Phonology-Syntax Analogies: A head-driven perspective

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Abstract

This chapter addresses the question as to whether syntax and phonology have a similar architecture, both in terms of their derivational and representational aspects. I provide some historical background to the recurrent discussion about potential analogies, or the lack thereof. However, I focus on more recent viewpoints which reflect considerable differences of opinions about the question whether there are real (rather than accidental) analogies between the organization of syntax and phonology. Positive or negative views depend, as we expect, on the theoretical frameworks that are adopted and/or meta-theoretical assumptions. I ask whether real analogies are to be expected (and why) or, on the contrary, are not expected given that the syntactic and phonological modules have very different roles in the grammar. A central derivational issue is the matter of whether language-specific, extrinsically ordered rules, and thus intermediate derivational levels, are required. As for the structure of representations, there is an almost universal consensus that, if phonology is constituent-based, it certainly does not allow for recursion (which it could not if phonology is 'flat', as some maintain). A second representational issue regards the question whether the notion *head* is relevant in both domains. My main point is that headedness is in fact the central unifying notion which, when relevant in both domains, forms the core of the so-called Structural Analogy Assumption which states that expecting analogies between syntax and phonology should be the null hypothesis. While the phonology-syntax interface is not a central topic in this chapter, I touch on certain aspects of this matter.

Key words

binarity
constraints
Dependency Phonology
External Merge

features
Government Phonology
headedness
innateness
Internal Merge
lexical phonology
metapatterns
Minimalism
postlexical phonology
recursion
repair rules
rule ordering
structural analogy
syntax-centrism
syntax/phonology mapping
transformations

1 Introduction

This chapter addresses the question as to whether syntax and phonology have a similar architecture, both in terms of their derivational and representational aspects.[1] I will provide a historical background to the recurrent discussion about the analogies, or lack thereof, between syntax and phonology. While traditionally, the view that significant analogies exist predominated, in later and several current generative approaches, the two modules started to diverge.[2] As a result, the current linguistic landscape displays several different approaches, both generative ones that followed the lead of Noam Chomsky during the 1980s and following decades, and various other models that rejected aspects of Chomsky's ideas. Assumptions about analogies or the lack thereof are dependent on theoretical commitments to specific syntactic and phonological models. A striking instance of divergence arose from Chomsky's decision in the early 1990s, in his Minimalist Program, to ban phonology from the innate language faculty and at the same time limit this faculty to a single operation for constructing abstract, universal syntactic structures. We should also note that, generally, linguists focus on either syntax or phonology, with some exceptions. This, unavoidably, means that someone's view on analogies or the lack thereof is often based on 'higher-level' (perhaps meta-)theoretical and philosophical views on the human language faculty, rather than on having done serious work in both domains. This author, who has mainly worked in phonology, is not an exception here.

As explained in section 2, I will examine views on analogies with respect to derivational aspects and representational aspects, given that one way or another all grammatical theories must incorporate these two aspects. Section 3.1 provides some

[1] An excellent discussion of syntax/phonology comparison is Bermúdez-Otero and Honeybone (2006), which is an introduction to a special issue of the journal *Lingua* devoted to this topic. My chapter owes credit to points and insights that are discussed in this introduction and the articles in this issue.

[2] A limitation of this chapter is that, apart from discussing some pre-generative views, I mostly discuss generative approaches to language that Noam Chomsky initiated in the early 1960s.

historical background on how for some time, starting in the structuralist and early generative period, syntactic theory took its cues from developments in phonology. Section 3.2 introduces the so-called Structural Analogy Hypothesis according to which expecting analogies between syntax and phonology should be the null hypothesis. I include a discussion of views that reject this expectation. Section 4 focuses on derivational aspects. We will see that early strong analogies have been replaced by views that phonology and syntax are very different in derivational aspects, with syntax gravitating toward a non-derivational, monostratal approach, while the idea of multi-step derivations (and thus rule ordering) was deemed inevitable in phonology, a view that has not been uncontested. I will briefly discuss two current phonological theories in which rule ordering is eliminated, namely Government Phonology and Optimality Theory. During the late 1970s and 1980s, the focus on derivational complexity came to be overshadowed by new theories about the complexity of phonological representations. Early views held that syntactic representations and phonological representations are very different, the former being constituency-based and the latter not. As discussed in sections 5.1 and 5.2, this divergence then made room for an era in which theories were developed that attributed constituent structure to phonological representations. However, as we will see, in a prevalent approach the idea took hold that phonological constituent structure is formally different from syntactic structure, notably by excluding recursivity. Section 5.3 briefly reviews the idea that we may need two phonological hierarchies, one closer to syntactic structure and the other (more) independent of it. Section 5.4 reviews developments in phonological representations that concern segmental structure, some of which are paralleled in syntactic theories. In section 5.5 we turn to the pivotal issue of recursivity, claimed to be definitional of syntax, while usually claimed to be absent in phonology. Section 5.6 turns to a new phase in the discussion about representational analogies which involves a return to the idea that phonological representations are not constituency-based after all (which then automatically precludes recursion and also movement). In an attempt to pinpoint the main reason for expecting analogies between syntax and phonology, section 6 proposes that the matter of constituency is not the issue, once we accept that the pivotal notion *head* plays a key role in both domains. I will argue against views that the ways in which this notion is used in syntax and phonology are fundamentally different. In fact, I will suggest that the notion of headedness provides the fundamental basis for the structural analogy between syntax and phonology, most clearly brought out in John Anderson's dependency approach, which covers both domains. A central claim of Dependency Grammar approaches is that appealing to headedness can replace constituent-based representations in both syntax and phonology. We will also see that dependency graphs, which are meant to replace constituent structure, are still hierarchical objects which allow for recursion (in both syntax and phonology), although this is dependent on a certain variety of the dependency approach which distinguishes between adjunctive and subjunctive dependency. I will suggest that because proponents of the idea that phonological representations are 'flat' must appeal to head/dependency relations, their models are in fact dependency models. This undercuts the claim that phonological and syntactic representations are fundamentally different, including the idea that what differentiates between them is the possibility of recursivity.

While the phonology-syntax interface (which usually asks how syntactic structure is mapped onto phonological structure) is not a central topic in this chapter, I will touch on certain aspects of this matter, too.[3]

2 The general design of grammatical modules: Representations and derivations

In the most general sense, grammatical modules define a set of representations and a set of functions that specify the relationships between representations, either within a module or across modules. In (1), I show a function that relates an Input representation to an Output representation.

(1) F (I) = O

Adopting the view in (1), any theory of phonology or syntax (or semantics for that matter[4]) must provide an answer to two fundamental questions:[5]

(2) a. What is the nature of the function F?
b. What is the *structure* of representations?

We will say that question (2a) concerns the *derivational* side and (2b) involves the *representational* aspect of a grammatical theory. [6]

On the derivational side, the function F could contain a partially extrinsically ordered set of rules that connect I to O via a number of intermediate representations. The phonological model proposed in Chomsky and Halle (1968) (*The Sound Pattern of English*; SPE) qualifies as such an approach and so do early versions of generative syntax. In SPE, the ordered rules were called 'phonological rules', while analogous operations in syntax were called 'transformations' (see (4) below). As we will see in section 4.4, Optimality Theory (OT; Prince and Smolensky 1993) sees the function F as a partially extrinsically ordered set of output constraints.

The function F in (1) relates representations within a single module (either within the same plane or across planes). As mentioned, we also need a function that relates different planes within a module, as well as functions that relate representations across

[3] I wish to thank Marcel den Dikken and Nancy Ritter for earlier collaborations and specific comments on an earlier draft that helped shaping my ideas. I also Thank John Goldsmith and two anonymous reviewers for comments on an earlier version and Péter Siptár for editing assistance. Finally, I offer my gratitude to Bridgit Samuels for a lot of great feedback, both on content and presentation of different versions of this chapter.

[4] From the outset we must ask whether 'semantics' must be included in a discussion about analogies between the components of the grammar. The main reason for limiting the discussion in this chapter to syntax and phonology is simply that the discussion with respect to parallels has mostly addressed these two components. My own views, as expressed in this chapter, are discussed in detail in van der Hulst (2000, 2005, 2006, 2010, 2020 and 2025).

[5] In stratal theories, such as lexical phonology/morphology (Kiparsky 1982, 1985) and other models (Goldsmith 1993; Lakoff 1993), notably Stratificational Grammar (Lamb 1966), we must reckon with an ordered sequence of such functions.

[6] If the input representation appears completely unmodified in the output of the module, function F is an identity function, and the model is called monostratal.

modules.[7] In most generative models there has been much discussion of a function that maps syntactic representation onto phonological representations (with Nespor and Vogel 1979 being the seminal reference; see section 5.2). In the classical Y-model in generative grammar, another such function maps syntactic representations onto a semantic representation ('Logical Form').[8]

Throughout the history of generative grammar, views on the nature of syntactic representations have remained fairly constant in the sense that such representations would always take to form of a specific kind of graph that represents the constituent structure in which nodes are provided with syntactic labels. This graph has a single root node which dominates lower nodes, with no nodes being dominated by two higher nodes; see Carnie (2008) for a review of diverse variants of this approach.

In the domain of phonology, however, many theories about the structure of representations have been developed since the appearance of Chomsky and Halle (1968). In SPE, a phonological representation consisted of a 'flat' linear string of feature bundles. Later theories proposed that (a) the linear string has a hierarchical, constituent-like structure and (b) the string can be 'horizontally' divided into a number of parallel strings (called tiers) of phonological features which thus creates multi-linear representations. In such views, which are reviewed in section 5.2, there would be one central tier with units (called skeletal positions) that function as anchors for the features on other tiers.[9] As we will see in section 5.6, the innovation that postulated hierarchically structured phonological representations later came to be questioned, which led to a return to the more linear, 'string'-like view of SPE.

3 General ideas about analogies between syntax and phonology

3.1 Syntax copies phonology

This section will provide a brief historical perspective on the subject matter of this chapter. The history of linguistics in the past two centuries indicates that the study of the sound structure of language (phonology in a broad sense) has consistently influenced how sentence structure (syntax) should be approached (Goldsmith and Laks 2000, 2008; Murray 1994; Durand and Laks 2002; Bermúdez-Otero and Honeybone 2006). As stated in Murray (1994), phonology was the 'pilot science' in linguistics, while Goldsmith and

[7] Within a module, different representations can be related in a derivational sense, then often called *levels* (or strata) or they can co-exist in different *planes* that characterize different aspects of the phonology or of syntax comparable to the notion of *dimension* in Halle and Vergnaud (1980) or to the ideas underlying *autolexical syntax* (Saddock 1991). An example of this in phonology is the function that relates metrical trees to metrical grids in Metrical Phonology (Liberman and Prince 1977). While different planes can thus be postulated *within* a module, the broadest use of this term, which this chapter focuses on, regards distinguishing, between planes across modules, i.e., between the phonological and the syntactic planes which reflects the notion 'duality of patterning' that has long been recognized as being characteristic of human language (see Hjemslev 1943; Hockett 1960; Martinet 1960).

[8] In the parallel architecture model of Jackendoff (2002) there are no functions that map syntactic representation onto phonological or semantic representation. Instead, there are bidirectional *linking rules* between independently generated syntactic, phonological and semantic representations.

[9] A constituent-like organization could in principle be imposed on each tier, but most attention went to constituent structure that takes the so-called skeletal positions as its terminal units; see wbctp0054.

Laks (2000: 3) claim that "phonology constituted the theoretical and methodological cornerstone of modern linguistics. The most contemporary concepts and models have derived from it, as have the formalizations, and they have been first applied there".[10] A good example of this influence coming from phonology is the analysis of phonemes into distinctive features, which became a central concern in syntax as well. Even the later proposals by phonologists for a 'feature geometry' (Clements 1975; Sagey 1976; wbctp0027) have found a usage in syntactic feature models (Harley and Ritter 2002a, b).[11]

3.2 The Structural Analogy Assumption

The most in-depth review of syntax-phonology analogies is by Anderson (1992; see also Anderson 2006, 2011, and for his most recent comprehensive work: 2022), who promotes the *Structural Analogy Assumption*, a notion that forms a cornerstone of the Glossematics theory proposed by Louis Hjelmslev (1943). In (3), I cite a definition of Anderson's Structural Analogy Assumption (SAA):

(3) The Structural Analogy Assumption (SAA)
Minimise (more strongly, eliminate) differences between levels that do not follow from a difference in alphabet or from the nature of the relationship between the levels concerned

Anderson (2006: 602)

Given the SAA, we expect structural properties to be shared. I here mention, as key structural properties, *hierarchy,* perhaps *binarity* but most importantly *headedness*. Fundamentally, hierarchical structure necessarily emerges when an object that results from combining two other objects can itself be combined with yet another object, whether basic or complex. The fact that a unit can contain a unit that is itself complex (like a syntactic phrase within a syntactic phrase) entails the specific case in which a complex unit of some type contains another unit *of the same type* lower down, a notable example being 'sentences that contain other sentences'; we could call this the 'Russian doll effect'. This *specific consequence* of allowing complex units to be part of larger units is what most linguists refer to as *recursion*, although, in essence, recursion is the automatic result of combinatorial rules that can take as input the result of other combinatorial rules. (For the moment, I'm staying agnostic about whether the combinatorial operations 'create' a constituent structure or a bare dependency structure; see section 6).

