



Why phonology is flat: the role of concatenation and linearity



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ABSTRACT

This article is about the relationship between Dependency Phonology and Government Phonology in general, and the more specific question how exactly a dependency relation may incarnate. The latter issue is raised by the genuine contribution of Government Phonology to phonological theory, i.e. lateral relations among syllabic constituents. Government and licensing describe a dependency relationship between a head and a dependent, but are non-arboreal. Their application therefore mechanically leads to the elimination of trees (deforestation).

Arboreal syllable structure, however, is the spine of Structural Analogy, since it parallels syntactic arboreal structure. The question is thus whether arboreal and lateral descriptions of syllable structure are just notational variants (in which case Structural Analogy with syntactic trees can be maintained), or whether they are really different. It is shown that the latter is the case, and that the different expression of dependency relations in syntax and phonology is due to two things: a design property of syntax, concatenation (which is absent from phonology), and an input condition to phonological computation, linearity (which is absent from syntax). Hierarchical structure is thus implemented in module-specific ways: concatenation in syntax (the minimalist device Merge) produces trees (while invalidating the lateral option). It is therefore argued that the arboreal means of expressing dependency relations is the result of concatenation, and of nothing else: no concatenation, no trees. It thus follows from the fact that phonology does not concatenate anything that there cannot be any tree-building device in this module. An appreciable side-effect of this perspective is an explanation of a long-standing observation, i.e. the absence of recursion in phonology: no trees, no recursion. On the other hand, linearity in phonology produces lateral relations (and makes trees unworkable).

A related issue discussed is what kinds of third factor explanation are desirable, given that everybody is after “more general, language-unspecific” motivations for the workings of grammar: Chomskian minimalism/biolinguistics as much as anti-chomskian “Cognitive” Grammar and the work by John Anderson. Candidates are global notions such as cognitive salience on the one hand, or more concrete things such as linearity and concatenation on the other. It appears that the current striving for the former is an attempt at turning back the clocks: the evolution of Cognitive Science since Franz-Joseph Gall’s 19th century phrenology was in the opposite direction.

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1. Introduction

Jacques Durand was a prominent figure among those who in the 1970s and 1980s developed the theory of Dependency Phonology (DP) in Edinburgh and (Northern) England. As far as I can see, he has written the first textbook in phonology in the autosegmental era, Durand (1990), i.e. after Kenstowicz and Kisseberth’s (1977, 1979) double strike of the late 1970s. While

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this textbook introduces to the autosegmental idea emerging from SPE, it also conveys the central tenets of Dependency Phonology. Prominent among these is Structural Analogy (SA): “[t]he idea is that we should expect the same structural properties to recur at different levels and that very strong support is required to motivate properties which are unique to a given level” (Durand, 1990, p. 281). In their synoptic introduction to a volume on Dependency Phonology, Anderson and Durand (1987, p. 9) say that “plane-specific structural properties require independent justification: phonological representations which invoke structural properties not replicated in the syntax are suspect” (modules are called planes in Dependency Phonology, on which more below).

This article is about the relationship between Dependency Phonology and Government Phonology (GP) in general, and the more specific question how exactly a dependency relation may incarnate. The latter issue is raised by the genuine contribution of Government Phonology to phonological theory, i.e. lateral relations among syllabic constituents. Government and licensing describe a dependency relationship between a head and a dependent, but are non-arboreal. We know from Dependency Phonology itself that trees are not the only means of expressing a dependency relation: infrasegmental representations encode manner in terms of a “C over V” relationship, which is non-arboreal.

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. With the intermediate step known as Standard Government Phonology that implements a hybrid lateral-arboreal model (which for that reason is not viable, Scheer, 2004, §165), CVCV (or strict CV), which was introduced by Lowenstamm (1996), has gone all the way down: syllable structure is the result of lateral relations, and of nothing else (deforestation, see Scheer, 2011, §42, 2012a, §9).

Arboreal syllable structure, however, is the spine of Structural Analogy, since it parallels syntactic arboreal structure. The question is thus whether arboreal and lateral descriptions of syllable structure are just notational variants (in which case Structural Analogy with syntactic trees can be maintained), or whether they are really different. I show that the latter is the case, and that the different expression of dependency relations in syntax and phonology is due to two things: a design property of syntax, concatenation¹ (which is absent from phonology), and an input condition to phonological computation, linearity (which is absent from syntax). This, in turn, licenses module-specific ways of implementing hierarchical structure. Anderson (1992, p. 2, 2011, vol. 3, p. 237, this volume) indeed identifies two sources for legitimate dissimilarities among modules (which he calls planes): different alphabets (domain specificity in Cognitive Science) on the one hand, and the (feeding) relationship between modules on the other. Arguably, concatenation and linearity are the result of the interpretative function that phonology has with respect to morpho-syntax.

I also argue that the arboreal means of expressing dependency relations is the result of concatenation, and of nothing else: no concatenation, no trees. In current minimalist syntax, Merge pieces items together, and the result of this process is a hierarchical arboreal structure. If trees are a consequence of concatenation (and of nothing else), and if phonology does not concatenate anything, it follows that there cannot be any tree-building device in this module. An appreciable side-effect of this perspective is that the absence of recursion in phonology, a long-standing observation, follows: no trees, no recursion. By contrast, if phonological computation includes a tree-building device, it overgenerates: recursion is then predicted to exist also in phonology (Neeleman and van de Koot, 2006).

Finally it is discussed what kind of third factor explanations are desirable, given that everybody is after “more general, language-unspecific” motivations for the workings of grammar: Chomskian minimalism/biolinguistics as much as anti-chomskian “Cognitive” Grammar and Anderson (2006, 2011, this volume).² Candidates are global notions such as cognitive salience, or more concrete things such as linearity and concatenation. It seems like the current strive for the former is an attempt of turning back the clocks: the evolution of Cognitive Science since Franz-Joseph Gall’s 19th century phrenology was in the opposite direction.

2. Structural Analogy and trees

2.1. Structural Analogy in DP and beyond

Dependency Phonology, as indicated by its name, has started out as a theory of phonology. Syntax is absent from the first survey of the framework edited by Anderson and Ewen (1980), where the former author only begins to explore morphology in a chapter called “Towards dependency morphology”. Understandably enough, then, there was no Structural Analogy either.

¹ As will be made explicit as we go along, concatenation in this article refers to the establishment of a hierarchical relationship between two items, but does not imply any linear order thereof. These are the workings of the operation Merge as used in current minimalist syntax. In this view, linearity is achieved by an independent post-syntactic process of linearisation, which is located at PF, but occurs before phonological computation (Section 5.1 expands on this architecture).

