomic (minimal) units that are characteristic of the construction that they occur in. Government Phonology takes up this idea, claiming, like Anderson and Ewen (1987), that combinations have at most one dependent, thus only allowing binary constituents. van der Hulst and Ritter (1999, in preparation), pushing this further, argue that head-dependency relations drive the whole phonology.

Headedness has, of course, also played a key role in generative syntax, leading to the development of the X-bar theory of syntactic structure. The details of how phrases are organized have changed over time, in particular regarding the issue of a distinction between two types of dependents, viz. complements and specifiers (or adjunctive and subjunctive

dependency, as Anderson would put it). In phonology, outside Dependency and Government Phonology, heads have been recognized too, explicitly or implicitly, but not rigorously, i.e., not consistently at all levels of structure, including intrasegmental structure. If we follow Anderson, however, headedness (or dependency) is taken to be an omnipresent structural property in both syntax (including morphology) and phonology. It is crucial to see that headedness goes beyond making a binary distinction (head-dependent); it is crucial that the binary opposition involves an *asymmetrical relationship* such that one pole of the relationship has the specific property of being characteristic of the construction.

It remains to be seen whether the parallelism between syntax and phonology includes the same number of hierarchical layers. In van der Hulst (2000), I presented a chart, similar to the one in (9), suggesting a high degree of parallelism between the syntax and phonology modules in terms of layers:

(9)



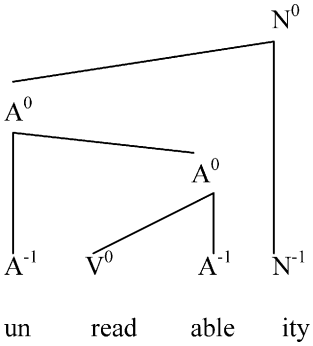
The comparison between syllables and sentences is commonly made. Most recently, Carstairs-McCarthy (1999) places this correspondence at the basis of his evolutionary account of human language, arguing that syllabic structures were used as models for sentential structures (cf. Tallerman, 2006, for a critical discussion of this idea).

In Government Phonology, syllables are not assumed to have the prominent status that is usually attributed to them, but it is still assumed that words consist of alternating strings of (O)nset and (R)hyme, where both units necessarily occur together bound by an 'interconstituent relationship'. In van der Hulst (in press b), I suggest that the onset–rhyme relationship forms part of an extensive network of interconstituent relationships, following generalizing proposals in Kaye et al. (1990), Dresher and van der Hulst (1998), and van der Hulst and Ritter (1999, in preparation).

Having established, or rather suggested, these parallelisms in the domain of structural organization (binarity, headedness) and layers, I would now like to focus on some apparent differences between phonological and syntactic structure.

To the extent that the internal structure of phonological segments parallels the internal structure of words, the actual structures needed in both domains differ in many details, although all are binary and headed. Of course, claims to this effect are totally dependent on the theory that one adopts or develops for these domains. For morphology, I follow the proposals in Hoekstra et al. (1981), where it is argued that affixes should be regarded as heads that take bases as their 'complements':

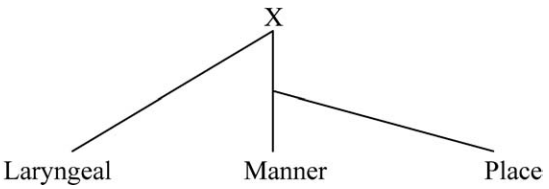
(10)



The head status of category-neutral prefixes is debatable, but I will ignore that point here. It is important to note that this kind of structure is not limited to concatenative morphology, since linear order is not a necessary property for having headed structures.

In my own work on segmental structure (van der Hulst, 2000, in preparation, in press-a), I have suggested (combining insights from Anderson and Ewen, 1987 and Clements, 1985) that segments have the following macrostructure:

(11)



Within each subsegmental unit, two elements (labeled C and V) define a four-way distinction (C, Cv, Vc, V). In other words, this proposal adopts an extreme degree of structural analogy between the three 'class-nodes'. The syllabic constituents are:

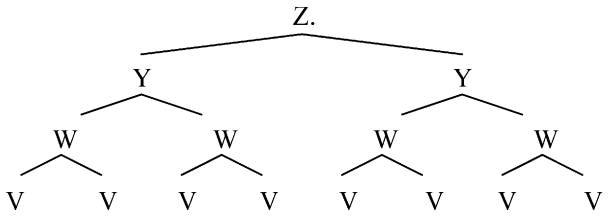
(12)

Rhymes combine into feet and feet into words, as exemplified in (6) above.