As stated in (3), we take the difference between modules to result from their different alphabets which, broadly, in syntax would be words (perhaps ultimately syntactic features) and in phonology phonemes (ultimately phonological features). The sets of features in both modules are expected to differ because they are grounded in

[10] I took these apt characterizations from Bermúdez-Otero and Honeybone (2006).
[11] Goldsmith and Laks (2019) provide an in-depth analysis of the developments of linguistic theories in the first half of the twentieth century, including the foundations of generative grammar.

different cognitive, conceptual domains, the semantic domain and the phonetic domain, respectively.[12]

An argument that one could make against the SAA between syntax and phonology is that the notion of modularity itself might suggest that no analogy is expected because each module will have a design that optimizes its ability to perform a certain function. This point is emphasized in the Evolutionary Psychology approach (see Tooby and Cosmides 2005). These authors argue that just like the parts of a Swiss Army knife differ for this reason, we would expect that mental modules also differ. However, this reasoning is not compelling. I here introduce the notion *cognitive economy* which holds that all things being equal, we would expect that different cognitive systems will tend to employ a common stock of 'tricks' (see Carruthers 2006 who supports this point) which can be called *task-specific submodules* (see van der Hulst 2024, chapter 5). With this in mind, we expect similarities between mental modules (due to sharing task-specific submodules), and this is what the SAA emphasizes. The expectation of organizational similarity is also supported by what Abler (1989) calls the *Particulate Principle*. Abler (1989) describes *particulate systems* as systems in which a finite set of basic discrete units are combined into hierarchical structures. Given their recursivity, he 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 also complex systems that are studied in chemistry, physics, and genetics. In all these systems, we start out with a finite set of primitives (elements, DNA bases) which are recursively combined in increasingly complex structures. In language, in line with the notion of 'dual patterning', arguably the Particulate Principle applies twice, both in phonology and in syntax. Indeed, linguists have long taken this point for granted. Particulate, hierarchical organization is also the focus of Simon (1996) who discusses the application of hierarchical structures not only in biological and physical systems, but also (human) symbolic systems, including language. I here also mention that binarity and headedness, as characteristic properties of linguistic structures, might be seen as instantiations of 'metapatterns' ('hierarchies', 'binaries', and 'centers', respectively) that can be observed in a wide variety of domains in the natural world; see Volk (1995).

I now turn to a second type of argument in favor of attributing unique properties to syntax, which are not expected to be shared with phonology. Since the development of generative grammar, and despite the early parallels between phonology and syntax, syntax became increasingly seen first as a central module of grammar, and eventually, in the Minimalist Program (Chomsky 1995), as the only module of grammar. In this syntactico-centric view, phonology and semantics are interpretive systems that 'read' the syntactic structure and deliver its phonological form and semantic content. Accordingly, one could say that there is no reason to expect that the organization of syntax is in any way paralleled by the organization of phonology (or semantics), as these modules have different functions and demands placed upon them. For example, Den Dikken and van der Hulst (2020: 69-70) state "phonological and syntactic structures are not fully on a par: arguably, phonology entirely lacks the kinds of *functional* projections." On page 70, they

[12] Both these domains are cognitive. This is obvious for semantic grounding. When we speak of phonetic grounding this refers to the mental representation of phonetic substance. Both forms of grounding are in essence conceptual because they organize mind-external events in terms of a conceptual system.

explain why phonology arguably lacks anything corresponding to functional structure in syntax. Firstly, "[…] there is no obvious role to play in phonology for functional projections such as IP and CP, whose specifier positions are usually not filled by base-generation but get occupied as a result of movement operations that externalize material from the argument-structural core of the structure." As such "functional categories are licensers of properties which cannot be satisfied in the position of External Merge (such as case and agreement, or [+wh]). […] For the remaining part, functional categories are present in order for syntax to get a handle on variation in linear order involving information-structural properties (topicalization, focalization, extraposition, etc.). Neither of these considerations comes into the picture in phonology. This is why functional structure has no place in phonology." [13]

Indeed, within the Minimalist approach, where phonology is seen as an 'evolutionary afterthought' that emerged to allow externalization of syntactic structures, the organization of phonology is solely attributed to so-called 'third factors' (see Samuels 2009b and van der Hulst 2026, chapter 4), i.e., to cognitive systems and physical constraints that are not specific to language, often shared with other animal species, or functional factors that are anchored in language use.[14]

To counter this argument, one could question the centrality of syntax, which is of course what has motivated Jackendoff (2002)'s Parallel Architecture Model. This model recognizes syntax and phonology (as well as semantics) as independent generative systems, each responsible for the grammatical wellformedness of one of the three layers of linguistic expressions. While this view of the organization of the grammar reduces the expectation that phonological structure is secondary to syntactic structure, it does not undermine or support the expectation that they share structural analogies. In fact, this issue is not directly addressed in Jackendoff's work. In his model, the correlations between syntactic, semantic and phonological structure are encoded in linking rules.

A third kind of argument against analogies between syntax and phonology comes from the field of Formal Languages Theory in which the oft-made claim is that syntactic patterns and phonological patterns point to the need for different kinds of formal grammars, as originally defined in the so-called Chomsky-Schützenberger (1963) hierarchy of formal languages or grammars and more recent extensions of this hierarchy (see Bird 1995; Bird and Heinz 2022; Chandlee and Heinz 2022; van der Hulst 2026: chapter 5). In this view, phonology falls with the so-called 'subregular region' of that hierarchy, while syntax reaches into the region of 'mildly-context-sensitive' grammars, notably to account for *overlapping*, *cross-serial dependencies*.[15] The weaker, subregular grammars cannot account for *non-local dependencies*, which are claimed to be absent in phonology.[16] This divergence between phonology and syntax is said to explain why phonological representations are strictly linear, whereas syntactic patterns require hierarchical, recursive structures. However, grammars of all formal types produce outputs

[13] A more in-depth discussion of functional categories is Anderson (2022, volume 1, Chapter 3.

[14] In the approach called 'Emergent Phonology' (Archangeli and Pulleyblank 2022), the idea is that children can learn the phonology of their language based only on general learning strategies, with no appeal needed to innate aspects that are specific to human phonology.

[15] See Huybregts (1976) and discussion in van der Hulst (2026: Chapter 5).

[16] Apparent non-local relations in phonology, as in for example vowel harmony, can be analyzed as local in a multi-tier theory (such as Autosegmental phonology) in which harmonic features can occupy their own tier.

with linear structure (the so-called *weak generative capacity*) and hierarchical structure (the *strong generative capacity*). [17]

Here I tentatively offer a possible rebuttal of this argument (also see van der Hulst 2026, chapter 5). If a grammar of a certain complexity is required for certain syntactic phenomena, it is not obvious that a learner would not consider this same grammar format for phonological patterns, even if said grammar type predicts phonological patterns for which there seemingly is no empirical evidence, such as long-distance dependencies especially in so-called center-embedding constructions, or recursion. If grammars for formal languages are taken as models for the human language capacity, this capacity would be simpler if we assume that a single grammar format is available to the learner, another instance of cognitive economy.[18] This would have to be the grammar type that can handle the attested most complex patterns. The alleged absence or more limited occurrence of certain patterns in phonology could be the result of independent 'third factors'.[19]

4 Derivational analogies

4.1 Early views about analogies

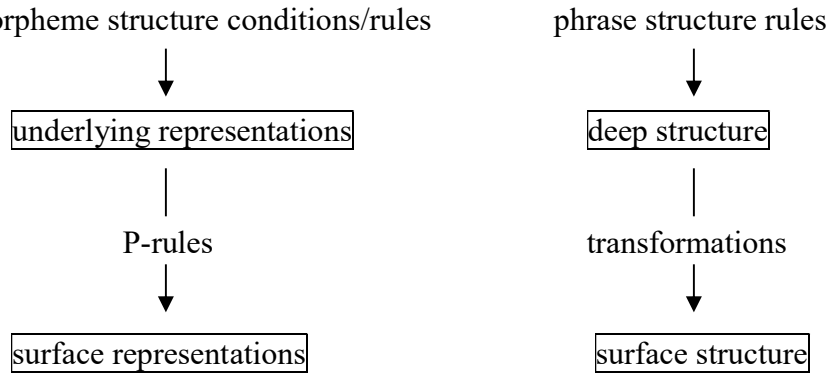
We now turn to the various ways in which phonology and syntax, and the relationship between them, has been viewed within Generative Grammar, taking the '*Aspects* model' (Chomsky 1965) as a starting point (although we could go back to earlier work by Noam Chomsky and his teacher Zellig Harris; see Goldsmith 2005). Following the *Aspects* model, it was widely understood that phonology and syntax from a derivational perspective are organized in a very similar fashion, see (4).

[17] Graff (2022) has proposed that both syntax and phonology can be formally represented with the same formal grammar type, one close to what was formerly thought to be relevant for phonology. His point is that the same formal grammar type can be used if the differences between syntax and phonology lie in the nature of the representations that these grammars manipulate which thus argues *against* representational analogies, while supporting derivational analogy.

[18] Lasnik and Uriagereka (2022) argue that even for certain syntactic patterns a simpler grammar would be sufficient, but this does not have to mean that the learner has access to simpler grammars if the innate system only makes one grammar type available to the learner.

[19] Gazdar et al. (1985) have shown that non-local dependencies in WH-constructions in English can be handled with context-free grammars. In van der Hulst (in prep a) I show that a context-free grammar can also deliver center-embedding structures, and I suggest a simple substance-based constraint that prevents the same grammar type from creating center-embedding in phonological structure.

(4)



In (4), I have used familiar terms, which are distinct for the two modules, but it is obvious that the terminological differences between phonology and syntax are entirely superficial. For example, P-rules ('phonological 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.[20] Transformations are context-sensitive operations that are deemed necessary in both modules to supplement the context-free rules or constraints that stated the grammatical form of underlying representations. Also, in both cases, the transformational rules were (partially) extrinsically ordered. The parallelism is no coincidence. Bromberger and Halle (1989) recount that Chomsky had wondered whether his work on the phonology of Hebrew (Chomsky 1951), using two levels or representation and rules that mediate between them (itself a continuation of earlier work by Bloomfield (1939) on Menomini and work by Zellig Harris), could be implemented in syntax, leading to the corresponding models in (4).

The least expected part of the correspondence in (4) lies at the starting point, the 'base'. I say 'least expected' because, whereas deep structures are 'generated' by phrase structure rules, the underlying phonological structures of morphemes must be *stored* in the lexicon. The actual set of phonological strings of morphemes has to be listed in the lexicon because of the arbitrary relation between their phonological forms and their meaning. Regularities in the segmental make-up of morphemes were captured in morpheme structure rules (wbctp0086) that, rather than generating phoneme sequences, stated their phonotactic wellformedness 'passively'. From the viewpoint of their role 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 input representations in terms of a finite set of building blocks and a finite set of combination rules.[21] Hence, the set of morpheme structure rules can be referred to as the phonological base (as suggested in Sampson 1970). The difference between the phonological and the syntactic base does not lie in production vs. storage if in both cases (as McCawley 1968 pointed out) rules are regarded as characterizing well-formedness of grammatical objects. Even from the viewpoint of Chomsky's own approach, using phrase structure rules, the

[20] Both phonological rules and transformations were context-sensitive operations, which, allowing for deletion, elevated the modules to the power of Turing machines. In formal language theories, these operations are called transducers; see Chandlee and Heinz (2022); Bird and Heinz (2022).

[21] Here we do not distinguish between 'rule' and 'constraint,' conceiving of both as statements that define grammatical representations, or parts thereof.

idea of 'generating' syntactic structures was always meant to characterize wellformedness and not as modeling the actual production of sentences.

An important change was that subsequent developments in phonology led to the view that the rules that define phonotactic wellformedness should not take morphemes as their domain, but rather simplex words, i.e. phonological objects that are not polymorphemic and that can occur as free-standing words.[22] This development marked a shift toward stating wellformedness constraints with respect to the output of phonological derivations (see Shibatani 1973; Sommerstein 1974; Clayton 1976). This shift to output 'filters' has a parallel in syntax when the output of transformations came to be checked by syntactic filters; see Chomsky and Lasnik (1977) and Lasnik and Lohndal (2010).