² I use quotation marks in order to refer to the framework that was founded by Langacker (1987) because the label chosen suggests that this theory has a copyright on cognitive aspects of grammar, and that anything which is non-Langackerian must be non-cognitive. This attempt to appropriate the word “cognitive” (which has a sizeable commercial value these days for real-world issues such as fundraising, etc.), is especially directed against Chomskian linguistics, which is argued to be not really cognitive (sic). This is made explicit e.g. by Taylor (2002): in a chapter called “Chomskyan linguistics as ‘cognitive linguistics’”, he writes that “there have been important approaches within linguistics which have denied, or simply ignored, the discipline’s cognitive dimension. Among these we can identify the formalist and the behaviourist approaches” (p. 5), and on p. 8: “one might well ask in what sense such an enterprise [Chomskyan linguistics] might legitimately be described as cognitive. [...] Chomskyan linguistics [...] has been driven by its own internal logic, not by any considerations deriving from independently established facts about human cognition”. See Laks (this volume) for more detail.

Its embryo, however, was introduced in Anderson (1980, p. 165) as the “natural recurrence assumption”, which holds that structure recurs within phonology, and across phonology and phonetics: “(a) phonological groupings (paradigmatic and syntagmatic) are not random; certain groupings recur; (b) phonological groupings and the relationships between them have a phonetic basis; they are natural.” Anderson and Durand (1986, p. 7) then conflate these two provisos into what they call Natural Appropriateness: “[a] phonological notation is such as to optimise the expression of phonological groupings and relationships which are natural and recurrent.”

Structural Analogy as such first appears in Anderson (1985) (of which Anderson (1987a) is a revised version), and is referred to as a “‘hyperphonological’ aspect of DP” in Anderson and Durand (1986, p. 2), a label that identifies the phonological roots of DP. In a host of subsequent publications by John Anderson, Jacques Durand and other representatives of Dependency Phonology, it has become a trademark of Dependency Phonology and offsprings thereof such as Radical CV Phonology and Head-Driven Phonology, which are promoted by Harry van der Hulst and Nancy Ritter.

Relevant work includes Anderson (1986, 1987a, 2006), Durand (1995, pp. 282ff), Anderson and Durand (1986, 1987), Anderson and Ewen (1987, pp. 283ff), Hulst (2000, 2005, 2006), Hulst and Ritter (1999, 2003), and Carr (2005). Bauer (1994) proposes a critical assessment of Structural Analogy (SA), and Hulst (2006) as well as Carr (2006) offer an overview of the history of syntax-phonology parallelisms that have been argued for in generative grammar.

Finally, Anderson (1992, 2011, vol. 3) has published two book-length syntheses in 1992 and 2011, which offer a useful summary of cases for analogies between phonology, morpho-syntax and semantics that have been made. Finally, in the last chapter of his aforementioned textbook, Durand (1990, pp. 276ff) provides a concise introduction to Dependency Phonology that includes SA and relevant illustrations. As far as I can see, this is to day the only chapter-length and pedagogically written introduction to DP (a section of Hulst (1995), p. 80 also introduces to DP), which reads as well in 2012 than it did 20 years ago.

Structural analogies have been argued for properties from different modules, claiming that they have the same essence. Such pairs include case relations (theta roles) and phonemic systems, which Anderson (1986, p. 86, 1992, pp. 58ff) holds to be expressions of contrast. Also, adjuncts in syntax (circumstantials in DP vocabulary) are argued to instantiate the same “stray argument” structure as extrametrical consonants in phonology (Anderson, 1986, p. 88, 1992, pp. 66ff, 2011, p. 261, this volume). Finally, cyclic derivation and namely the lexical vs. post-lexical distinction familiar from phonology are also found to be active in syntax (Anderson, 1986, pp. 113, 1992, pp. 99ff, 2011, pp. 23ff).

This catalogue is merely designed to give a flavour of the kind of things that are actually matched under SA. More, and more detail, may be found in the literature quoted, and in a survey offered by Durand (1995, pp. 282ff) which also looks beyond DP. Below I concentrate on the one analogy that is of interest for the present article, trees, and which is also central in the DP edifice. Before doing so, however, it needs to be mentioned that if DP certainly gets the credits for having brought the SA issue to the forefront of the agenda, arguments based on cross-modular similarities have also been made elsewhere.

Most prominent in this context is Government Phonology, whose ambition in 1990 is to build a “syntax of phonological expressions” (more on this in Section 4). In explicit reference to the syntactic theory of the time, GB, Government Phonology has implemented proper government (which as in syntax controls the existence of empty positions), an Empty Category Principle (ECP), a Projection Principle (that guarantees Structure Preservation, i.e. bans resyllabification), a Minimality Condition, islands (government cannot cross government domains) (all in Kaye et al. (1990)) and c-command (Lowenstamm, 1989; Charette, 1991).

More recently, Jonathan Kaye, Markus Pöchtrager and others (so-called GP 2.0, or Big Tree Phonology) work on representing infrasegmental structure with syntax-inspired trees and mechanisms (such as c-command, Pöchtrager, 2006; Živanović and Pöchtrager, 2010). Above the skeleton, Relativized Minimality (Rizzi, 1990) is argued to have a parallel in phonology that, in CVCV, rules out the only non-local governing relation where government applies over entire branching onsets that enclose an empty nucleus: no lateral relation can relate two constituents with the same kind of constituent intervening (Scheer, 2000; Brun-Trigaud and Scheer, 2010). Also, with respect to more recent syntactic theory, Scheer (2008a, 2011, §765) shows that the phase edge (Chomsky, 2000, p. 108) was anticipated in Kaye’s (1995) work on phonological domain structure: spell out your sister! (rather than your mother) when you are spelt out. Finally, it is worthwhile mentioning so-called intermodular argumentation, i.e. where a property of one module referees competing theories in another module. For example, Scheer (2009, 2011, §769) argues that since derivation by phase is based on selective spell-out (not all heads are phase heads), the phase impenetrability condition (PIC) and the phase edge, phonological effects of cyclic spell-out must also feature these devices. That is, phonological theories that require all nodes to be spelt out, where no-look-back devices (such as the PCI) play no role, or which do not spell out the sister of the phase head, do not qualify (see also Scheer, 2010a).

Finally, there is of course work outside of DP and GP that emphasizes parallels between syntax and phonology: Riemsdijk (1982) (locality), Levin (1985) (application of X-bar to syllable structure) and Michaels (1991) (movement) are cases in point. Specifically about the parallel between sentence and syllable structure are Pierrehumbert (1990) and Carstairs-McCarthy (1999).