A rather important difference between phonological structure and structure in morphology and syntax seems to lie in the absence of recursion in phonology (see also Carr, 2006). Intrasegmentally, we detect no recursion. At most, segments can be said to have two nodes of the same type in order to account for complex segments (cf. van der Hulst, in preparation). However, we do not find the kind of recursive structure that we see in morphology (cf. (10)). Likewise, at the level of syllabic constituents we do not find the recursion that we find in syntactic phrases in which complements are maximal projections. Onset heads and rhyme dependents are basic X^0-structures, i.e., segments as in (11) that are, if anything, simpler than their X^0 heads; van der Hulst (in press-b) argues that syllabic dependents only have manner properties (i.e., only segmental head properties).

Moving up the phonological hierarchy, we do not encounter recursivity either. Rhymes combine into feet that are maximally binary and feet form words, which arguably are also maximally binary (cf. van der Hulst and Ritter, 1999, in preparation). In fact, we encounter here a typical feature of phonological hierarchical structure, referred to as 'strict layering': each unit dominates at least two units at the lower level (ignoring headedness):

(13)



Morphological and syntactic structure does not have this property of strict layering (which in phonology is violated in the case of clitic structure both at the word and the utterance level). The complexity of the 'phrasal structure' (again at both levels) is largely dependent on the presence of morphological or syntactic complexity. It is, however, not necessarily the case that multiple affixation and multiple compounding correspond to phonological structure that is recursive rather than layered. Giegerich (1985) and Visch (1989) show that multiple compound structures, no matter what their morphological constituency is, converge on simple rhythmic patterns that do not require cyclic assignment of stress. Likewise, at the utterance level, embedding patterns in syntax do not correspond to embedding patterns in the prosodic hierarchy. Rather, again we get strict layering.

In certain areas of phonology, it has been argued that there is a need for unbounded constituents, which thus show recursivity. Early metrical phonology recognized so-called unbounded feet and, for example, both Clements (1981) and Huang (1980) have proposed treatments of downdrift that rely on unbounded metrical trees. Unbounded feet, however, are no longer considered to be constituents with multiple embedding (cf. Hayes, 1995); in fact, it is doubtful that the relevant systems have feet at all. As for downdrift, in this case it would seem that embedded structures are a means to an end that can also be arrived at in terms of local computation of pitch levels with reference to the immediately preceding pitch level (cf. Pierrehumbert, 1980).

The absence of recursion in phonology is noteworthy in view of the strong parallelism between the phonological and the syntactic component. One might speculate that in an evolutionary sense syntax has perhaps copied the recursive trick from semantics, or more generally from cognitive representations of social relationships and complex embedded events (cf. Bickerton, 1990).

7. Where and what is phonology?

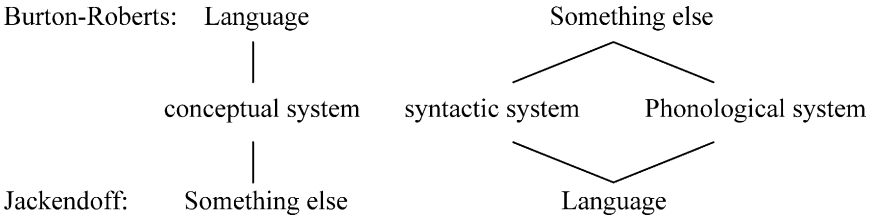
In this article, I have tried to address the organization of the grammar as a whole allowing myself to speculate a little on aspects that are outside the expertise of a phonologist. I hope that my colleagues in syntax and semantics will feel inspired to address the questions that I have raised for their domains. Following the idea of Jackendoff (e.g., 2002), and fully in line with Government Phonology (e.g., Kaye, 1989; Ritter, 1995), I have placed phonology squarely within the cognitive domain, along with syntax and semantics (cf. van der Hulst, 2003). It is now necessary to indicate how phonology relates to phonetics, or, more generally to the non-cognitive. The position that I adopt here seems clearly in disagreement with that of Burton-Roberts (2000), Burton-Roberts and Poole (2006), who place phonology outside the cognitive computational system (C_{HL}) that forms the innate human language ability. Phonology for them is concerned with the external representation of linguistic expressions characterized by C_{HL} in the same way that a painting is a representation of some real world object. In this conception, phonology includes morphology and a large portion of what is traditionally called syntax. In fact, phonology includes everything that is not invariantly universal, since C_{HL} is thought of as being an invariant, universal system. It almost seems as if Burton-Roberts' C_{HL} is the 'grammar of human thought', with phonology being a parametrized system that produces and parses utterances that represent (in the sense described above) 'thought expressions'. Burton-Roberts does not deny that 'phonology' is a cognitive system; phonology, as an acquired, internalized system, is the locus of conventions that determine how a given phonetic phenomenon gets to represent a given expression characterized by C_{HL}.