4.2 Getting rid of extrinsic ordering

Despite these early and some persistent analogies, during the 1970s, and beyond, syntax and phonology developed in different directions, led by linguists who were not necessarily in agreement with the idea, let alone with the expectation, that there should be a close correspondence between phonology and syntax. This resulted in different and diverging varieties of both modules, a trend that culminated in their radical conceptual separation in the Minimalist Program (Chomsky 1995).

For example, in the early seventies, we witnessed a growing dissatisfaction with the holistic approach in Chomsky and Halle's SPE-model (Chomsky and Halle 1968), which essentially recognized only one type of phonological rule (the P-rule in 4). In several new approaches to phonology (Vennemann 1971, 1974; Stampe 1973; Koutsoudas, Sanders and Noll 1974; Hooper 1976; Ringen 1977), it was argued that a distinction should be made between 'automatic', phonetically motivated rules dealing with allophonic variation and phonotactically motivated rules accounting for segmental alternations in the surface forms of morphemes (allomorphy) that are sometimes dependent on idiosyncratic, lexical and morphological information. Within the latter category, some models made a further, explicit distinction between general, productive allomorphy rules that mostly rely on phonological conditions (such as typical vowel harmony rules) and rules that are tied to specific morphological contexts (such as velar softening in English *electric/electricity* or 'learned backing' in French *fleur/floral*; cf. Dell and Selkirk 1978); see Anderson (1976).[23] Along with such proposals, but sometimes independent of them, came a trend in the literature to avoid extrinsic ordering

[22] Included in the set of words that are characterized by 'word structure conditions' are words derived with so-called cohering affixes. I am here glossing over the many issues that surround definition of the notion 'word', assuming that we have to reckon with syntactic, phonological and semantic criteria that do not necessarily converge on the same linguistic objects. With phonological wellformedness being stated over simplex words, the need for a set of morpheme structure rules is much smaller, although some have argued that significant generalizations about morphemes can sometimes be made (see Paradis and Prunet 1993; Booij 1999).

[23] It is important to note that such distinctions in phonological rule types were made by some of the founders of phonology, especially in the work of Mikołaj Kruszewski and Jan Baudouin de Courtenay; see Radwańska-Williams (2022: 179–202). Also, later linguists in the pregenerative period (for example, Hockett 1955) made distinctions of this kind; see Silverstein (2022) and Ladd (2022). SPE stands alone in the history of phonology in not making such distinctions, although a class of 'phonetic' rules that convert binary feature values into gradient distinctions was assumed.

by replacing it with universal ordering principles or re-analyzing data that seemingly had motivated their need (for example, Koutsoudas et al. 1974).

Within generative phonology this trend found a synthesis (while also folding in other unrelated proposals such as the level ordering hypothesis developed in Siegel 1974 and Allen 1978) in the lexical phonology/morphology model proposed in Kiparsky (1982, 1985) which distinguished so-called *structure-preserving* (i.e., non-allophonic) lexical rules (accounting for potentially different classes of allomorphy, associated with different morphological strata) from postlexical rules (which would cover allophonic processes, both those that are seemingly obligatory and those that reflect the influence of speech rate/style, if that distinction can even be made).[24] This model implicitly reinstated another distinction that had gotten lost in SPE, namely that between word and sentence phonology, which was explicitly stated in Trubetzkoy (1939) and also in the work of some of the European and American structuralists; see Ladd (2022). Given that the individual lexical strata and the postlexical stratum were extrinsically ordered in terms of the organization of the grammar, the need for extrinsically ordering phonological rules was greatly diminished.

Interestingly, before the lexical/postlexical distinction was embraced by many phonologists, a similar theoretical movement had arisen in syntax, leading to 'lexical syntax' dealing with base-generated structures and with structure preserving alternations such as Dative Shift in English, as opposed to 'postlexical' syntax dealing with unbounded dependencies such as WH-movement (see Hoekstra, Moortgat & van der Hulst 1980 for an extensive discussion of this movement). Kiparsky (1978) notes the parallelism between the two developments and also between the criteria that were developed to distinguish lexical from postlexical rules in both phonology and syntax, such as the notion of structure preservation. However, the division between lexical and postlexical syntax was rejected by Chomsky (1970). Parallel to this development, during the early 1970s, the notion of a level-ordered morphology, with a block of phonological rules associated with each level, came under criticism, as problems had been noted regarding the morphological implications (notably regarding the ordering of affixes) by several authors (Aronoff 1976; Fabb 1984; Halle and Vergnaud 1987).[25] Meanwhile, Kiparsky's Lexical Phonology/Morphology approach remained part of the phonological landscape, embracing, in later version of this model, for each level, the Optimality Theory model.

Following these developments that lead phonology and syntax in different directions (despite remnants of parallelism; see below), it looked as if phonology and syntax were no longer seen as very similar, if this issue was even addressed. In syntax, the lack of parallelism was enhanced by the spectacular reduction of the transformational component (leaving no room for construction-specific rules, let alone rule ordering). In phonology, meanwhile, extrinsic ordering of construction-specific phonological rules remained the norm in dominant versions of generative phonology. Thus, Bromberger and

[24] I ignore here the fact that the correlations between non-allophonic and lexical on the one hand and allophonic and post-lexical on the other hand are not unproblematic; see for example Harris (1987).

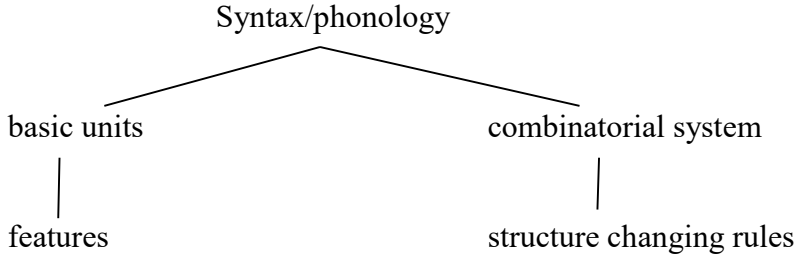
[25] Contemporary with questioning the idea of level-ordered morphology (and partly fueled by it) came the rise of Distributed Morphology (Halle and Marantz 1993) which, given that phonology was seen as post-syntactic, much as in Chomsky's Y-model, did not suggest organizational analogies between syntax and phonology.

Halle (1989) conclude that phonology is fundamentally different from syntax, especially because of the need for extrinsically ordered sets of rules.

Nevertheless, certain very general analogies, not often made explicit, remained. In both phonology and syntax, there had to be a finite alphabet of basic units, the atoms of structure (usually referred to as 'features'), which were organized in wellformed structures following a finite set of 'structure-building' rules. As long as at least some syntactic transformations were deemed necessary, structure-changing rules were needed in both modules as well that could change the 'base-generated' structures to conform with 'output filters'. [26]

In certain phonological models, the structure changing rules came to be called 'repair rules' that removed violations of output filters in morphologically complex words; Singh 1987; Paradis 1988; Sommerstein 1974; Calabrese 1995, 2005). This label also seems appropriate for the various syntactic operations that operate on base-generated structure (such raising and agreement[27]). The architecture of both phonology and syntax, then, could still be represented schematically as follows:

(5) The general design of syntax and phonology



The presence of structure-changing rules in (5) maintains a derivational aspect in both modules, although we will show below that such rule types have come under attack not only in syntax but also in both phonological models that dispense with structure-changing rules of any kind.

An apparent lack of parallelism results from phonology comprising a class of rules that account for allophonic variation which arguably find their motivation in the fact that phonological representations need to be 'realized' (in speech or sign). In van der Hulst (2024: Chapter 6) such rules are attributed to a post-grammatical implementation module. That said, it is not unreasonable that we also need a realizational module for syntax, especially if accounting for constituency and linear order are separated. Whereas in the minimalist approach linear order is located 'in the phonology', it makes sense to this author to see such rules as syntactic realization rules which, as in phonology, may account not only for 'word ordering' that is obligatory but also for optional, stylistic effects.

Analogies between syntax and phonology also involve other theoretical notions. Firstly, it must be mentioned that ideas of rules being bound to *local* operations (however

[26] Arguably, even in the Minimalist approach to syntax, movement transformations are in effect, albeit under the guise of 'Internal Merge'.

[27] There are several introductions to current syntactic models that subscribe to the minimalist program, for example Radford (2012) or van Gelderen (2017).

defined precisely), as well as being restricted to *domains* that are delimited by boundaries or 'barriers', are ubiquitous in both syntactic and phonological theories.[28]

Secondly, as mentioned before and included in (5), both in phonology and syntax basic units (phonemes in phonology and category labels in syntax) are commonly analyzed in terms of smaller units, called features, an idea that actually started in phonology (see Jakobson et al. 1952) and then found its way into syntax as well; see section 4.1.

Thirdly, a further analogy is the notion of *parameters*. The idea that the alleged Universal Grammar provides for syntactic structure an array of universal *principles* and, to account for differences across languages, a set of *parameters* was adopted in phonological theories, notably those in the domain of word stress systems (Vergnaud and Halle 1978; Hayes 1980, 1986, 1995; Dresher and Kaye 1994;). In phonology, the use of parameters was mainly developed for 'prosodic structure', especially syllable structure and stress. However, Archangeli and Pulleyblank (1994) also proposed parameters for phonological rules. I add that a paradigmatic approach to phoneme inventories is entirely possible if each phonological feature is associated with a parameter which specifies whether the feature in question is active or not in a given language. This analogy in the use of parameters, whatever the generality of their use in phonology, was not long-lived, however, because syntacticians working in the minimalist framework grew suspicious of parameters in syntax which were found to grow too large in number; see Newmeyer (2005). Borer (1984) proposed that syntactic parameters had to be transferred to the lexicon, paving the way for a syntactic module that only contains universal principles, perhaps only one (i.e., recursive Merge). Mostly, the disenchantment with parameters of the sort envisaged in Chomsky's (1981) ground-breaking approach was driven by the realization that the clustering of properties around a single parameter setting (which one was expected to find) was mostly illusory. It's the 'macro-parameters' of the early Principles and Parameters theory that have mostly fallen out of grace (with the exception of Baker's 2002 book). The rise of 'micro-parameters' in early minimalism (founded on the Borer proposal) has, in turn, led to its own disenchantment ('they're calling it a parameter but it's just a single lexical difference with no additional consequences'). Most syntacticians today are essentially avoiding the term 'parameter' altogether or, if the term is used, it is argued that parameters are not part of the innate system, but instead emerge in the course of language acquisition (see Roberts 2019). We will see in section 4.4 that the parametric approach to phonological phenomena has been undercut by the rise of Optimality Theory.

Assuming that Internal Merge is just another name for a general movement transformation (like the earlier 'Move alpha'), a difference between syntax and phonology would remain if all movement is of precisely one type ('raising'), which can be said to be a general 'repair' strategy that is necessitated to validate syntactic features ('feature checking'; see references in fn. 24). This is because in phonology no such unifying operation has been proposed to account for all cases of allomorphic alternations. While elaborations of the structure of phonological representation due to new theories

[28] In some approaches to vowel harmony, the notion of locality, has been explicitly understood as 'nearest' (Mailhot and Reiss 2007; Nevins 2010). This approach account for vowel harmony in terms of a 'search-and-copy' operation which is explicitly compared to a similar operation in Minimalist syntax.

such as Autosegmental and Metrical phonology (which we discuss in sections 5.2 and 5.4) held the promise that "if the representations are right, the rules will follow" (McCarthy 1988), this promise did not pan out in any clear sense. Phonologists continued to write rules to account for construction-specific allomorphic alternations. At best phonological operations could perhaps be reduced to a small set that would manipulate association lines, given an autosegmental approach; see section 5.4.[29]

In looking for analogies between syntax and phonology, we should also consider approaches in phonology that took issue with the idea that phonology is fundamentally different from syntax because it needs extrinsically ordered rules. I have already mentioned that the need for extrinsic rule ordering had already been questioned in the 1970s. In part this line of work argued against the holistic SPE approach, which led to the development of Natural Generative Phonology, as well as level-ordered theories such as Kiparsky's lexical model, which diminished the role of extrinsic rule ordering by assigning rules to different levels.

However, there also were other approaches that did away with phonological rules and replaced them with constraints on different levels, such as Goldsmith (1993) and Lakoff (1993), in a volume with the telling title *The Last Phonological Rule*. Such proposals in a sense predated and perhaps inspired later versions of Kiparsky's Lexical Phonology/Morphology model in which the phonological rule sets that mediate between levels are replaced by OT-style ordered sets of constraints; Kiparsky (2000).

Still other trends that diminished the gap between syntax and phonology, albeit not necessarily with that purpose in mind, resulted from developing non-transformational, monostratal models of syntax (e.g. Gazdar et al. 1985; Pollard and Sag 1994; Bresnan 2001), which were then mirrored in monostratal 'no-rule' phonological models (e.g. Declarative Phonology; Scobbie 1991; Bird 1995; Scobbie et al. 1996).[30]

An inevitable consequence of adopting 'no-rule' models was that certain provisions were necessary to deal with allomorphic and allophonic alternations which had always been the primary motivation for postulating 'construction'-specific, structure-changing phonological rules.