2.2. Unlabelled dependency trees organize syntactic and phonological structure above the skeleton

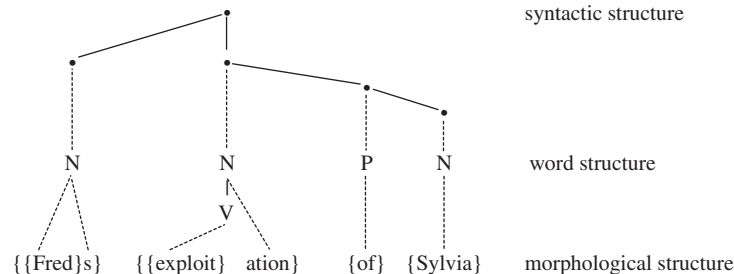
Structural Analogy at first really only concerned structure (as opposed to computation), and the comparison between syntax and phonology (semantics entered the scene only in Anderson (1986)). That is, the spine of Structural Analogy, chronologically speaking but also otherwise, is arguably the comparison of syntactic and phonological trees. Anderson and Durand (1986, p. 2) define dependency as a non-symmetrical relation between a head and a modifier (also Anderson, 1987a, p. 15,

1992, pp. 15ff, 2011, vol. 3, pp. 52ff; Hulst and Ritter, 1999, p. 115). Heads are prominent in various ways (semantically, perceptually). In addition, in syntax they are obligatory and “atomic”, i.e. non-phrasal. Anderson (1987a, p. 16) illustrates the former property with the sentence *[[very scruffy]₁ gatecrashers]₂ will [come [to their parties]]₃* where every bracket-delineated chunk has an obligatory (head) and an optional (modifier) element. Hence *scruffy* is the head of domain 1, *gatecrashers* of domain 2 and *come* of domain 3, while *very*, *very scruffy* and *to their parties* are the corresponding modifiers.

In syntax, all this is represented by so-called unlabelled dependency trees (Anderson, 1987a, pp. 18ff, 1992, pp. 17ff), of which one is reproduced under (1) below (from Anderson (1987a, p. 20)). Anderson and Durand (1986, p. 15) explain the unlabelled character of dependency trees, a major contrast with respect to regular generative syntax (and also to the Prosodic Hierarchy, on which more below): “[t]he identity of the head and thus the construction follows from its placement in the hierarchy; therefore NO LABELLING IS NECESSARY” (emphasis in original).

Note that solid lines (called *arcs*) describe a (hierarchical) dependency relation between so-called *vertices* (i.e. the solid dots, where the head is placed higher than the modifier), while dotted lines signal a simple (non-hierarchical, i.e. symmetric) association. Heads are said to *govern* modifiers if both items are related by only one arc (e.g. *exploitation* governs *Fred’s*), while *subordination* is a special kind of (long distance) dependency where the subordinated item is removed from its subordinator by more than one arc (e.g. *Sylvia* is subordinated to *exploitation*).

(1) unlabelled dependency tree in syntax

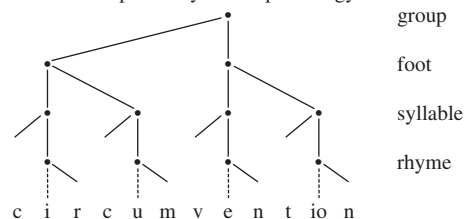


The diagram also shows the difference between two types of dependency, adjunction and subjunction (e.g. Anderson, 1987a, pp. 18f, 2011, vol. 3, pp. 13f). Graphically, the former is represented by sloping (solid) lines and introduces a new terminal element, while the latter identifies as vertical (solid) lines and does not introduce additional lexical material. Also, adjunction describes a relationship of linear precedence, while the items related by a subjunction do not follow each other. This is a take-home information for the discussion below: linear order of words is present in syntax, and encoded by dependency trees. Anderson is explicit on this: “[s]yntax also involves linearisation, which is a grammaticalization of our perception of time” (2011, vol. 3, p. 2), “[l]inearity is a grammaticalization of our perception of time” (this volume).

Word structure is made of subordination (e.g. the N–V relationship describing the category modification of the root *exploit*), which however also occurs in syntax and phonology. An important difference between these and word structure is that the latter is labelled. Word structure, in turn, is distinct from morphological structure which identifies morphological units (roots, affixes, etc.).

Phonological structure above the skeleton, i.e. syllables and feet, displays the same properties known from syntax in two respects: modification and obligatoriness. That is, an obligatory head is modified by an optional element. The head of the syllable and the rhyme is the nucleus, while the head of the foot is the stressed syllable: “no nucleus, no syllable/rhyme; no ictus, no foot” (Anderson and Durand, 1987, p. 8). While nuclei and rhymes are obligatory within a syllable, and stressed syllables within a foot, onsets and codas as well as unstressed syllables may or may not be present without this endangering the existence of the syllable or the foot. Based on these analogies, Anderson (1987a, pp. 22ff, 1992, pp. 31ff) argues that phonological structure above the skeleton is organized in the same unlabelled dependency trees as syntactic structure (see also Anderson and Ewen, 1987, pp. 96ff or other DP writings of that period). Table (2) below reproduces the relevant representation of the word *circumvention* (from Anderson, 1987a, p. 23).

(2) unlabelled dependency tree in phonology



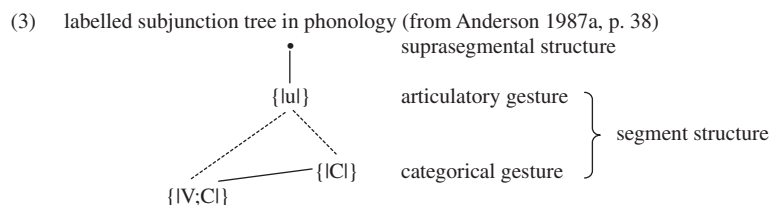
Since dependency trees are unlabelled and reproduce the same structure as high up as necessary, Anderson (1987a, p. 23) rejects the Prosodic Hierarchy altogether: “prosodic categories such as those envisaged by Selkirk (1980, 1981) are thus unnecessary.”

In sum, there are two similarities that give reason for the recognition of identical arboreal structure in syntax and phonology: (1) some elements are obligatory, others are optional, (2) the obligatory ones are more prominent. While headhood in phonology is reflected by perceptual salience (Anderson and Ewen, 1987, pp. 126ff; Anderson, 1992, pp. 40f, 52, 2006, p. 616, this volume), heads are semantically prominent in syntax (Anderson, 2006, p. 616, this volume). Within the foot, stress of course confers perceptual prominence. Within the syllable, sonority alone defines perceptual prominence, and hence headhood: obligatory elements are more sonorous than optional items (nuclei are more sonorous than codas and onsets).

In cases where obligatoriness plays no role because no item is more or less obligatory than others, it is also sonority that determines headhood: in the word *blend*, l is the head of b (while bl modifies e), and n is the head of d (while nd modifies e as well). Note, however, that the traditional constituents (branching) onset and (branching) coda have no status (Anderson, 1987a, p. 30).

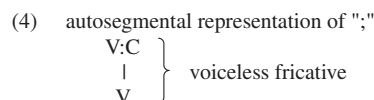
2.3. Subjunction trees organize word structure and phonological structure below the skeleton

Regarding the infrasegmental area, Anderson (1987a, pp. 37ff) contends that it is parallel to word structure under (1), i.e. made of labelled subjunction. Classical Dependency Phonology distinguishes between two distinct types of infrasegmental structure that use different alphabets: manner is defined by hierarchically organized combinations of the extremes of the sonority hierarchy, C and V, while place is made of unary melodic primes [i], [a], [u] that are called components (and were introduced by Anderson and Jones (1974)).³ The labelled subjunction tree for the complex segment ^mb appears under (3) below.