Understood in this way, it is perhaps unnecessary to disagree with Burton-Roberts. I have no quarrel with there being a computational system that generates 'thought expressions'. In fact, one might reasonably call this system 'internal language', or C_{HL}. It seems to me, however, that most linguists are apparently studying what Burton-Roberts calls 'phonology', i.e., the acquired computational system, that generates the utterances that can serve as representations of thought expressions. This system, by Burton-Roberts own view, comprises virtually everything that has always been understood to be part of the mental grammar. Burton-Roberts' C_{HL} is perhaps not very different from Jackendoff's conceptual module, and indeed, Jackendoff (2002) argues that the conceptual system

> . . . is not part of language per se—it is part of thought. It is the locus for the understanding of linguistic utterances in context, incorporating pragmatic considerations, and 'world knowledge'; it is the cognitive structure in terms of which reasoning and planning takes place. That is, the hypothesized level of conceptual structure is intended as a theoretical counterpart of what common sense calls 'meaning'. (Jackendoff, 2002: 123)

Both Burton-Roberts and Jackendoff assign status to a cognitive component that deals with 'thought expressions' and that is distinct from the phonological and the morpho-syntactic component, although the latter for Burton-Roberts essentially form one component. Jackendoff regards this component as dealing with semantics (which, as any particulate system, contains a 'syntax' that accounts for permissible combinations of primitives), while Burton-Roberts' discussion suggests that this component is what is left of the T-model in a radical interpretation of the minimalist program. The bottom line, however, is that whatever the precise nature of this system, or its degree of universal invariance, we still need to account for the other two components (morpho-syntax and phonology). To place these outside 'Language' boils down, as Burton-Roberts realized himself, to narrowing down the definition of Language to 'the language of thought'. Meanwhile, the components that deal with morpho-syntax and phonology are just as cognitive as C_{HL}, a point that Burton-Roberts does not deny. In any event, what is called Language turns out to be rather subjective:

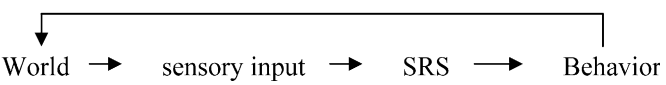
(14)



More important than these terminological differences is the agreement that linguistics, in the tradition of Chomsky's revolution, is the study of the cognitive components that form a 'language organ', for which the study and description of languages, as well as of native speaker's intuitions form the most important sources of information.

Having 'settled' this issue, I will now discuss how these cognitive systems, in particular phonology are related to the non-cognitive world. Here I take inspiration from the evolutionary discussions in Bickerton (1990) and Jackendoff (2002). To kick off the discussion, I will assume that all higher animals have something that we might call: a sensory-based representational system (SRS) that is fed by experience, although it may to a large extent consist of innate ''expectations'' (cf. Popper, 1999). This system mediates between sensory input and behavior:

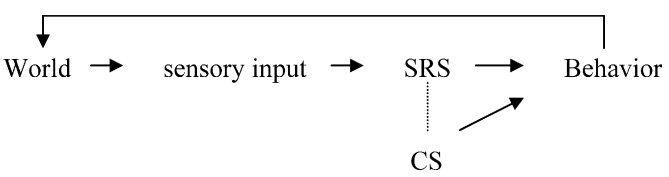
(15)



I take it that the SRS is a system of *categories* that enable the organism to recognize things and events in the world and to initiate appropriate behavior. Behavior, of course, is also driven by body-internal signals such as hunger or fear. It is perhaps reasonable to believe that in very primitive species, e.g., snails, flies, sensory input is linked to behavior by an even more elementary system, a direct mapping without the intervention of a SRS.