As for allomorphic alternations, it would have to be denied that such alternations fall within the realm of phonology, dispatching them to the morphology, where they would be specified as phonological 'subroutines' of morphological operations.[31] The alternative would be to represent such alternations in the lexicon by listing allomorphs and stating 'distributional rules' that would stipulate the context in which allomorphs appear (as was done in Hooper 1976).[32]

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[29] Van Riemsdijk (2021) pursues the use of autosegmental formalism in syntax, which is tenable in that it presents an interesting structural analogy between syntactic and phonological representations.

[30] It is interesting that Declarative Phonology, in fact, largely restates, in specific formal terms, the kind of model that had been advocated by Natural Generative Phonology (cf. especially Hooper 1976; van der Hulst 1979), in which phonological rules had to be 'true generalizations' over surface forms. This model, like Declarative Phonology, does away with extrinsic ordering.

[31] This view was present in the works of the founders of phonology, especially in the work of Mikołaj Kruszewski and Jan Baudouin de Courtenay; see Radwańska-Williams (2022: 179–202). It re-merged in early works that criticized the SPE model (Linnell 1979), in Aronoff (1976) and also, among others, in Government Phonology (Kaye 1995).

[32] Another interesting, but unfortunately isolated approach that aimed at bringing phonology and syntax closer together was Bach and Wheeler (1981), who developed a categorial theory of phonology in the spirit of Montague's categorial grammar.

The other major traditional task of phonology, namely to account for allophonic variation, was covered by claiming that such rules would have to be placed outside phonology and be relegated to a 'realizational implementation module' (see Pierrehumbert 1980; Liberman 2018).[33]

4.3 Government Phonology

A no-rule approach was proposed in the model of Government Phonology (Kaye, Lowenstamm and Vergnaud 1985, 1990; Ritter 1995, 2022; see wbctp0054, wbctp0130, wbctp0135, wbctp0144). The originators of this model set as their specific goal to develop an approach that was analogous to the 'Government-and-Binding' model of Chomsky (1981), incorporating principles (such as the Empty Category Principle (ECP) and the Projection Principle) and mechanisms called government and licensing.[34] The ECP played a key role in accounting for vowel-zero alternation, which invokes the notion of an empty nucleus that is silent if governed (wbctp0144). The idea that postulating covert units needs to be constrained by principles that restrict their distribution to where they are locally governed by an overt unit was clearly shared by syntax and phonology. The Government Phonology approach was meant to be a rule-free phonological approach in which the phonetic interpretation that characterizes something close to the phonetic surface had access to a single level of representation; see Ritter (2022, to appear) for an overview of this model. Some syntacticians took issue with the parallelism between the tools of Government Phonology and syntactic notions, but I will here not dwell on the details of such discussions, among other things because, as we will see in section 5.6, Government Phonology, while maintaining a central role for government and licensing relations, moved away from the original theory.

4.4 Optimality Theory

In the early 1990s a new phonological theory rapidly became very influential: Optimality Theory (OT; Prince and Smolensky 1993). Given that, as we have seen, input constraints (morpheme structure constraints; see wbctp0086) had made place for output 'word structure constraints' which would motivate repair rules, the architects of OT asked the reasonable question whether both constraints and repair rules are needed. They decided to do away with repair rules and thereby reduce the derivational aspect of the theory to a single step from input to output, thus eliminating the need for intermediate representations that occur in rule-based theories.

The basic architecture of OT is simple. For any given input (i.e., underlying representation), we 'imagine' an infinite set of outputs (i.e. surface representations) from which one 'candidate' is selected as optimal. The choice for this optimal candidate is

[33] Whether similar claims were made in non-transformational syntactic theories (for example, to deal with stylistic syntactic 'transformations') is not obvious, as far as I know (but I stand to be corrected).

[34] Government enables the absence of content (as in the case of empty nuclei), while licensing enables the presence of contentful units (as in the case of harmonic features or dependent structural units); see Scheer (2004).

made by evaluating all candidates against an extrinsically ordered set of (universal) constraints. A candidate that violates a constraint that is lower ranked than all other constraints that other candidates violate, is the one that 'wins'.[35]

Van der Hulst and Ritter (2020) point to several properties of OT that are reminiscent of the SPE theory. For example, the constraint set forms a single 'block' just like SPE has a single block of P-rules. The approach is thus holistic. Also, like SPE lacked a theory of possible rules, OT does not contain a theory of possible constraints. (This eventually undermined the claim that all constraints are innate.)[36] A formal similarity lies in the use of extrinsic, language-specific ordering, not of rules but of constraints. Interestingly, this formal similarity prevented OT from being able to capture the phenomenon of phonological opacity that SPE accounted for in terms of counterfeeding and counterbleeding rule orders, which were deemed necessary to deliver outputs that violate a rule that applies 'earlier' in the derivation. In SPE, there was thus no requirement that rules must express generalizations that are 'surface-true'.[37] The problem for OT was, in a nutshell, that no constraint ordering can select an output as optimal if there is another candidate that gets a pass on a constraint that this alleged optimal candidate violates. In a direct minimal competition between two candidates, the winner cannot be the one that violates a constraint that the other candidate obeys. A logical consequence that followers of OT could have drawn is that opacity is not 'real'; see Potts and Pullum (2002). However, since many of the OT proponents (including the architects) had been 'raised' within the SPE tradition that heralded accounts of opacity, critically using extrinsic rule ordering as its biggest achievement, denying that opacity exists was a bridge too far for most of them. Various solutions were proposed, but those that were deemed successful acknowledged that there have to be multiple cycles of evaluation. In one version, called Serial OT (McCarthy 2000), the idea is that there are several cycles of evaluation, which in essence appeals to intermediate steps between the input and the output, which resembles the appeal to intermediate levels that extrinsic rule ordering made possible in SPE. A second version, called Stratal OT (Kiparsky 2000), recognized different blocks of constraint sets that are extrinsically ordered. Details aside, both procedures can deliver an ultimate winner that would be considered opaque, but it should be noted that the original OT idea that a phonological derivation is a single-step procedure is abandoned.

We should finally note that OT is a theory about constraint ranking. As such it has nothing to say about the structure of representations, whether phonological, syntactic or semantic. It can only count as a derivational theory and as such it can be applied to any domain in which competing choices are at play, including non-linguistic domains such as how people or countries make financial choices. This means that applying OT to various linguistic modules entails a strong form of analogy.

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[35] The set of all candidates is delivered by a 'generator' (GEN) which delivers for any given input all candidate outputs that differ from the input in one way or another (including one that is identical to the input). In a sense, this generator delivers every possible and (impossible) repair. The evaluation of this set could not be a finite procedure if the candidate set is infinite, but a formal argument was given to eliminate that problem. In OT analyses, evaluation tableaux only contain 'reasonable' candidates.

[36] They also refer to the fact that in many cases critically ranked constraints (like NOTROCHEE and NOIAMB) simply correspond to the two options of the older binary parameters.

[37] This requirement was made in Natural Generative Phonology (Hooper 1976, van der Hulst 1978).

4.5 Interim summary

We have considered various ways in which analogies might obtain between phonology and syntax, focusing on derivational aspects. While generative grammar started out with a conception of both modules that was near-perfect in correspondence (see (4)), subsequent developments in syntax and phonology, mainly in syntax, created a divergence: syntax reduced or abandoned transformations (and with that extrinsic ordering), while many phonologists 'doubled-down' on using language-specific rules and extrinsic ordering, in some cases recognizing that the tool of extrinsic ordering would apply to blocks or levels of rules. The idea of separating lexical from post-lexical blocks was temporarily paralleled in syntax with the recognition of lexical and post-lexical transformations, but this was before transformations came under fire. Nevertheless, phonological models, having turned to constraint-based approaches, were proposed that rejected a rule-based approach, often by delegating an account for 'phonological phenomena' to either lexical listing (or the morphology) or phonetic implementation, sometimes by relying on different levels, with constraints at each level being unordered (Goldsmith 1993) or ordered (Kiparsky 2000). Such approaches, potentially, offer accounts of (alleged) opacity effects. Arguably, OT has the potential of returning to a strong form of analogy to the extent that this approach could be extended from phonology to syntax and semantics. However, it is not the case that the OT approach parallels the development of minimalist approaches in syntax.

We have seen that parallels between syntax and phonology on the derivational side have come and gone for various reasons. This is due to varying and changing views on how the derivational dimension takes form and perhaps mainly to the persistent notion that there is a derivational dimension to begin with. That said, there is no escaping from the fact that most linguists will agree that an account of allomorphic and allophonic variation is required. If, in the broadest sense, phonology accounts for the realization of 'underlying' representations of words (including those that involve morphological structure), allomorphic variation must be relegated to the lexicon/morphology, while allophonic variation must occur in the phonetic implementation. What this leaves for phonology is an account of the structure of representations both following morphology and prior to phonetic implementation. Arguably, as discussed in section 5.3, these two levels appeal to different representational theories with respect to suprasegmental constituency. As for segmental structure, I will here assume that theories such as Articulatory Phonology (Browman and Goldstein 1986) aim at characterizing the implementational level which appeal to non-discreteness and temporal properties, while traditional 'phonological' models aim to characterize the pre-implementational level which is assumed to be discrete and atemporal.

5 Representational analogies

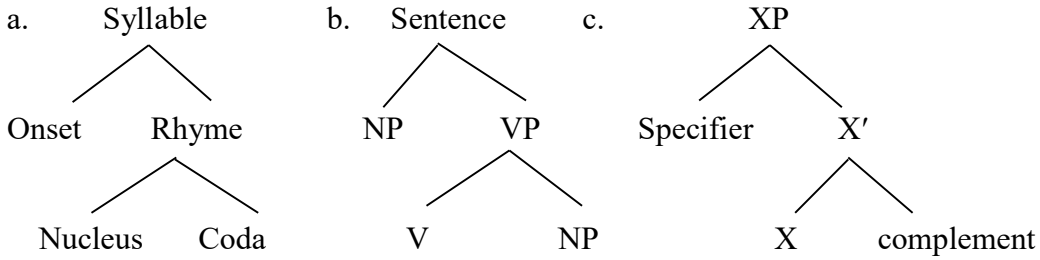
In this section we will shift our attention to representational parallels between phonological and syntactic representations. As I will show, such parallels have been

formally acknowledged most explicitly and clearly in John Anderson's dependency model. [38]

5.1 Syllables and sentences

I first mention a specific analogy between syntax and phonology that drew attention quite early on and which has continued to be a topic of discussion to the present day. It has been remarked more than once that there is a *possible* analogy between the internal structure of syllables (here assuming an onset–rhyme division, and a division between nucleus and coda in the latter), as in (6a) and the structure of a 'simple' sentence, as in (6b) (Kuryłowicz 1948; Pike and Pike 1947; Fudge 1969, 1987):

(6)



Carstairs-McCarthy (1999) speculates that the structure of syllables may have served as a model for syntax in the course of language evolution, a view that is criticized in Tallerman (2006), who doubts that the parallelism is real (as does Carr 2006), let alone that syntax copied phonology; Bickerton (2000), in his review of Carstairs-McCarthy (1999), shares this skeptical view. Despite these objections, this analogy was later identified as one between syllable structure and phrasal structure as in (6c), especially when both are construed as X-bar type structures (Levin 1985; see wbctp0135).

From the earliest days, generative syntax (like earlier structuralist approaches to syntax) was hierarchical, while phonology was 'flat'. The phonological representation in SPE was a linear string of phonemes (each phoneme being an unordered and unstructured set of features), interspersed with so-called boundary symbols between morphemes and larger units, with bracketing (triggering a cyclic application of the phonological rule set[39]) that was purely morpho-syntactic. The most notable absence was any representation of syllable structures, whether in terms of boundary symbols or a hierarchical organization. This 'minimalist' view stood in contrast with earlier models that had embraced the need for some kind of syllabic organization (even in some cases with recognition of their hierarchical organization; see below) whether for the proper statement of phonotactic constraints or for that of phonological rules.

[38] John Anderson's work on dependency phonology goes back to the early 1970s, with many later publications and recent comprehensive works: 2011abc, 2022ab in which he unfolds a dependency approach to the whole of grammar. For a survey of Dependency Phonology, see van der Hulst and van de Weijer (2018) and van der Hulst (to appear c). For a synopsis of the theory that notes differences between dependency phonology and 'traditional' generative phonology, also see Anderson (2002).

[39] We do not see cyclic rule application as an analogy between syntax and phonology, since the cyclicity of phonology is entirely dependent on the 'cyclic' structure of the morpho-syntactic representation.