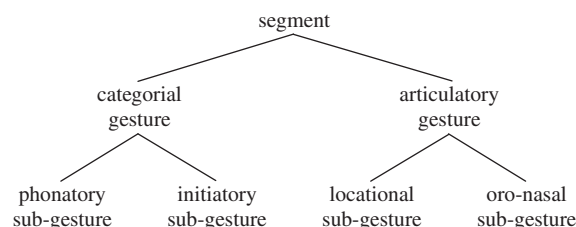
Nasality is represented as [IV;C]: “;” notes a dependency relation whereby the item to its left heads (or governs) and is modified by the item to its right. Nasals thus identify as “V over C”. Finally, [C] in the diagram under (3) represents the manner of articulation of the plosive part of the prenasalized ^mb. Finally, both components of the complex segment are labial, hence both are associated to [u].

Aside from “;”, the symbol “:” represents a situation of mutual dependence: in [IV:C] (voiceless fricatives) for example, [V] and [C] mutually govern each other. The “:” relationship is also sometimes represented graphically by an autosegmental type of diagram as under (4) below, where the head of the structure, the complex V:C, dominates a modifier, V. The modification by V turns voiceless (V:C) into voiced fricatives. The structure under (4) is thus a notational variant of [IV:C];[V] (Anderson, 1987a, pp. 34f, 1992, pp. 44f, this volume).



Finally, DP also uses regular feature geometric trees for representing another aspect of infrasegmental structure. These trees are not made of vertices, solid and dotted lines, but as far as I can see they also represent a dependency relation. That is, they group melodic primes that are of the same kind, i.e. share a property (either articulatory or as members of a natural class). In DP, the groupings of melodic units are called gestures: the abovementioned components ([i] etc.) belong to the articulatory gesture, while C/V-based structures constitute the categorial gesture. Anderson and Ewen (1987) propose the following structure.

- (5) infrasegmental structure: gestures are organized in regular feature-geometric trees
Anderson and Ewen (1987, p. 149)



³ In a later development, Radical CV Phonology (Hulst, 1995 and following), the C/V alphabet was extended to also describe place of articulation (and in fact all mother melodic properties).

There are different groupings and labels of gestures and sub-gestures in further evolution (e.g. in Radical CV Phonology, see Hulst, 1994, 1995). But as far as I can see, the notion of gestures, as well as the hierarchical organisation thereof in terms of regular feature geometric trees, is an essential of DP that has not varied over time.

2.4. Three distinct means of expressing dependency

There are thus three distinct means of representing a dependency relation: (1) by solid lines in a (labelled subjunction or unlabelled dependency) tree, (2) by two typewriting symbols, “;” and “:”, and (3) by regular feature-geometric trees that group melodic primes into gestures. The two former may co-occur in the same representation, as under (3), and one senses that this “recursion” is the reason why two distinct representations of dependency are necessary (I could not find any explicit statement regarding this issue): it would be hard, probably impossible, to use the tree diagram for representing all dependencies under (3), and of course trees as such cannot be abandoned since this is what the whole analogy between syntax and phonology above the skeleton is about. Gesture-grouping trees as under (5) come on top of that.

A relevant question of course is whether the graphic impossibility to represent all dependency relations under (3) by trees is significant theoretically, or whether it is just a graphic artefact. That is, are there two distinct dependency relations, with distinct formal properties, or are there merely two ways of graphically notating a unique dependency relation? This question then needs to be extended to gesture-grouping trees. Again, I could not find any discussion of the issue, which is quite fundamental though, in the literature. But there is clear indication that we are facing (at least) two concepts which are really formally distinct: the typewriting kind of dependency allows for mutual dependency, which however is unheard of in the DP-characterization of syntactic relations, or in gesture-grouping trees. There would probably be a way to graphically represent “:” in a dependency tree diagram (by a solid horizontal line that connects two items), but this does not seem to be warranted by DP practice.

The take-home information for the discussion below is that trees are not the only way to represent a dependency relation, and there are two distinct kinds of trees. Also, the only similarity that the alleged analogy between word structure and infra-segmental phonology is based on appears to be the fact that both arboreal structures need labels (while phonological structure above the word and syntactic structure does not). This is of course aside of the fact that more generally all structure reviewed is asymmetric, i.e. may be organized into heads and modifiers. Finally, note that the third criterion for headhood in syntax, atomicity (heads are non-phrasal, Anderson, 1992, pp. 15ff), does not seem to have any analogue in phonology.

2.5. Linear order expelled from the lexicon

Up to this point, the classical incarnation of DP was described. In more recent writings, Anderson (2011, vol. 3, pp. 88ff) has changed his mind regarding a fundamental property of speech, linearity, which is also a critical notion for the present article. The modification of the status of linearity then issues multiple shock waves through the entire DP model.

The evolution originates in a paper entitled “the limits of linearity” (Anderson (1987b) (subsequently, see also Anderson, 1994; Anderson et al., 1985, pp. 213f; Sauzet, 1996), and is called *total non-sequencing* in Anderson (2011, vol. 3, p. 82). The idea is that the linear order within the syllable is never (or almost never) contrastive: within the onset and the rhyme, linear precedence is predictable from the relative sonority of segments (i.e. the Jesperssonian bell-curve whereby sonority decreases from the syllable centre to the margins). In other words, it is enough to know whether a segment belongs to an onset or a rhyme, sonority will do the rest of the linearizing job. And to the extent that this is true empirically, the general rule applies according to which the lexicon only contains unpredictable information.

Therefore linearity is absent from the lexicon. Anderson (2011, vol. 3, pp. 79ff) provides illustration for the English word *clump*, whose lexical representation is $(k,l(p,m,a))$. Segments are affiliated to either the onset or the rhyme. These groupings are called “bundles” and “sub-bundles”, and one senses that their linear order needs to be specified because of languages such as Czech where liquids may also be the syllable nucleus: if in $(k,l(p,m,a))$ the rhyme bundle is identified by the presence of the vowel *a* (and delineated by brackets), the bundles of the Czech word *vlk* “wolf” identify as (v) and (l,k) , but nothing indicates whether the result is the actual *vlk*, or rather *klv*. Anderson (this volume) introduces the idea that within bundles embedding decides which sub-bundle is linearized first: linearisation proceeds from the most embedded sub-bundle outwards. This, however, still does not determine the linear order of sub-bundles. Be that as it may, once we know that (p,m,k) is the rhyme and (k,l) the onset, and also that onsets always precede rhymes, relative sonority only allows us to construct one single linear order, *clump*.