Now, assume that humans, and perhaps some other closely related species as well, possess a higher-level representational system that can be thought of as a 'projection' (in an evolutionary sense) from the sensory-based system that 'leads a life of its own'. I will use the term Conceptual System (CS) to refer to this higher-level system. The primitives for building up the CS are derived (from an evolutionary point of view) from the 'ingredients' that form the SRS. Thus, the CS is also a system of categories, which I will call **concepts**. The concepts enable the organism to construct a 'mental world', which means that the CS also must have a set of 'rules' for combining simple concepts into complex concepts:

(16)



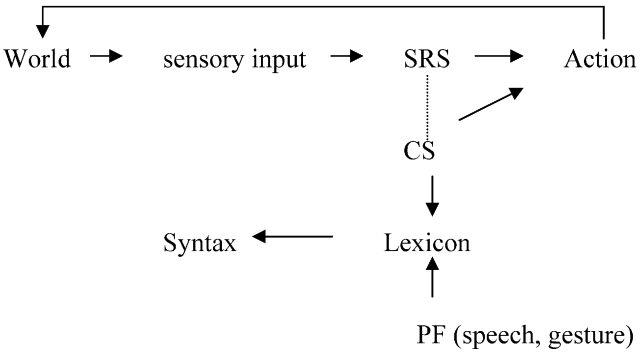
Here are a few important properties of the Conceptual System:

- The CS is not 'synchronically' dependent on sensory input, nor on input from the SRS
- The CS can by itself cause behavior; thus humans do not need sensory input in order to act
- The CS can construct 'worlds' that do not reflect the 'here' and 'now'
- The CS has the property of 'recursion', it allows us to 'imagine' an infinite array of 'possible worlds'

Let us now fit language into this picture. Imagine first a simple communication system that links basic and complex expressions of CS to a specific kind of behavior, viz. the ability to produce a sound or gesture that, in a natural or conventional manner, represents (in the Burton-Roberts sense) that expression of CS. Let us call the result of this behavior *perceptible forms*. The resulting packages of CS-units and (the knowledge of how to produce) perceptible forms (PF), i.e., sounds or gestures, constitute **signs**. At this point, i.e., now that we have signs, I will use the term **meaning** as referring to the 'conceptual content' of signs (as in Jackendoff, 2002). The inventory of signs will be called the/a lexicon. A system of this type would need an ever growing inventory of sounds and gestures in order to express whatever can be imagined in CS, assuming, due to the recursive property, that there is no limit to what can be imagined. Now, even though the lexicon is an open-ended system, adding a new sign for every conceptual structure that (literally) comes to mind would eventually impose an incredible (but not necessarily unbearable) burden on our memory, which, enormous as it may be, is not infinite.

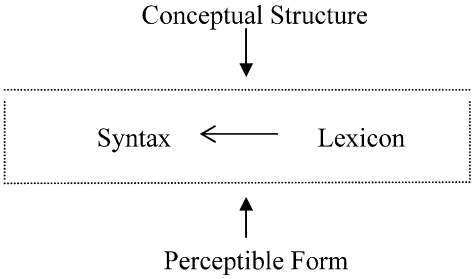
Language, as we know it, indeed does not seem to rely on a lexicon only. It also has a system for combining the signs (i.e., words) into constructions (i.e., sentences). We call this system the Syntax. The Syntax is a combinatorial system, just like CS. This means that it consists of a finite set of primitives and a finite set of combination rules (cf. Section 3):

(17)



If we now 'home in' on what constitutes language, we will first isolate from the previous diagram the components 'Syntax' and 'Lexicon', together with CS and PF:

(18)



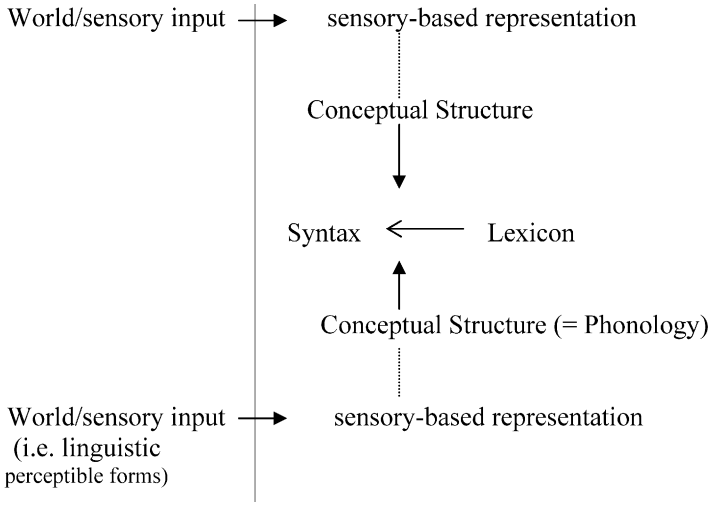
I have pointed the arrows departing from CS and PF to the combined result of syntax and lexicon, since, in a combinational, particulate system, complex expressions have conceptual and perceptible properties that go beyond the simple sum total of their parts, in particular due to their specific mode of combination. Specific syntactic structures may carry meaning of their own (''i.e., constructional meaning''), and prosodic structure can contain specific phonetic markers that do not derive from the PF of its parts.