Soon after SPE appeared, various phonologists argued for the re-introduction of the syllable (Anderson 1969; Vennemann 1971, 1974). This trend was picked up in the mid-seventies when the same point was made in various MIT dissertations (Kahn 1976; McCarthy 1979; Liberman 1975). Many phonologists supported a hierarchical view of at least syllable structure, with competing theories of what the internal structure of syllable is. Those concerned with syntax/phonology analogies would favor the Onset-Rhyme (OR) theory (cf. (6a)), but other approaches, such as a 'flat' view of the syllable (Kahn 1976; Clements and Keyser 1983) and moraic theories (Hyman 1985; Hayes 1989) have also been adopted; see van der Hulst and Ritter (1999a) for a review of these various approaches.[40]

We should here note that while it may be true that phonology has long been a pilot science, thus influencing theories about syntax, looking for representational analogies (or even non-representational analogies) between phonology and syntax does either not seem to be a concern for syntacticians or is looked upon with skepticism, as for example in Tallerman (2006) and Carr (2006) in a special issue of the journal *Lingua* that specifically invited both phonologists and syntacticians to reflect on the issue of analogies. Especially in the current climate of minimalist generative grammar, syntacticians have explicitly denied any significant analogies with respect to the structure of representations in both domains. Syntax is claimed to be constituent-based (and not linear), universal and innate, while phonology is said to be 'flat', language-specific and due to third factors; I return to this issue in section 5.6, but for now I will assume that the notion of constituent structure in phonology has wide, albeit not universal support. When the structures in (6b) and (6c) are claimed to appeal to the notion *head*, this could constitute another analogy, one that is also called in question in Tallerman's and Carr's articles.

Contrary to these views, I will argue, in section 6, following the work of John Anderson, that the notion of headedness is fundamental in both syntactic and phonological representations which can take the form of (a) constituent structures in which nodes are augmented with head/dependent labels or (as Anderson would have it) of (b) pure dependency structures that do not appeal to constituency, which are both hierarchical.

5.2 The rise of constituency in phonology

From the outset, we must realize, although this is often forgotten in survey articles, that there are two different traditions within generative phonology concerning suprasegmental constituent structure in phonology. The first approach stems from Liberman (1975), a dissertation which focused on developing a theory for intonation and which proposed a hierarchical way of representing stress, both within the phrasal and the word domain.

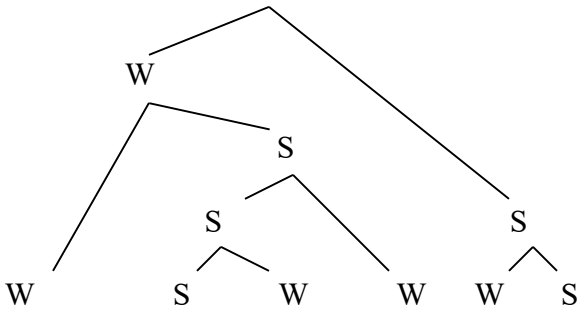
In a language like English, phrasal stress refers to syntactic constituents. SPE proposes the *Nuclear Stress Rule* (NSR), which assigns a phrasal stress to the rightmost

[40] Interestingly, after the syllable had been welcomed in generative phonology as a necessary unit, various phonologists questioned the need for hierarchical phonological structure (in whatever form). A need for hierarchical syllable structure was questioned early on, claiming that phonotactic restrictions could be captured in other ways (Steriade 1999; Blevins 2003).

word in each phrase (cyclically from the smallest to the largest phrase). Two phonologists proposed that phrasal stress can be represented by enriching the syntactic structure with a Strong-Weak labelling, turning it into a phonological representation. The Danish linguist Jørgen Rischel (1982) uses pluses and minuses to indicate this, while Mark Liberman uses the labels S and W.

Here is an example from Liberman's work:

(7)

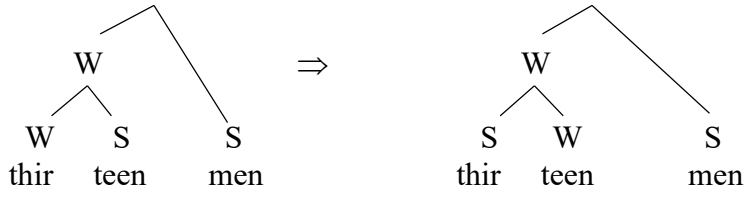


[[[John's] [[[black] [board]] [eraser]]] was stolen]]

This sentence contains the compound *black board eraser* which shows the SW labelling for compounds. This metrical approach was then also applied within non-compound words, including simplex words. It is important to note that only within simplex words (or derived words that phonologically behave like simplex words; typically, level 1 derived words in the sense of Siegel (1974) or those involving + boundaries in SPE jargon) metrical structure cannot be projected from an independently given structure, as it can for phrases, compounds, and level II derived words (which have a # boundary in SPE). This is an important difference when, in the next section, we will ask whether phonological constituents allow recursion.

While in Liberman's approach the tree geometry of metrical structure mirrored the morpho-syntactic structure in principle, it became clear that adjustments were necessary in specific cases. The idea was that metrical structure could be subjected to metrical transformations. As an example, we can mention the rule of stress retraction (e.g. Kiparsky 1979). Consider the following example:

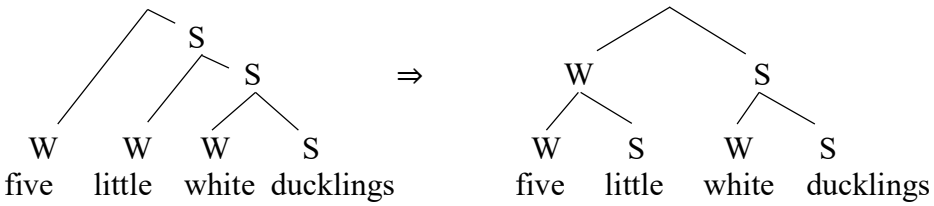
(8)



In this case the stress on *teen* and on *men* 'clash' which results in reversing the labeling of the word *thirteen*.

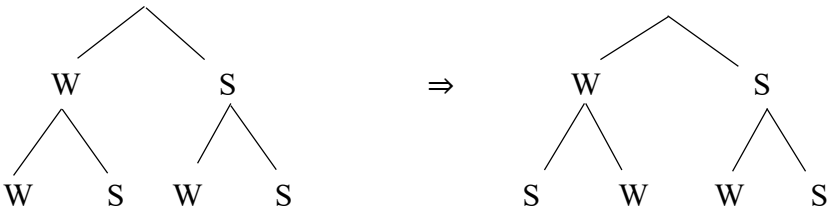
As shown in the work of Giegerich (1985), metrical transformations can result in 'flattening' of the constituent structure, driven by rhythmic principles which for example divide right-branching structures into smaller binary units:

(9)



It was then shown that the output of this rhythmic division is subjected to another rhythmic principle which derives a so-called 'hammock' pattern with a strong 'beat' on the left edge that is opposite to the primary phrasal stress on the right side:

(10)



'hammock' pattern

The Giegerich approach establishes two factors that motivated these transformations:

(11) a. Rhythm (which favors binary units)
b. 'Hammock' (which favors a strong unit, opposite to the main stress)

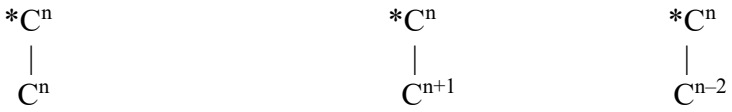
These developments restored a certain analogy between syntax and phonology by differentiating two levels of representation mediated by structure-changing transformations.[41]

It is not clear what precisely caused Liberman's model of suprasegmental phonological structure to be superseded by the strictly layered model, often called Prosodic Phonology, that was proposed by Selkirk (1978), culminating in the comprehensive model of Nespor and Vogel (1986); see Kager and Zonneveld (1999). Likely, it was the finding that prosodic structure appeared to be 'flatter' than syntactic structure that gave rise to a new theory of prosodic structure which adopted a strictly layered hierarchical structure that differed from the syntactic constituency in fundamental ways.

As originally proposed by Selkirk (1978) and elaborated with extensive empirical evidence in Nespor and Vogel (1986), the prosodic hierarchy (PH) had a fixed number of layers. While still being depicted as a rooted tree, the PH was said to be subject to a number of constraints which caused it to differ from garden-variety syntactic structures.

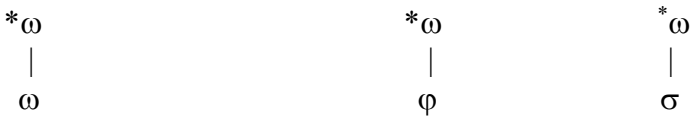
[41] Ladd (1996) adheres to the view of prosodic structure that follows the original ideas in Liberman (1975). For a general discussion of metrical structures of compounds and phrases, see Visch (1990).

(12) a. Non-recursivity b. Layeredness c. Exhaustivity



Non-recursivity states that at each layer a unit cannot dominate a unit of the same type (i.e., it excludes self-embedding). The other two constraints state that a constituent cannot dominate a unit of a higher layer, and not one that is more than one layer down, respectively. For example (φ = prosodic phrase; ω prosodic word; σ = syllable):

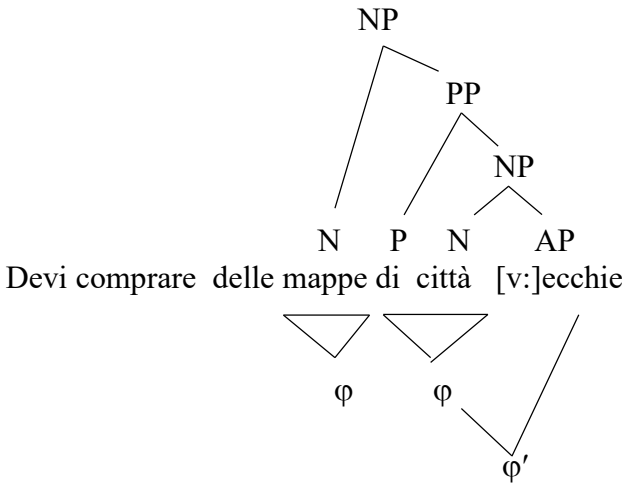
(13) a. Non-recursivity b. Layeredness c. Exhaustivity



These three constraints only allow a strictly layered PH, accounting for the fact that prosodic structure, while hierarchical, has different formal properties from syntactic structure.

Soon after the switch to the prosodic strict-layer model was made, it was recognized that a limited case of self-embedding recursion was necessary. For example, in Nespor and Vogel (1986), it was recognized that phonological phrases could contain smaller phonological phrases ('You must buy some maps of old cities'):

(14)



The reason for why *vecchie* 'old' is here incorporated into the preceding prosodic phrase, forming a higher prosodic phrase, notated as φ′, is due to a principle that militates against non-branching prosodic units. If the complement that follows the head is non-branching (i.e. one word), it is incorporated into the prosodic phrase that is formed by the head. Note that the recursive structure here does not mirror the syntactic structure. Itô and Mester (2009) suggest a general format for a limited use of recursion in phonology. For

criticism of identifying any type of recursion in prosodic structure, see Miller and Sande (2021).

I refer to Fox (2000, chapter 6) for a good overview of various proposals for prosodic organization. His review makes it clear that the question of recursion in prosodic structure is not a recent one. He refers to earlier work, e.g. by the linguists Kenneth Pike and Paul Tench, who distinguish between basic units in the hierarchy and 'expansions': "the expansion is a group of units whose role is the same as that of the basic unit which constitutes its head" (Fox 2000: 351). For further discussion of the match between higher prosodic structure and syntactic structure, we refer to van der Hulst (2010a; see section 5.5).

There is a lot of controversy about the interface relationship between syntactic structure and the layers in the prosodic structure. One reason for this is that syntacticians do not always agree on what the syntactic structure of sentences is. A second factor is that phonologists, likewise, do not always agree about the prosodic structures of sentences. A third factor is that the mapping from syntax and to phonology was no longer seen as 'being done' with respect to a complete syntactic structure, but rather following the phases in terms of which the syntactic structure unfolds; see wbctp0150.

Along with the phase-based theory of mapping, a later development in prosodic phonology, under the name of *Match Theory* (Selkirk 2011), proposes a specific correspondence between syntactic and prosodic categories which in essence restored to some extent Liberman's theory of phonological constituency.

Meanwhile, some phonologists argued that we do not need a hierarchical phonological structure at all in order to explain the domains of sentence level phonological rules. In the so-called direct reference (or direct syntax) view (e.g., Seidl 2001; see wbctp0150), it is claimed that all relevant phonological rules can refer to syntactic structure directly, rather than indirectly, i.e., by referring to a prosodic structure that is motivated by syntactic structure. Scheer (2004) refers to the prosodic hierarchy as 'diacritic'. An early proponent of direct reference is Kaisse (1985) who separates syntax-based phrasal phonology from so-called fast-speech rules which, arguably, one could perhaps locate in a phonetic implementation component.