Another question is raised by languages where the linear order of consonants is contrastive, at the left margin of the word for example. Czech, again, offers minimal pairs such as *klát* “to cut wood” vs. *lkát* “to whine, to moan”. Obviously, the initial cluster cannot be an onset in both words under total non-sequencing, since otherwise *lkát* would never be able to be derived. Therefore, one senses that the cluster will be declared an onset in *klát*, i.e. $l,k(\acute{a},t)$, while the *l* will be said to lie outside of the onset, either as an extrasyllabic item, or as a separate syllable (i.e. $[(l)]_{\sigma} [k(\acute{a}t)]_{\sigma}$).

In any event, it is not the case that total non-sequencing leaves the lexicon without linear structure: syllables and bundles are linearized as before – the only labour that is now done during phonological computation is the establishment of linear order *within bundles*. And there is another critical aspect of total non-sequencing, of which I could not find any discussion in the literature: it is not the case that the removal of linear order from the lexical representation of bundles is for free. Rather, the system is based on a trade-off between the lexical encoding of two distinct types of information: linearity in the classical

system, bundle-affiliation of segments under total non-sequencing. What in regular syllabification is done by phonological computation, i.e. the decision whether C_1 in VC_1C_2V belongs to the previous or the following vowel, is lexically encoded under total non-sequencing (otherwise *Petra* would come out as *Perta*). This means that the linear information of the speech signal is transformed into bundle-affiliation information upon lexicalisation, i.e. when infants or adults store newly acquired morphemes in long-term memory. By contrast, the labour that is done by computation under total non-sequencing, linearization, is encoded lexically under classical syllabification.

All in all, then, the appeal of total non-sequencing is not really clear: on the one hand most of classical linear structure is still present in the lexicon, since the linearity of bundles and syllables still needs to be lexical. On the other hand, the linearity of bundle-internal items, whose elimination from the lexicon is the whole point of total non-sequencing, is in fact encoded lexically, albeit in a non-lexical guise (by bundle-affiliation). The overall process, then, does the labour twice, and needs a syllabification algorithm anyway: an infant or an adult who lexicalizes a morpheme must first apply some syllabification algorithm in order to find out to which bundle (onset or rhyme) consonants such as C_1 in VC_1C_2V belong (see Section 4.6 on the same issue in GP). They then need to store this bundle-affiliation in their lexicon, but only in order to have it reverted into linear order when the morpheme is retrieved from storage and subject to phonological computation.

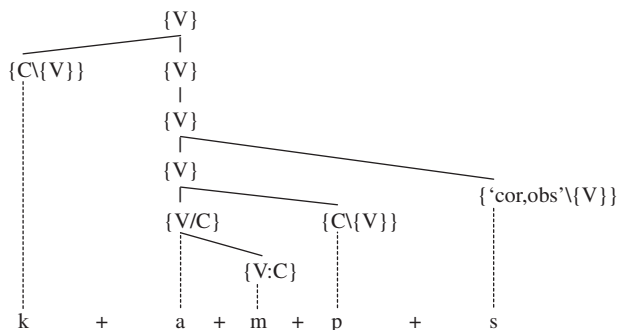
It is hard to see what the import of this additional machinery is, given that it is redundant: we know for sure that speakers apply a syllabification algorithm anyway.

2.6. The absence of linear order in the lexicon requires a kind of phonological Merge

The absence of linear order in the lexical representation of bundles has three important consequences for the dependency model. Two lie at the heart of the argument to be made below.

If linear order is absent from the lexical representation of bundles, it must be somehow established during phonological computation. Anderson (2011, vol. 3, pp. 84ff, this volume) therefore devises a scenario where syllable structure is progressively erected over non-linearized lexical strings. That is, a Merge-like mechanism concatenates lexically unordered pieces according to relative sonority, which determines dependency relations. Unlike in the classical dependency literature, this process projects labels, and the result is a labelled (rather than an unlabelled) dependency tree. Table (6) below shows the representation of the English word *camps* (pl.).

(6) Anderson (2011, vol.3, p. 94): labelled dependency tree for syllable structure, Engl. *camps* (pl.)



Note that the “+” symbol on the base line, absent from previous unlabelled syllabic trees, denotes the fact that segments have been concatenated. There are thus three important innovations: (1) the delinearization of the lexicon (or bundles) and its consequence, (2) a phonological Merge operation, as well as (3) the labelling of syllabic dependency trees. As far as I can see, Anderson (2011) does not motivate this move on the backdrop of the familiar Dependency Phonology model, or provide historical discussion.

While the presence or absence of labels will play no role below, the other two innovations are central for the argument. What we should take stock of here are two things. First, the existence of trees presupposes linear order, i.e. concatenation: Anderson (this volume) argues that intrinsic properties of phonology dictate that linearisation precede the establishment of hierarchical structure in this module (unlike in syntax, where the order is the other way round). Second, the existence of concatenation in phonology, in Anderson’s revised model, is due to the absence of linear order from the lexicon. No absence of linearity in lexical entries, no concatenation.

3. Structural Analogy as a heuristic tool for the discovery of linguistic structure

3.1. Planes (modules) and levels

Since its inception, John Anderson has always considered Structural Analogy a heuristic tool for the discovery of linguistic structure, rather than a principle that needs to be strictly enforced, i.e. where any dissimilarity between modules is failed. It

was already mentioned that what is known as a module in cognitive science (e.g. Stillings et al., 1995, pp. 16ff) in general, and in generative grammar in particular (the inverted T model, see Scheer, 2011, §§628, 634 for the use of the word in GB), is called a plane in the dependency literature. The dependency notion of planes follows the basic definition of modules in cognitive science: a module is a specific ontological space where computation transforms items that belong to a specific alphabet (or vocabulary: so-called domain specificity, e.g. Fodor, 2000, pp. 58ff; Gerrans, 2002, p. 261) into an output structure (e.g. Anderson, 1987a, p. 15, 1992, p. 1, 2006, pp. 603ff, 2011, vol. 3, pp. 5ff, 37, this volume).

Another relevant notion in the dependency literature is the level or, in Anderson's more recent writings, the sub-module. In short, levels are sub-units of a plane where a shared alphabet (of which pieces may be missing at some levels, though) is combined according to different principles (Anderson and Durand, 1986, p. 4). That is, a plane “constitutes a particular kind of difference in level: a plane is a (set of) level(s) constructed out of a distinctive kind of alphabet of categories; distinctiveness of alphabet necessitates a difference in level” Anderson (2006, p. 604). Anderson (1987a, p. 15) for example says that phonology and phonetics are different levels (but occur in the same plane) because they involve “distinct constraints on organization.” In Anderson (this volume), different sub-modules (levels) are concerned with the establishment of linear and hierarchical structure (whereby the former precedes the latter). This is also the case of syntax (but in the reverse order). Another example of syntax-internal levels are phrase structure rules and transformational rules, which work on the same vocabulary (Anderson, 2006, p. 604, 2011, vol. 3, pp. 36f).