I will now argue that PF is like a conceptual system itself. So far we have assumed that words with respect to their PF are stored in the memory as holistic (meaning here 'non-compositional' or 'atomic') sensory-based representations of sounds or gestures. However, given the ability to form a higher level projection, conceptual structure, we might assume that this applies to the sensory-based representations of linguistic signs, just as it applies to the sensory-based representation of other things in the world. This conceptual system is called **Phonology**. The conceptual system that we call phonology differs from sensory-based representations in constituting 'a world of its own', independent from sensory-based representations and the world. This is the fundamental 'abstractness' of phonological representations. This line of reasoning implies that phonology is just as cognitive as semantics, or syntax (cf. van der Hulst, 2003). A crucial property of phonology is its compositionality *below the level of the smallest morphological units*. Phonological representations of minimal signs (in human language) are not holistic. Rather, they seem to consist of meaningless smaller parts (elements, phonemes,

syllabic constituents and feet), a situation which has been called 'dual patterning'. In other words, like all cognitive representational systems, phonology uses a set of discrete categories and combination rules; it forms a particulate system. Why is this so? It may very well be that the memory space of the human mind, as well as its ability to quickly search in this collection, is so powerful that an inventory of 10,000 holistic forms could be handled. Rose (1992) reports on research showing that the recognition of 10,000 holistic visual images is not beyond the reach of humans. Perhaps the same holds for acoustic images. Thus, we cannot be sure that the evolutionary leap from holistic forms to compositionality took place for reasons of storage and retrieval *necessity*. However, it remains true that a compositional system seems superior in several ways. Firstly, it comes automatically with a means to provide new forms according to rules. Secondly, it provides a notion of wellformedness, making it possible to characterize a form as belonging or not belonging to the language. Thirdly, it facilitates retrieval because the stored collection can be organized in terms of the atomic building blocks. Without being able to prove the point, it seems obvious to me that these factors could very well have stimulated the emergence of compositionality in phonology, given that compositionality was already a faculty of the human mind. Indeed, we will probably never know whether the evolutionary emergence of compositionality in phonology preceded or followed the emergence of syntax; both may have borrowed this 'trick' from somewhere else (such as a faculty dealing with social relations, as suggested in Bickerton, 1990, or from the neuronal structures that are responsible for complex motoric behavior, as suggested in Lieberman's work; e.g., Lieberman, 2002).

With phonology being a conceptual system, we now arrive at the following diagram:

(19)



Note that the perceptible forms are indeed a part of the mind-external world. Everything to the right of the line is mind-internal.

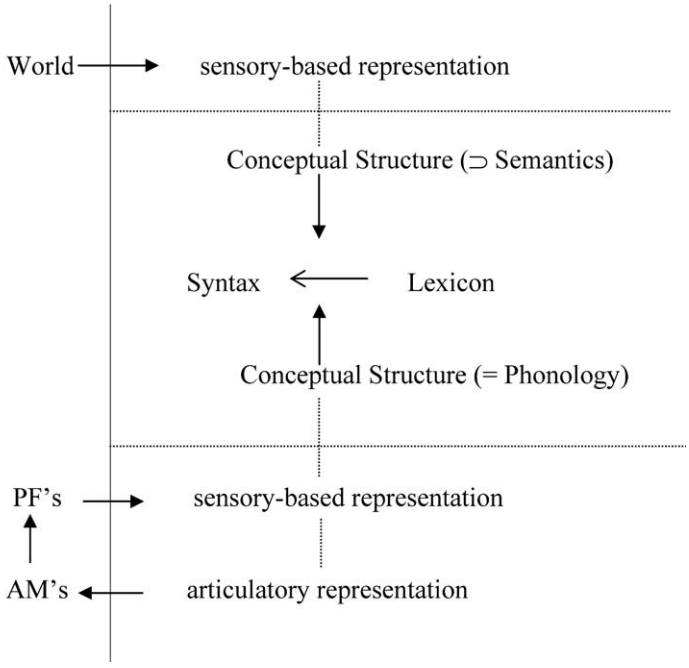
Given that, in diagram (19), we use the term conceptual structure twice, we might want to use a special term for (non-phonological) conceptual structure. At this point, we need to