5.3 Excursus: Two phonological hierarchies?

Rather than denying that phonology needs any hierarchical structure at all, and building on the distinction between phonological rules that make reference to the syntactic structure and fast speech rules, a case could be made that we need two phonological hierarchies. The discussion here starts with Lahiri and Plank (2010, 2022) who make a case for a kind of hierarchical prosodic structure that has very little to do with syntactic structure. As these authors document, a structure like this is directly driven by rhythmic principles, as proposed long before the generative era, going back to linguistic traditions in Germany and England during the nineteenth century.[42] They also show that the kinds of grouping that have long been proposed provide a better basis for explaining historical

[42] A pivotal unit in this structure is the so-called 'Abercrombian foot' which groups 'main stressed' syllables with unstressed syllables up to the following main stressed syllable. This kind of grouping is also found in Anderson and Ewen (1987) for what they call 'utterance structure'.

processes than the prosodic grouping in the strict layer version of prosodic phonology. Arguably, this prosodic organization could be relevant for fast speech rules.

Van der Hulst (2009) discusses various reasons to postulate two phonological hierarchies. One such hierarchy closely copies the syntax (in the manner that Liberman 1975 and Rischel 1982 and Selkirk's Match Theory), provided with S/W labelling and with only minor deviations (mostly due to cliticizing elements). The other hierarchy would be more 'surface-oriented', driven by the rhythmic realization of utterances, along the lines of what Lahiri and Plank propose. Here I mention the telling title of Rischel (1987): "Is there just one hierarchy of prosodic categories?" (also see Fudge unpublished ms.). It is perhaps interesting to add that the theory proposed in Liberman and Prince (1977) advocated for two different phonological structures, one closer to the morphosyntax, the metrical S/W labeled tree, and one, the metrical grid, which was motivated in terms of its representation of rhythmic properties of linguistic expressions.

An important question that arises here is whether these two hierarchies are derivationally related (via 'metrical transformations'). Another possibility, suggested in van der Hulst (2009), is to place the two hierarchies at different phonological strata, the former after the morpho-syntax, thus being 'grammatical', and the latter in the implementational module, being post-grammatical.

5.4 Segmental structure

The developments in Generative Phonology during the 1970s and 1980s did not only lead to proposals for phonological constituent structure. The SPE view of segments was that these units (as the terminal elements in this structure) were unstructured sets of phonological features, so-called feature bundles, that exhaustively parsed the sound stream in vertical slices. Two complementary proposals radically changed this view (see wbctp0027). Firstly, Goldsmith (1976) proposed his Autosegmental Phonology model in which the sound stream is horizontally split into tiers, first for tonal features, with the other tier for all other features. This allowed tonal features to take scope over ('spread over') multiple 'segments' on the latter tier. Then separate tiers were suggested for other features that can take wide scope, notably in vowel and nasal harmony. A second proposal known as 'Feature Geometry' (advanced in Clements 1985 and Sagey 1986) was that features (and thus tiers once proposed) are hierarchically organized.[43] This idea has influenced proposals for hierarchical grouping of morphosyntactic features; see Harley and Ritter (2002a, b), which is another example of syntax following phonological theories.

Meanwhile, another discussion, with analogues in phonology and morphosyntax, was whether features are binary or single-valued; see van der Hulst (2016). While in Dependency and Government Phonology subsegmental structure invoked head/dependency relations between phonological features (wbctp0133), a further analogy

[43] The rise of a phonological hierarchy and autosegmental phonology was first reviewed in van der Hulst and Smith (1982), who point out that a proposal for a 'feature geometry' had been made in early publications in Dependency Phonology (culminating in Anderson and Ewen 1987). A review of feature theories, including the question of the valency of features and feature grouping is Den Dikken and van der Hulst (1988); also see McCarthy (1988).

between phonology and syntax could be to explore head/dependency relations between morphosyntactic features.

I will return to proposals for intrasegmental hierarchical structure in the next section where we discuss recursivity.

5.5 Recursion in phonology?

As we have seen in section 5.3, a recurrent claim (or assumption) has been that syntactic structure is recursive while phonological structure is not. A classical slogan was that while 'sentences can contain sentences, syllables cannot contain syllables'. [44] The potential occurrence of recursivity in phonology has been extensively discussed in van der Hulst (2010a). It is important to distinguish between recursive phonological structure that correlates with (i.e., copies) the recursive structure of morphologically and syntactically complex expressions and phonological recursion proper, i.e., in domains that do not display morpho-syntactic structure. As for the former and accepting the idea that there are two phonological hierarchies, we have seen that in the Liberman style structure, which in principle copies syntactic structure, we expect recursivity. However, in the more surface-oriented structures (proposed in Lahiri and Planks' work), recursivity is not expected when rhythm is the driving force. (Here we need to recall that in one view the two structures can be seen as derivationally related with various metrical transformations making the 'deeper' syntax-driven structure more surface-oriented, i.e., flatter and more rhythmic.)

As for the need of recursion in expressions that do not have morpho-syntactic structure, a prevalent idea is that in this latter case, no argument can be made for recursivity. At best, so-called ternary feet (wbctp0052) can be viewed as involving an adjunctive kind of recursion as well as cases of alleged recursivity of the prosodic word node.[45] What is important here is to distinguish between recursivity that results from adjoining an element A creating a 'bigger' unit A (e.g., adding an adjective phrase to an NP which delivers what covers what is called *tail-recursion*) and recursion that results from expanding the 'complement' of a unit into a full phrase (e.g., providing a verb with an NP complement). The latter type of structure building recursion, which my cause center-embedding, is the primary focus of identifying recursivity in syntax and it is this type of recursivity that appears to be absent in phonology.

Some phonologists have taken issue with this claim. Van der Hulst (2010a) discusses proposals for limited phonological recursion at different levels of syllable structure. Den Dikken and van der Hulst (2020) develop van der Hulst's (2010a) proposal for recursion in syllable structure, solving certain issues with this proposal and enhancing the analogies between phonological and syntactic structure in their 'one syntax for all' program which here means: phonology and syntax share a single system for hierarchical, recursive structure both supra- and intrasegmentally.

[44] Likewise, foot structure was replaced by lateral licensing/government relations (Takahashi 1993); see Szigetvári and Scheer (2005) and Faust and Ulfsbjorninn (2018).

[45] Van der Hulst (2010) asks whether the original metrical theory made a commitment to word-internal recursivity by grouping feet into left- or right-branching 'word' trees that, when more than two feet are grouped, have more than one 'word' node.

This brings us to asking whether we have to reckon with intrasegmental recursion. From its inception, and similar to Dependency Phonology, Government Phonology adopted a theory of segmental structure that appealed to a set of monovalent features, called elements, including the well-known set A, I, and U which were deemed relevant for both vowels and consonants (wbctp0133). In both models, additional elements were added to this set. In Government Phonology attempts were then made to reduce the set of elements. These developments have been discussed in Backley (2011) and van der Hulst (2020). A further reduction of elements was achieved in Pöchtrager and Kaye (2013) in their GP 2.0 model (also see Pöchtrager 2006, 2020; Ritter 2022, to appear). The reduction in this case is counterbalanced by providing phonological segments with a richer internal, recursive hierarchical 'syntactic' structure in which different hierarchical levels correlate with distinct phonetic interpretations.

A different elaboration of intrasegmental, recursive structure is offered in Nasukawa (2015, 2017, 2025; see wbctp0138), who develops a single hierarchy that comprises phonological segmental structure and syntactic structure. Nasukawa thus proposes one plane in which syntactic structure is a direct continuation of phonological structure, rather than phonology and syntax being represented on parallel planes.[46]

5.6 A potential deep analogy: two basic features in both phonology and syntax?

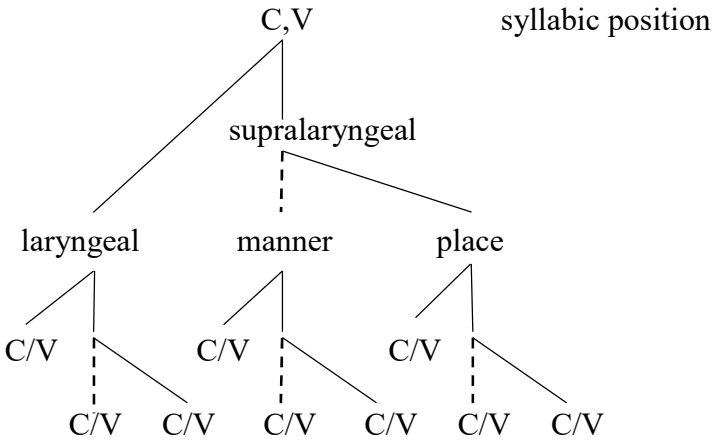
In a model called Radical CV Phonology (RCVP), which is based on earlier Dependency Phonology proposals, it is proposed that we can account for all cases of phonological contrast with just two features, C and V. Crucial to understanding the basic idea behind RCVP is that, if we assume that the segmental structure involved different class nodes, each with a separate set of features, the question must be raised whether the features in these structural units are totally distinct or whether perhaps the same features can occur in more than one class, albeit with different, but similar, phonetic correlates. In their excursus on representations for tonal distinctions, Anderson and Ewen (1987: 273) made the intriguing suggestion that the elements I and U, originally proposed for place distinctions in consonants and in vowels, could be employed for high and low tone, as part of the tone class. They made a similar suggestion concerning the identity of the place feature A and the manner feature V (which captures vowelhood) (1987: 215). In short, in two places, these authors suggested employing the same features in different classes, while attributing the phonetic interpretation of these features to the class that they occur in. I note that this line of reasoning completely parallels the traditional and commonly accepted strategy to reduce allophones to phonemes. It is as if the different phonetic implementations of features are 'allofeatures'.

Radical CV Phonology (RCVP) pushes the idea of using the same feature in different classes to its extreme (van der Hulst 2020, 2021, to appear b) by proposing two features (labeled C and V) for the representation of all phonological contrasts that are attested in the languages of the world. The structure in (15) expresses that the components C and V can occur multiple times in the three classes: Laryngeal, Manner

[46] For other proposals regarding submorphemic or subsegmental recursivity see various chapters in Backley and Nasukawa (2020).

and Place. I will return to the labeling of the top node that represents syllabic positions below).[47] We note the recurrence of an X-bar-like organization in which the head can be combined with a 'first' and 'second' dependent (comparable to complements and specifiers in X-bar syntax):[48]

(15) The 'geometry' of elements in RCVP



- Vertical broken lines dominate heads
- Slanted lines dominate the dependents
- C/V = C or V

The choice of elements resulting from the head element and the first dependent is subject to polarity, which excludes CC or VV. Because of this restriction, we could call the first dependent the 'complement' even though it is not obligatory. This allows for four possibilities:

(16) C C;V V;C V

Each of these four options can be provided with a second dependent, which can freely be C or V (we could call this the specifier). The dependent subclass is assumed to not allow for combinations of the two elements.[49] This adds up to the following set of possible structures for each class node:

[47] My presentation of the RCVP syntax here is slightly improved (and simplified) from that in van der Hulst (2020) with respect to the internal organization of class nodes/gestures.

[48] I am not invoking the idea of X-bar syntax as (once) used in syntactic theory in support of the X-bar-like structure in (15). However, I do believe that syntactic X-bar theory was correct in making a distinction between two types of dependent units, one close to the head and one more distant. Besides, despite the fact that X-bar theory has gone 'out of fashion', syntacticians still generally use the distinction between complements and adjuncts. Note that the RCVP model promotes a strong intraplanar structural analogy by hypothesizing that all three class nodes (as well as syllable structure which is not discussed here) have the same structure.

[49] In van der Hulst (2020), I considered the need for allowing the specifier being a combination of C and V. However, I general, there is a very strong tendency for the specifier to only require either C or V. Hence, here I push for disallowing combinations in the specifier position.

(17)

{C}	{C;V}	{V;C}	{V}
{C{C}}	{C{C;V}}	{C{V;C}}	{C{V}}
{V{C}}	{V{C;V}}	{V{V;C}}	{V{V}}

Dependents are never obligatory. The 'option' of having structures that *lack* a head element, which would create four additional possibilities, is simply not available as part of the RCVP syntax (because dependents cannot be more complex than heads and, moreover, because dependents need a head). RCVP also rules out a completely unspecified class node as a contrastive option.