The exact definition, difference and relevance of planes and levels are orthogonal to the purpose of the present article. The only thing that needs to be understood, as we will see shortly, is that both planes and levels are the units among which SA holds according to Anderson.

3.2. *Heritage: anomalist vs. analogist attitudes in linguistic thinking*

The heuristic conception of Structural Analogy as a guiding light in the exploration of unknown linguistic wilderness is expressed as follows in Anderson (1987a, p. 15): “structural properties that are claimed to be unique to either plane [morpho-syntax and phonology] require very strong support indeed in the form of a demonstration that they represent phenomena that are unique to the plane in their type.”

On the first page of the first article on Structural Analogy, Anderson (1987a, p. 15) already mentions that what he intends to do has structuralist roots: Hjelmslev (1948, §7) is quoted with what he called “l’analogue du principe structural”. Anderson (2006, pp. 602ff, 2011, vol. 3, pp. 19ff) at greater length, then place Structural Analogy in a broader landscape, beginning with Ancient Greece where two attitudes occurred: anomalists thought that language is irregular in essence, while analogists (Aristarchus is quoted) believed that regularity and homogeneity are essential to language. “There are manifest irregularities in this and other respects in any natural language. But implementation of particular ‘analogist’ assumptions, as part of general grammar, can limit the potentiality for anomaly in various ways” (Anderson, 2006, p. 602).

Both anomalist and analogist thinking in the Chomskian tradition are mentioned. Bromberger and Halle's (1989) “Why phonology is different” falls into the former, while a representative of the latter is the unification of syntax into a single computational system (instead of distinct deep and surface structure) (e.g. Emonds, 1976, implemented by current minimalism).

Anderson (2006, pp. 605f) shows, however, that the strongest heritage to defend by analogists was accumulated by structuralism. He reviews relevant work of, among others, Kenneth Pike, André Martinet, Charles Ernest Bazell and Michael Alexander Kirkwood Halliday. Anderson (2006, p. 605, 2011, vol. 3, p. 21) then quotes Hjelmslev (1953, p. 101) in order to summarize the essence of this work, isomorphism: “the two sides [the planes, translates Anderson] of language have completely analogous structure.” This is a much stronger (and non-heuristic) version of the analogist's attitude, which denies the existence of differences across modules altogether.

3.3. *Similarity and dissimilarity: how do we judge what is right?*

Anderson argues against Hjelmslev's inflexible view, which is not tenable empirically speaking. Instead, he reiterates his weaker version of the analogist attitude. The heuristic essence of Structural Analogy is also the reason, one senses, why it appears as the Structural Analogy Assumption in 1992 when Anderson gathers all previous work in a book-length exposition (while it was always referred to as Structural Analogy in earlier sources). The quote from the 1992 book below is completed with an equivalent statement from the 2011 book.

- (7) “The structural analogy assumption: 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 (1992, p. 2)

“[I]ntrinsic differences between the two modules of syntax and phonology [...] can be attributed to the differing demands and limitations of the extralinguistic domains with which they interface, and to the architectural relationships between the two planes themselves and with the lexicon.” Anderson (2011, vol. 3, p. 237)

Anderson thus contends that differences in the workings of modules may arise for two reasons, and for two reasons only. One is the nature (or indeed the size: Anderson, 2006, p. 604) of the lexical items that computation takes as arguments. Anderson (2011, vol. 3) expands on this line of thought, which indeed is the central idea of the book. Consider first that

“all aspects of linguistic structure are grounded in non-linguistic mental ‘substance’” (p. 1): “(a) the categories of phonology are phonetically grounded; (b) the categories of syntax are semantically grounded” (p. 10). The exclusively extra-grammatical origin of grammatical categories being set, it will consequently shape grammatical structure and computation in ways that are peculiar to its own properties, i.e. what Anderson (2011, vol. 3, p. 244, this volume) calls semic and phonic substance. That is, dis-analogy is the result of “demands of semanticity and restrictions by phoneticity” (Anderson, 2011, vol. 3, p. 241).

Modules “show the same structural properties, to the extent that this is permitted, in the case of syntax and phonology, by the ‘demands’ of their different alphabets, which [...] necessitate distinctive kinds of organization. [...] Alphabets incorporate expectations and restrictions from outside the linguistic system, both associated with the role of language in presenting our cognition, on the one hand, and with its perceptually accessed incarnation, on the other” Anderson (2011, vol. 3, p. 11).

“Powerful distinctive demands on the syntax are imposed by its semanticity, then; the conceptual complexities of the domain that it is interfaced with demand elaborations that are not required in the phonology” Anderson (2011, vol. 3, p. 242).

The other reason is what Anderson calls the relationship between levels. For example, one level may have an interpretative role with respect to another, and this may be the reason for dissimilarities (Anderson, 2006, p. 604).

These two criteria decide, according to Anderson, whether an alleged dissimilarity between levels is legitimate or not. I argue below that a completely flat phonology, i.e. from which trees are absent because there is no concatenation and hence no tree-building device in phonological computation, is compatible with Structural Analogy.

Before we pursue this argumentation, however, the logic of “deforestation” is introduced in the following section: lateral relations as conceived of in GP are dependency relations, but inevitably lead to the elimination of trees in phonology.

4. Lateral relations vs. trees

4.1. Structure and causality lateralized

Lateral relations are the genuine contribution of Government Phonology to phonological theory (Scheer, 2004, §166). Together with particles (Schane, 1984 and following), the melodic primes of GP, Elements (Kaye et al., 1985), are a specific incarnation of unary primes, which are due to Anderson and Jones (1974).⁴ By contrast, the idea of lateral relations is unprecedented in phonological thinking as far as I can see. On the first page of Kaye et al. (1990), the authors explain that the GP research programme seeks to build a “syntax of phonological expressions”. That is, lateral relations are introduced as an explicit analogue to syntactic mechanisms.

“What is at stake here goes well beyond a mere search for interesting or suggestive similarities. Rather, if (some of) the same principles can be shown to underlie phonological as well as syntactic organisation, the idea that such principles truly express special, idiosyncratic properties of the mind (such as the kind of asymmetries typical of natural language) will be correspondingly strengthened” Kaye et al. (1990, p. 194).

This led to a progressive lateralisation of structure and causality in syllabic matters. One step was taken in Standard GP (represented by the articles published in the special issue of Phonology (Yearbook) in 1990): some arboreal structure and causality was lateralised, but other chunks of the traditional syllabic tree were left in place (Scheer, 2004, §165).

Vowel-zero alternations and its government-based analysis provide good illustration of the hybrid character of Standard GP. The pattern that occurs in language after language is illustrated under (8) below.