face the question as to whether (non-phonological) conceptual structure is identical to semantics, or whether semantics forms a proper subpart of conceptual structure. I suggest that semantics forms a subpart of conceptual structure if we understand semantics as that part of conceptual structure that is part of the system of linguistic signs. Jackendoff, however, emphasizes the more general nature of conceptual structure and this is probably why he places conceptual structure outside the linguistic.

There is one final important aspect to the relationship between phonological conceptual structures and perceptible forms. In addition to being a part of the non-mental world, these forms have to be produced by the organisms that perceive them. We also produce other parts of the world (like furniture, cars, sculptures; in general: cultural artifacts), but only the production of perceptible forms is relevant to language, more specifically to Phonology. The articulation of PFs can be thought of as a form of behavior. However, the sensory-based representations of PFs cannot, as such, be the basis for articulatory behavior because they are *perception*-based. Thus, independent from the sensory-based representations of PFs, there must be an articulatory-motor representation that drives articulatory movements. We can assume that there is a 'link' between the sensory-based representations of perceptible forms and an articulatory representation that underlies articulatory movements (AM). The articulatory movements, which I take to be part of the mind-external world, cause the perceptible forms.

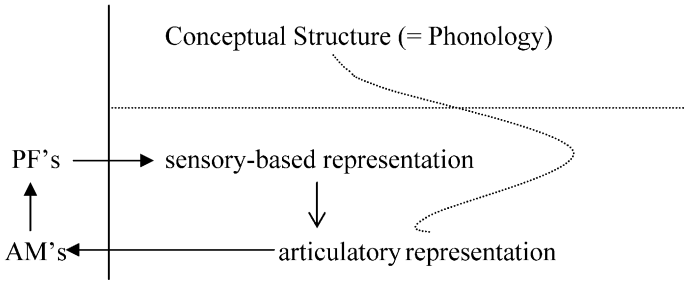
We end up with the following diagram. The part between the horizontal lines is Language. With respect to Semantics, one might want to restrict Language to that part of it that deals with Meaning. Alternatively, one might place conceptual structure entirely outside Language proper, as is done in Jackendoff (2002):

(20)



Interestingly, many theories of phonology postulate conceptual primitives that appear to correspond to the articulatory representation, rather than to the sensory-based representation. In the case of sign languages, it might actually be easy to confuse the two because the sensory-based representations of signs are directly based on our perception of AMs. Nonetheless, also here, perception-based representations are not identical to articulatory representations (cf. Crasborn, 2001; van der Kooij, 2002 for discussions of this important point). In the case of spoken language, however, the perception of articulation (even though it is known to play an important role when available) is completely overruled by the perception of the acoustic effects of articulation. In line with this, I have implicitly assumed that the *substantive nature* of phonological primitives is perception-based. There is a contrary view, which has it that the substantive nature of phonological concepts is articulatory:

(21)

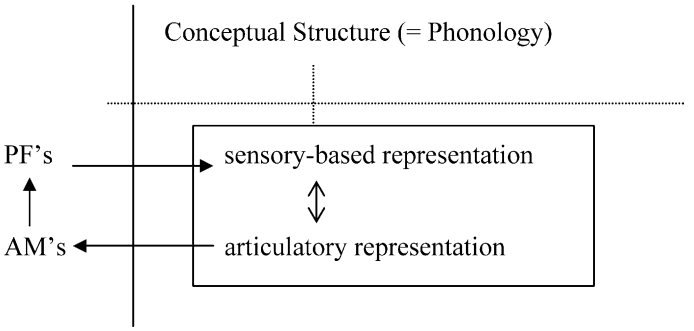


This view entails that recognizing perceptible forms as representations of phonological structures takes place by linking the sensory-based representations to the articulatory representations that correspond to that structure. This is called 'the motor theory of speech perception' for which Fowler and Galantucci (2002) offer a coherent and persuasive defense.