It is to be expected, as we have seen in section 5.5, that the reduction in one part of a theory leads to more complexity in other parts. Hence reducing the set of *representational* features to just two, comes with the need to invoke more 'structure', both in terms using class nodes (as in (15)) and appealing to a structure within class nodes, I refer to van der Hulst (2020) where extensive typological evidence from phonemic inventories is given in support of the need for the structures in (17) *for each class node*. (Of course, the full array of structural possibilities in (17) is unlikely to be exploited in any given language.). The basic gain of RCVP is to replace arbitrary sets of features by a principled set of structures: 'structures not lists'.[50]

Let me finally add that the case for the emergence rather than listing of distinctive categories is supported by the fact that the RCVP approach is not modality-specific. As I show in van der Hulst (2020, Chapter 10), the same principles that give use the structures in (15) predict 'feature geometries' for the phonological structure of sign languages which are supported by extensive work on the phonological analysis of *Sign Language of the Netherlands* in van der Kooij (2002) and van der Hulst and van der Kooij (2021).

We now turn to a possible analogy with syntactic features. In early proposals for syntactic features, Chomsky (1970) proposed that the four basic lexical categories can be characterized in terms of two basic features, [+/–Noun] and [+/–Verb]. In the works of John Anderson, two unary features, N and V, are used for the same purpose. Anderson notes an analogy between those two features and the phonological features C and V. I conclude this section by suggesting that it is perhaps possible to develop an approach to syntactic categories that represents all of them in terms of combinations of N and V along the lines of what RCVP does with C and V. In doing so, a 'Radical NV model' could perhaps take clues from scenarios that have been developed by Grammaticalization Theorists for how grammatical categories in modern languages could be historically derived from the basic categories Noun and Verb; see Heine and Kuteva (2007, specifically chapter 2, page 111).

5.7 Turning back the clock: 'flat' phonology

In this section, I will discuss some more recent views which hold that syntactic and phonological representations are essentially different. A central concern revolves around the distinction between 'structures' and 'strings' (see Everaert et al. 2015).

In the early days of generative grammar, there was a focus on the sets of *strings* that a formal grammar type would produce, the so-called *weak generative capacity* (see

[50] In RCVP, the syllable is generated by the same structure that applies to class nodes.

Levelt 2008). It was of course recognized that the sentences in natural languages have hierarchical constituent structures but these would emerge as a consequence of generating strings with production rules (i.e., phrase structure rules) contained in the formal grammar. When asking about the hierarchical structure of the generated string, the concern would be the *strong generative capacity* of the formal grammar. Attention to structure when representing sentences in natural human languages was crucial because syntactic transformations were not just string-based: they would also be 'structure dependent' which necessitates the availability of structure.[51]

The difference between hierarchical structure and linear structure can be enhanced by making different parts of the grammar responsible for these two aspects. In Minimalist syntax, the only aspect that is said to matter is hierarchical constituent structure, while linearization is dispatched to 'the phonology'. In this view, the syntactic engine ('Recursive Merge') is taken to produce a 'mobile-like' object with hierarchical structure but no linearity. A similar separation was advanced in an older approach, called Functional Grammar (Dik 1981), while the model called *Generalized Phrase Structure Grammar* (Gazdar et al. 1985) also separates hierarchy from linearity. In the minimalist approach 'phonology' is made responsible for the linear order of morphemes and words on the argument that linearity is an automatic result of the impossibility of pronouncing words simultaneously. In the domain of syntax this faces the problem that linearization depends on syntactic information and only rarely on phonological information, but this does not mean that the matter of hierarchy and linearity cannot be somehow formally distinguished in the grammar.

We should not be surprised to find that aspects of syntax can be dependent on the channel of communication, but regarding externalization as completely irrelevant to syntax cannot be maintained in light of the view that essential properties of the syntax in sign languages depend on the affordances of the visual mode of such languages (Sandler to appear). Whatever one decides about where to account for syntactic linearity, the question of the roles of hierarchical structure and linearity in phonology needs to be considered separately. As we will see, answers in that domain can then be used to fuel the discussion on analogies between phonology and syntax. Anderson (1987) argues that linearity and hierarchy can be separated in phonology to the extent that that former can be derived from the latter.[52]

We have seen that early Government Phonology capitalized on parallels between phonology and Government and Binding-style syntax. However, with reference to the analogy in (6), this model did not recognize the syllable as a constituent, replacing this unit by a universal 'government' relation between onsets and rhyme constituents. Then, Lowenstamm (1996) questioned the need for onsets and rhymes, arguing that phonological representations could be linear sequences of Cs and Vs tied together by directional, lateral linear licensing relations. Scheer (2004) adopted this 'strict CV' approach and subsequently concluded that, as a result of the elimination of all syllable constituency, phonology had become 'flat' and linear, thus establishing a major

[51] See Goldsmith (2005) for the continuity between Chomsky's proposals and the work of Zellig Harris.

[52] On linearity in phonology, see also McCarthy (1989) and chapters in Apostolopoulou and Krämer (2025). In Raimy's model of reduplication, an appeal to a linear ordering of phonological segments is central; see Raimy (2000) and wbctp0100.

difference between phonology and syntax by asserting that phonological representations are 'flat' strings (see also Scheer 2013, 2023).

This trend against phonological constituent structure did not only concern syllable structure. Foot structure was also replaced by lateral head/dependency relations; see Takahashi (1993). Foot structure also came under attack within metrical phonology. Firstly, Prince (1983), in view of the fact that standard Metrical Phonology had proposed so-called grid structure to complement the metrical tree structures, proposed that grids might be sufficient to represent prominence relationships in words and phrases. Other authors replied that such constituency grouping may be required to explain certain phonological rules and this prompted Halle and Vergnaud (1987) to adopt a bracketed grid notation, which essentially was a notational variant of the older metrical tree structures. This, however, changed when Idsardi (1992) allowed opening or closing brackets to occur without a corresponding partner, a move that could be construed as treating brackets as boundary symbols, as was explicitly recognized in Reiss (2008). This meant that phonology was made flat above the level of 'stress-bearing units' (which could be moras or syllables). To 'finish off' this move toward phonological flatness, the need for all hierarchical prosodic structure was questioned in Neeleman and van der Koot (2006). Here also recall that Scheer (2004) refers to the entire so-called prosodic hierarchy as 'diacritic' and he replaces its function by interspersing empty CV units on the skeletal tier.

Clearly, the idea that there is no proper phonological recursion gets a new dimension when the whole notion of hierarchical structure in phonology is called into question. If phonological representations are 'flat', i.e. strictly linear and constituency-free, there cannot be recursion either. This argument is made explicit in Scheer (2013, 2023). To motivate that syntactic structure is quite unlike phonological structure, Scheer (2023) points out that phonological structure does not involve *concatenation*, while the structure of complex words and sentences (hence syntax) does. Here we have to be aware of a terminological issue. Samuels (2009a) states as the difference between syntax and phonology that whereas structure building in syntax involve the operation Merge (which creates hierarchical structure), the operation in phonology is concatenate which results in linear structure. Scheer uses the term concatenate for structure building, claiming that phonology simple does not involve any kind of structure building: the linear structure of phonology 'is' given in the lexicon; it is not constructed.

> Concatenation and linearity are thus in complementary distribution: concatenation is present in syntax but absent from phonology, while linearity is an input condition of phonology that is unknown in syntax. This correlates with the existence of different means to express hierarchy: phonology has no trees because it does not concatenate anything; there cannot be any lateral relations in syntax in absence of linearity. That is, trees in syntax and lateral relations in phonology are two ways of expressing hierarchy that are adapted to the design properties of their environment. (p. 284)

He then states that by implication there can be no recursion in phonology:

> Arboreal structure being thus unavailable to phonology, hierarchy is expressed by a different means, which concords with its linear conditions: lateral relations. If there are no trees in phonology, of course the existence of recursion is excluded. No concatenation, no trees – no trees, no recursion. (p. 269)

Scheer's view aligns with the view discussed in the previous section which is captured in the slogan "structures, not strings" that is employed by syntacticians to characterize the mobile-like organization and non-linearity of syntactic structures.[53]

We should first note that an account of the wellformedness of phonological strings, even if they are based on flat, listed representations that are stored in the lexicon, does not logically preclude that such an account appeals to a constituent structure if that structure provides the most economical and explanatory basis for stating phonotactic restrictions.

In van der Hulst (to appear a) I offer a response to Scheer's argument that recursion is formally impossible if phonology is 'flat'. This response firstly includes the claim that Scheer's theory, with its appeal to lateral relations that account for the coherence of the linear string of segments, might fall within the realm of dependency-based theories.[54] Scheer (2023: 55) himself states:

> Lateral relations are thus an instance of a dependency relationship, though a competitor of the arboreal description of syllable structure. As such, their application mechanically leads to the elimination of trees.[55]

Indeed, dependency-based theories are meant to be alternatives to constituency-based approaches. However, Scheer does not seem to consider the possibility that a theory that relies on lateral relations is in fact a form of dependency phonology. He characterizes Anderson's Dependency Phonology as a theory that relies on 'arboreal' representations but the tree-like graphs in Dependency Grammar approaches are representations of dependency relations and not of constituency. The resemblance between dependency graphs and constituent structure graphs is superficial. Perhaps then Scheer overemphasizes the difference between his theory and Dependency Phonology. The second part of my reply to Scheer is that, if his lateral phonology is a form of dependency phonology, the absence of recursion does not follow because dependency-based representations can be recursive, at least in Anderson's construal of the dependency formalism which in both syntax and phonology incorporates a distinction between dependency as adjunction and dependency as subjunction, thus acknowledging that there

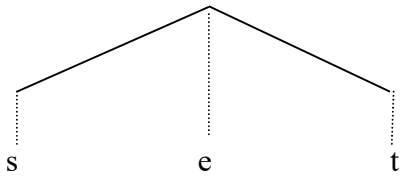
[53] Phonological flatness has been supported on evolutionary grounds, on the view that having 'arboreal' structure was an evolutionary step that created syntax, leaving phonology as it was from the beginning, namely linear. In this connection, a comparison between human phonology and bird song has been made (Samuels 2009), leading to what we might call the 'bird song theory of human phonology', which perhaps does allow certain groupings, as evidently present in bird song, that, however, do not necessarily imply an unlimited degree of hierarchical organization.

[54] Anderson himself would likely not characterize strict CVCV theory as a form of dependency phonology; see Anderson (2014).

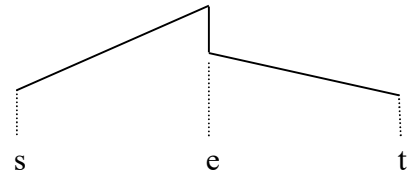
[55] We have to bear in mind that when Scheer uses the term 'arboreal' he means constituent-based.

are two types of dependency with respect to the head. We can illustrate this with two versions of a dependency account of syllable structure:[56]

(19) a.



b.



In (19b), /e/ is dominated by two nodes in the dependency graph, one subjoined to the other. The /t/ is taken to be directly dependent on the vowel, while /s/ is dependent on the vowel via the unit /et/ (see section 4 for what motivates this difference).

As suggested in van der Hulst (to appear a), the appeal that Government Phonology makes to head-dependency, so-called lateral, relations strongly suggests that this version of Government Phonology is a dependency model. If this is so, it no longer follows that phonological representation cannot be recursive if one adopts a version of grammar that allows the distinction between adjunction and subjection can be recursive. If this is so, we need to find independent reasons for why recursion in syntax is more pervasive than it is in phonology. In van der Hulst (2010a), I have suggested that recursion in syntax is 'needed' because syntactic structure caters to conceptual structure, which is intrinsically recursive. Phonology on the other hand caters to (a cognitive representation of) phonetic structure, which is intrinsically mostly linear (or rather multi-linear), although its rhythmic nature fosters grouping and dependency.

6 The core unifying notion: headedness

Throughout this chapter, the notion of headedness has played a role in both syntactic and phonological models. In this section I will argue that *headedness* is fundamental to the structural analogy that unifies syntax and phonology. In its most general form, headedness results from a property of complex structures, which is that when units are combined there will always be an asymmetrical relationship between them such that one unit, called the head, is characteristic of the combination, and as such obligatory, while the other unit is somehow dependent on this head (being either selected by the head or modifying it). From this it follows that when syntactic units are combined to form phrases and sentences, headedness is an automatic consequence. This immediately

[56] This may not be the case for all dependency theories. What sets Anderson's formalism apart from other varieties is the use of both adjunction and subjunction. The latter kind of dependency has been criticized in Osborne, Putnam and Groß (2011), who argue that distinguishing between adjunction and subjunction brings the dependency approach too close to a constituency approach.

suggests that headedness must also be a property of phonological representations on the generally accepted assumption that such representations are not random and unconstrained sequences of phonological segments.[57]

The idea of headedness in syntax has a long history; see Imrényi and Mazziotta (2020). Given that no linguist would ever say that sentences are random combinations of words, it has long been proposed that the non-randomness of combinations involves dependencies between words such that certain words could not occur unless being dependent on (or governed by) another word. In this view, a sentence is exhaustively 'parsed' into a set of dependency relations with ultimately one word, the head of the sentence, not being dependent on any other word. In the 20th century this understanding of what makes a sentence wellformed has given rise to various kinds of a Dependency Grammar model (Tesnière 1959; Hays 1964; Gaifman 1965; Robinson 1970, among others; see de Marneffe and Nivre 2019 for an overview).