(8)	zero C__C-V	vowel C__C-∅	vowel C__C-CV	gloss
Moroccan Arabic	kɪtəb-u	kətɪb-∅	kɪttɪb	write pf act 3pl, 3sg, 3sg causative
German	innør-e	inner-∅	inner-lich	inner+infl, inner, internal
Somali (Cushitic)	nirøg-o	nirig-∅	nirig-ta	young female camel pl, sg indef, sg def
Turkish	devør-i	devir-∅	devir-den	transfer ACC, NOM, ABL
Slavic (e.g. Czech)	lokət-e	loket-∅	loket-ní	elbow GENsg, NOMsg, adj.
Hungarian	majøm – on	majom-∅	majom-ra	monkey Superessive, NOM, Sublative

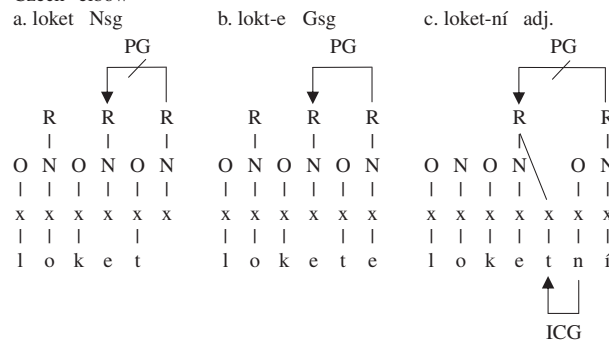
⁴ Unary primes are not to be confused with privative versions of distinctive features, which have become standard for features such as [nasal] in feature-based theories over the past decade or so (e.g. Hall, 2007). It is true that privativity is a property of unary primes (also called holistic or, indeed, monovalent or privative), which has thus been taken over by feature theory for certain features (as was already the case in various versions of underspecification in the 80s, e.g. Archangeli, 1988). Another property of unary primes, though, is that they are bigger than features: the DP prime [i] for instance describes an object that is inherently [-back], [-round] and [+high], and which cannot be further divided into smaller pieces.

In all systems on record, alternation sites show zero before a single consonant followed by a vowel (___CV), while a vowel appears before word-final consonants and word-internally before consonant clusters (___C{C,#}). The reverse distribution, or any other pattern, have never been reported. On classical syllabic standards, the generalization is thus that zero appears in open, but vowels in closed syllables. This may be called a “vertical” analysis because it defines the distribution of the two alternants according to a vertical parameter: iff a coda is present in the syllable of the alternation site, this site will be vocalised. Else, zero appears. In other words, if an alternation site wants to know whether it is vocalized or not, it needs to look up in order to determine whether the consonant to its right is dominated by an onset (result: zero) or a coda (result: vocalization).

Standard GP proposes a different causality: rather than depending on the arboreal status of the following consonant, the vocalization of alternation sites is a function of a lateral relation contracted by the alternation site with the following nucleus. This lateral relation is called Proper Government in explicit recognition of the mechanism of the same name that was held to control the grammaticality of empty categories in the syntactic theory of the time, GB. According to this analogy, empty categories (empty constituents that contain a trace in syntax, empty nuclei in phonology) are only licit if they are properly governed, i.e. if they entertain a lateral relation with another (distant) constituent that is contentful.

The Standard GP analysis of vowel-zero alternations is shown under (9) below.

(9) vowel-zero alternations in Standard Government Phonology:
exclusively lateral causality
Czech “elbow”

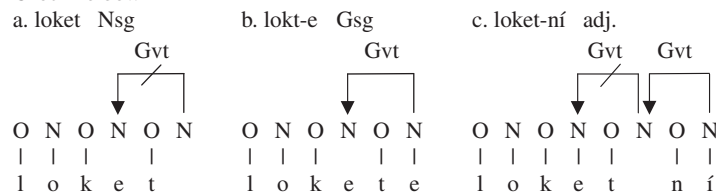


It may be seen that the *causality* is exclusively lateral, and also that a consequence of this move is to eliminate a piece of the arboreal *structure*. Following the syntactic analogue, nuclei may only be empty if they are properly governed. The alternation site is thus vocalized iff it escapes PG, and this is the case if either the following nucleus is empty and hence not a good governor (9a), or if a governing domain intervenes between the potential governor and the potential governee (Interconstituent Government, ICG under (9)c). The piece of arboreal structure is lost under (9)b: the presence of the unpronounced nucleus makes the preceding consonant an onset (while it would be a coda under regular assumptions). Hence there is a trade-off between empty constituents and arboreal structure: a coda is turned into an onset, which means that an arboreal dependency (with the rhyme) is lost.

While the lateralization of causality is complete, a piece of arboreal structure has survived: there is still a branching rhyme under (9)c. This is also the reason why Standard GP cannot reduce the coda disjunction ___C{C,#} to a single phonological object. This reduction played a prominent role when linear SPE was replaced by autosegmental syllable structure (Kahn, 1976): word-final and pre-consonantal consonants behave in the same way with respect to a number of phonological processes and must therefore share a phonological identity. This is the coda constituent in regular arboreal syllable structure, but Standard GP is unable to propose an alternative lateral account: the stem-final t is an onset under (9)a, but a coda under (9)c.

Standard GP thus introduces lateral relations into the arboreal landscape, but runs out of breath half way: pieces of arboreal structure remain (a detailed list is provided in Scheer (2004, §172)), and exactly these pieces are also responsible for the failure to express well-supported empirical generalizations. The coda disjunction for example shows that either lateralization is a bad idea (i.e. the coda constituent is an adequate solution), or that it has not gone far enough. CVCV pursues the latter option by introducing an additional empty nucleus in the midst of the tn cluster under (9)c. The result is shown under (10) below.

(10) vowel-zero alternations in CVCV:
exclusively lateral causality *and* structure
Czech “elbow”



As before, the functional load of arboreal structure is taken over by additional unpronounced nuclei: the branching rhyme under (9)c is eliminated. It also opens the way for a reduction of the coda disjunction in lateral terms: a coda consonant occurs before an empty nucleus, i.e. (10)a and (10)c (while an onset consonant is followed by a filled nucleus as under (10)b). The definition is a little different when branching onsets are taken into account (in which case coda consonants occur before *governed* empty nuclei, see Scheer, 1999; 2004, §68), but its lateral character remains the same: if you are a consonant and you want to know whether you are an onset or a coda, you look to your right in order to see whether your nucleus is empty or contentful (rather than up in order to see whether you are dominated by a coda or a rhyme).

4.2. Lateral and arboreal devices do the same job twice – one has to go (Takahashi, 1993)

In an article entitled “A farewell to constituency”, Takahashi (1993) draws the logical conclusion of the presence of lateral relations in phonology (see also Takahashi, 2004, pp. 141ff; Scheer, 2004, §209): vertical constituent structure and lateral relations do the same job. For example, saying that the two members of the distributional class TR are tied together because they pertain to the same constituent (a branching onset), or because they contract a governing relationship (Constituent Government in Standard GP), is equivalent.⁵

Having both lateral relations and arboreal structure is thus doing the same job twice – a nightmare for any theory. The two devices are redundant, and one has to go. Following this track, CVCV replaces the last pieces of arboreal structure by lateral relations, a programme that may be called deforestation (Scheer, 2011, §42, 2012a, §9).