Now, in either alternative, the phonological structure might be expected to reflect properties of the primary representation that it was derived from (phylogenetically and to some extent ontogenetically). In other words, the relation between phonology and either perception or production is, in part, a natural or iconic one. One would, therefore, assume that the matter can be settled by simply looking at the set of primitives that decades of phonology has delivered. One would think that these primitives, and the way in which they allow the phonologist to group segments (natural classes) and express regularities, would simply reveal their acoustic-perceptional or articulatory basis. The somewhat surprising fact is that they don't, at least not in an obvious way. In fact, outside debates that address the issue directly, a phonologist can lead a productive and fruitful life without really taking sides on the issue. I would like to suggest that this can only mean that the units of the articulatory system aim at realizing the units of the sensory-based system, which, of necessity means that both systems of primes are *extensionally* identical. Note that this does not preclude that in some cases it might seem that a phonological prime corresponds more invariantly with an articulatory representation, whereas in others, the acoustic-perceptual representation is more constant. Nor is it excluded that certain acoustic targets can be realized by more than one articulatory

movement, or indeed require a combination of enhancing movements. Perhaps, then, the following diagram can satisfy everyone:

(22)



Summarizing, I have argued that phonology, as a cognitive system (in terms of its primes and syntax) is independent from sensory-based-cum-articulatory representations (not denying the cognitive nature of the latter). I have also implied that, despite this independence, there is a relation of correspondence in that, in some sense, the conceptual structure is 'projected' from these lower-level representations which themselves stand in a direct relationship to outside world events. This is the 'substantive basis' of phonology.

What are the consequences of this for the differences between sign and spoken languages in as far as their phonologies are concerned? According to some, the phonological primes are part of the human innate language capacity, perhaps derived from 'phonetics' in an evolutionary sense, rather than being constructed from scratch in the course of language acquisition. However, if this is so, and if spoken language phonetics has determined the nature of the primes in the evolutionary past, how can this same endowment be helpful to a deaf person? Clearly, it cannot. As a consequence, deaf people either must construct their phonology in some other way (perhaps using some non-specialized general cognitive ability that allows them to construct a phonology-like conceptual system) or they have no compositional conceptual system comparable to phonology at all, which implies that conceptual or sensory-based representations of PFs of signs are stored in the lexicon holistically.

The first option is logically consistent, although it might predict certain differences between the course of acquisition of the phonologies of spoken and signed languages. There appears to be little support for differences. If anything, the contrary is true. Similarities between the acquisition course of languages in both modalities have been put forward as 'evidence' for the claim that sign languages and spoken languages are both natural human languages, stemming from the same innate capacity. The second option (sign languages have no phonology) flies in the face of the results that installed the idea that sign languages are natural languages in the first place. Stokoe's seminal work (Stokoe, 1960) regarded the idea that sign languages have a phonology, and thus duality of patterning. Cf. van der Hulst (2000) for a detailed discussion of phonological compositionality in signs.

If both options, then, are deemed to be implausible, the alternative is that the endowed capacity for phonology embodies a system of primes and modes of combination that is even more independent from sensory-based and articulatory systems than I have suggested so far. My own view so far has been that the innate phonological endowment is indeed not necessarily biased towards the phonetics of the spoken modality. Rather, I have argued that phonological systems are constructed in the course of acquisition, given that the mind comes equipped with a way of constructing conceptual systems on the basis of appropriate experience. The theory of phonological primes and segmental structure proposed in van der Hulst (2000, in preparation, in press-a) as well as theories of higher phonological levels that I have discussed in earlier sections, all driven by general notions such as binary, head-dependent relations and hierarchical organization, are attempts to flesh out these innate cognitive capabilities and the resulting conceptual systems. Elsewhere (in van der Hulst, 2000), I have argued that these principles are neither modality nor, in fact, module specific (as per the Structural Analogy Hypothesis). A consequence of this view is that the dotted line that connects the phonological conceptual system to the sensory-based and articulatory representations is ontogenetic, rather than phylogenetic, and that the modality-specific set of basic phonological concepts (i.e., features, elements) is not innate as such, but rather constructed in the course of acquisition.

A similar assumption need not be made for the non-phonological conceptual system, or the syntactic system. Both need not be different for languages in different modalities, although it is perhaps too early to tell in the case of the syntactic system. Depending on the outcome of research in this area, we will be able to answer the question as to whether there is indeed something different about phonology.

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