Most syntacticians have been trained in the early tradition of Generative Grammar (based on earlier structuralist models) in which sentence structure would be represented in terms of a constituent structure (built by phrase structure rules) and they have come to learn about headedness when Chomsky (1970) added this notion to constituent structure, identifying one word as the head of each phrase which then would project its word category label ('X') to the phrase label (XP). This resulted in a cross-categorial X-bar structure, in which the head could have two dependents, a complement (which would be selected by the head) and an optional specifier. This cross-categorial view can be seen as an intraplanar form of structural analogy. While Anderson (2006) questions the cross-categorial validity of a uniform phrasal structure (thus questioning syntax-internal analogy), the details of phrasal structure have changed over time, with some questioning the notion specifier (initially thought to be non-phrasal) and others pointing to a distinction between phrasal complements (obligatory) and phrasal adjuncts (optional), the notion of headedness and some phrasal constituents being dependent on heads has remained. To review these developments is not this chapter's task, although a distinction between types of dependents that differ in terms of how closely they are related to the head has also remained, even in Minimalist descendents of generative syntax. An important question is how we know which unit in a combination is the head and thus projects its label to the whole constituent. This issue of 'labeling' has been central in Minimalist approaches. In the dependency approach of John Anderson, syntactic headedness correlates with the *semantic salience* of a unit, thus adopting the view that syntax is grounded in semantics. Such a view is impossible in generative, constituency-based approaches which proclaim the autonomy of syntax.

To underline the parallelism between syntactic and phonological heads, Anderson refers to analogies such as the use of 'subcategorization' or 'complementation'. In languages such as English, lax vowels require a following (closing) consonant, which can be viewed as a subcategorization 'frame' for that type of vowel, much like transitive verbs subcategorize for a following complement.

Meanwhile, headedness also came to be acknowledged in phonology. Here, we must first mention its use in Dependency Phonology (DP; originating in Anderson and Jones 1973 and fully worked out in Anderson and Ewen 1987). As per the SAA,

[57] See Ewen (1995) for a general discussion of phonological headedness, disentangling the notions of dominance or projection ('mother/daughter'), and head-dependency between 'sisters'.

headedness, if this motion plays a pivotal role in syntax, is expected to also be central in phonology. In DP, headedness plays a role intrasegmentally and suprasegmentally. In the latter domain, headedness is acknowledged with respect to syllables and groupings of these in feet. As a well-known example, an appeal to headedness in phonology is that vowels qualify as heads of syllables, being the obligatory segment type in most cases. However, DP proposed a phonological dependency structure up to the level of complete utterances, thus anticipating developments within 'mainstream' generative phonology that I will mention next.

Independent of Dependency Phonology, Liberman (1975) and Liberman and Prince (1977) proposed a model of phonological 'metrical' structure, a crucial claim of which was that syllables group into binary feet. In such grouping, one syllable was labelled 'S(trong)', the other 'W(eak)', indicating relative prominence, or indeed perceptual salience. The S/W labelling was subsequently replaced by reference to the strong syllable as the head of the foot. In this approach feet were grouped in larger units, such as the prosodic word, and this eventually led to recognizing a prosodic structure for the whole utterance, with headedness being marked at each level in this structure. These proposals essentially replicated what had already been proposed in the context of Dependency Phonology.

As mentioned in section 5.4, headedness also plays a role subsegmentally, first in Dependency Phonology and later in Government Phonology and eventually in other segmental models, either independently developed or based on DP in one way or another, such as van der Hulst's Radical CV Phonology model.

Following DP, other work emphasized the central notion of head-dependent relations at all levels of phonological structure, such as Dresher and van der Hulst (1997) and van der Hulst and Ritter's (1999b) Head-driven Phonology model.

Several recent writers, such as Carr (2006) and Tallerman (2006), deny that the notions of *head* in syntax and phonology are truly analogous. However, this view results from a syntax-biased understanding of heads which, in the words of Carr (despite the autonomy of syntax), is semantically based. Therefore, he reasons, there can be no heads in phonology because phonological units do not have meaning. Anderson, while certainly seeing syntax as grounded in 'semantic substance', associates headhood with a notion 'salience' which is not committed to a specific type of grounding. For him, phonological heads are *perceptually* salient due to properties such a high sonority. It should be clear that with an appropriately abstract characterization of what it means to be a head, the view that there is no analogy between heads in syntax and phonology seems unfounded.

In the view of this author, the idea that syntax appeals to hierarchical 'structures' (that do not express linearity) and phonology is all about 'flat' strings is incorrect. Once we acknowledge that both syntax and phonology are *head-driven*, the question arises whether headedness is a 'label' of nodes in a constituent structure or is 'directly' expressed as head-dependency relations between atomic units (words, phonological segments) in a constituent-free representation. While, with appropriate arguments, answers to this question could differ for syntax and phonology, the fundamental analogy that both modules involve hierarchical, head-driven structures remains. While the crucial difference between Dependency Grammar approaches to syntax and phonology and constituent-based approaches is the rejection in the former of constituent structure, some dependency grammarians have wondered whether the more recent generative view of

constituent structure approximates the essence of Dependency Grammar approaches; see Carnie (2008) and Osborne, Putnam and Groß (2011).

Perhaps, in some varieties of Dependency Phonology (as well as Government Phonology) and generative syntax, the 'distance' between these two approaches has become very small, albeit not insignificant. Perhaps one can imagine a model in which both constituency and headedness are co-present in different simultaneous planes in both syntax and phonology.

What are the implications of this view for claims that syntactic representations are hierarchical, due to merge, and phonological representations are flat due to concatenate (here using the terminology from Samuels 2009)? I would like to see this difference in relative terms. I would say that syntax is *more* hierarchical (in terms of its dependency graphs) because it must interface with semantic/conceptual structure which I assume is deeply hierarchical (including recursive). In other words, syntax must do the best it can to be faithful to semantic/conceptual structure. Syntax caters to semantics. On the other hand, phonology must cater to phonetic structure which is inherently pretty flat and thus does not require much if any appeal to hierarchy, let alone recursion (perhaps just a little bit). I do not rely on a difference between merge and concatenate, which I regard as epiphenomenal, i.e. as the impression that we get from the fact that syntax is more hierarchical than phonology.

I conclude with another often-mentioned difference between syntax and phonology. Syntax has movement and phonology does not. To say that this difference is a logical consequence syntax being based on merge (which phonology is not) is clever (even though it uses a special kind of merge). 'Movement' is a kind of metaphor and so is 'external merge'. What these metaphors (or formal mechanisms) capture are non-local relations. Here my mind goes in the same direction as before. Because syntax wants to be faithful to conceptual structure (which I here assume crucially includes the coding of informational structure), it can generate structures (although it does not have to) in which elements, like WH-phrases, are 'out of place'. (Instead some languages make such phrases more prominent in situ.) Phonology does not have to do that, which is not to say that non-local relations are absent; they are just more modest (as in vowel harmony). As mentioned earlier, search-and-copy in syntax and phonology are a way to capture certain formal similarity between both domains.

7 Epilogue: Is phonology even necessary?

In this section I will address the claim that emerging sign languages have been claimed to do not need to have 'a phonology', which would seriously undermine the notion of structural analogy! Here I am ignoring, and in fact rejecting, the idea that phonology is an (evolutionary) afterthought (see Fitch 2018) and thus as such not an essential part of human language (which it isn't if language if taken to primarily be a system for organizing thought, as is the premise of the Minimalist Program). I assume that both phonology and syntax constitute the form of language, being together necessary for the externalization of conceptual structure.

Sandler et al. (2011) analyze the signs in the emerging language called Al Sayyid Bedouin Sign Language (ABSL), finding no evidence for a compositional phonology in

terms of distinctive features. The phonetic form of the signs is highly variable, subject to interpersonal and cross-personal variation, and being highly iconic. They suggest that the phonetic form of signs has not (yet) been subjected to a phonological analysis (by the signers) in terms of representations that use contrastive features, as has long been proposed for 'mature' sign languages (see Sandler to appear; Brentari 2007; van der Hulst 1993). What I will question here is the claim that the emerging language ABSL does not have a 'phonology', even though signs correlate with holistic, iconic representations in the minds of the signers.

In van der Hulst (in prep b) I make a case for recognizing that the task of phonology is not limited to accounting for a compositional structure in terms of distinctive features/structures. We also have to explain how signers (or humans in general) are able to map a conceptual structure iconically onto a perceptible form. This mapping falls within the domain of phonology. I therefore propose that we have to broaden our idea of what phonological theories are about. Let us say that a complete theory of phonology comprises these two submodules:

(20) a. *Symbolic phonology*: deals with the compositional organization of signs in terms of meaningless units.
b. *Iconic phonology*: deals with the mapping from a semantic conceptual structure to phonological form.

We should not be surprised that iconic phonology precedes symbolic phonology in the emergence of a new language, especially in the visual domain. When seeking a form to represent a concept, people naturally come up with an iconic gesture whenever possible. My point here is that phonology is about the perceptible form of mental, linguistic expressions. The bias toward symbolic, compositional phonology is the result of a long exclusive focus on spoken languages in which iconicity pays much less of a role than in sign languages, even though the role of iconicity in spoken languages has come to be recognized (see Perniss et al. 2010 and wbctp0177). The agenda for phonology is to develop theories about iconic mapping, based on early and important contributions (see van der Hulst and van der Kooij 2022).

For the purpose of this chapter it is important to note that a distinction between symbolic and iconic factors is also relevant in syntax given that it has long been shown that iconic factors play a role in this domain; see Haiman (1985).

8 Conclusions

In this chapter I have discussed potential analogies between syntax and phonology, with arguments pro and con specific ideas about such analogies, focusing first on the derivational aspects. We have seen that in generative grammar, after an early analogy between phonology and syntax in terms of different levels that are connected by structure-changing 'transformations', syntactic theories and phonological theories developed in very different directions, with different views on the nature and even the need for multi-step derivations. However, even if we put the matter of derivations aside, there is no denying that both phonology and syntax share design features in the sense of both appealing to a distinction between basic units and combinatorial rules, which they

share with many other complex systems. We then focused on representational issues. Here, while early analogies were seen, the SPE theory postulated that whereas syntax is constituency-based, phonology is string-based. Soon, however, the view took hold that there is a suprasegmental phonological constituent structure, albeit one that is formally very different from syntactic constituency. A more recent view has turned the clock back, claiming that syntax and phonology are representationally more fundamentally different, namely constituent-based and 'flat', respectively.

Following the work of John Anderson, I focused on the so-called Structural Analogy Assumption (a thesis that goes back to Louis Hjelmslev's glossematics model) which holds that analogies between syntax and phonology are to be expected. I have suggested that a pivotal notion in seeing analogies lies in recognizing that in both domains headedness (or head-dependency *relations*) is a central organizational notion. I discussed the fact that, within the Generative Grammar field, headedness has been presented as a property of constituents in both syntactic and phonological theories. However, within the field of Dependency Grammar it has been used as a direct tool to analyze linguistic expressions in terms of head-dependency relations which replace an appeal to constituent structure.

Various early and later views on analogies, or the lack thereof, between syntax and phonology have been discussed, both with reference to derivational and representational aspects of these grammatical modules. Even though, as I have emphasized, an appeal to headedness unifies syntax and phonology, in the current landscape of Generative Grammar we encounter two popular assertions that syntax and phonology are fundamentally different. The first assertion is that while syntax is constituency-based, phonology is 'flat'. This 'structures vs. strings' view holds that linearity is not even a property of syntactic representations, while it is an exclusive property of phonological representations. However, as we have seen, a flat phonology must appeal to dependency relations to account for the coherence and grammaticality of its linear strings, while the constituency of syntax, when augmented with headedness, could omit constituency (as is proposed in Dependency Grammar models). If this is the right way of looking at things, the core of the structural analogy assumption is the fact that both syntactic and phonological structure appeal to head/dependency representations which can be represented in terms of hierarchical dependency graphs (or in terms of constituency that is augmented with head labelling). Whether or not the resulting structures are taken to represent linearity is an independent issue, especially given that linearity can be (partly) predicted from dependency graphs.

We also focused on a second popular assertion, which is that syntax and phonology differ fundamentally in that syntactic structure is recursive while phonological structure is not, either by stipulation or because if it is 'flat' then recursion is claimed to be impossible. However, I have suggested that if representations in both domains are organized in terms of head-dependency relations, which is an almost universally accepted view, recursion is formally possible in both domains. Independent facts ('third factors') can explain why recursion is less pervasive in phonology than in syntax.

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