4.3. Arboreal syllable structure is empirically inadequate: the Coda Mirror

The arguments thus far only concerned a situation where lateral relations are taken for granted: a hybrid lateral-arboreal model is self-contradictory, redundant and empirically problematic. Let us now consider two arguments why there should be lateral relations in phonology in the first place. One is empirical and treated here, the other is based on a fundamental property of phonology that sets this module apart from morpho-syntax: linearity (discussed in the following section).

The strong position is a well-established empirical object known since the 19th century, which occurs in a number of genetically unrelated languages: word-initial consonants and consonants that occur after codas behave alike and then experience an effect of segmental strength (either by being shielded against lenition, or by actual strengthening). Ségéral and Scheer (2001, 2008) call this disjunction, {#,C}_, the Coda Mirror because it is exactly symmetric with respect to the aforementioned coda disjunction _{#,C}, both regarding its structural description and the effect produced: consonants are weak in the coda, but strong in the Coda Mirror. This structural and resultative antagonicity can hardly be accidental. Hence (syllabic) theory needs to be able to (1) reduce the Coda Mirror disjunction, (2) reduce this disjunction in such a way that it is somehow the reverse of the identity of the coda disjunction, and (3) explain why the coda is weak and its mirror strong, rather than the reverse.

Classical syllabic tools are already failed on the first challenge: they cannot describe the strong position as a uniform and unique phonological object. Word-initial and post-coda consonants belong to onsets, but so do intervocalic consonants, which however are weak. The way in which CVCV meets the three challenges is discussed in, among others, Ségéral and Scheer (2001, 2005, 2008), Scheer (2004, §110), Szigetvári (2008). In order to introduce the argument, a number of basic properties of GP, independent of lenition and the Coda Mirror, need to be recalled.

The multiplication of empty nuclei is marshalled by government: nuclei can only be empty if they are governed.⁶ As licensing, government is head-final, and only phonetically expressed nuclei are good governors. Therefore a structure where two or more empty nuclei occur in a row is ill-formed. Empty nuclei thus call for the government of the following nucleus; in case this nucleus is unable to govern because it is empty (i.e. itself governed), the structure is ill-formed. Implicit in this description is that government is not recursive: nuclei can only govern (and license) one single target at a time.

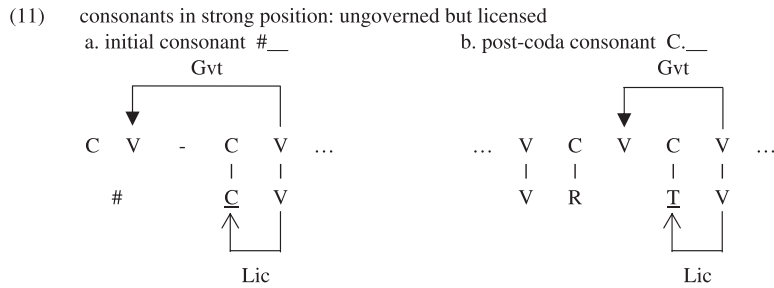
Also note that government and licensing have opposite effects: while the target of the former is inhibited in its melodic expression (a fact known from the aforementioned vowel-zero alternations: the zero alternant appears under government), it is backed up by the latter. The necessity for two distinct lateral forces is discussed e.g. in Scheer (2004a, §151) and Szigetvári (2008).

Finally, the Coda Mirror relies on the assumption that the phonological identity of the beginning of the word is an empty CV unit. This idea was introduced by Lowenstamm (1999), and a survey of work in this direction is available in Scheer (2012a). Diacritics such as # (or ω, i.e. items of the Prosodic Hierarchy) are meaningless placeholders that carry morpho-syntactic information into the phonological string without having any predictable effect: nothing inherent in # or the left edge of, say, the prosodic word allows us to tell whether word-initial consonants will be strong or weak – any effect and its reverse is compatible with these diacritics. The left edge of words, however, produces stable effects across languages. Therefore colourless diacritics will not do: arbitrarily chosen symbols cannot produce regular and non-arbitrary effects. That is, morpho-syntactic information must incarnate as truly phonological objects (Scheer, 2008b, 2012a,b).

We are now prepared to see what kind of characterisation this system provides for the five relevant consonantal positions (target consonants are underscored).

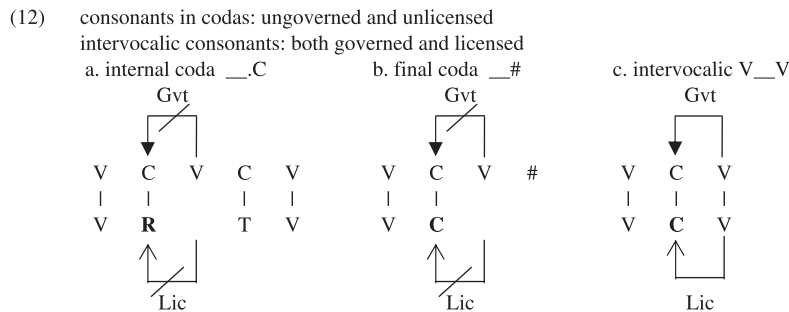
⁵ T is shorthand for any obstruent, R for any sonorant.

⁶ Other circumstances allowing for the existence of empty Nuclei are discussed by Kaye (1992), Gussmann and Kaye (1993) and Scheer (1999, 2004, §14).



Under (11), the nucleus following word-initial and post-coda consonants is called to govern its preceding peer, which is empty. Therefore it cannot govern its own onset. At the same time, the nucleus in question has no specific licensing duties and therefore licenses its own onset. A consonant in strong position thus (1) occurs after an empty Nucleus and (2) is licensed but ungoverned.

Table (12) below shows the situation of the three remaining positions.



We have already seen in Section 4.1 that consonants in the coda disjunction (12)a,b occur before an empty nucleus. They are both ungoverned and unlicensed for that reason: empty nuclei are laterally disabled. On the other hand, intervocalic consonants are not adjacent to any empty nucleus. They are both governed and licensed because their nucleus is contentful (and hence a good lateral actor), but (unlike under (11)) has no governing duties.⁷

The three contexts that are relevant for lenition and fortition are thus defined by empty nuclei: the phonological identity of the strong position (11) is its occurrence after an empty nucleus ($\emptyset$ __), the coda disjunction (12)a,b is symmetric and reduces to the context before an empty nucleus ($_\emptyset$); finally, no empty nucleus occurs in the vicinity of intervocalic consonants (12)c. Note that the three contexts not only enjoy a uniform description (reduction of the two disjunctions): their phonological identity is also unique (recall that this is what fails arboreal syllable structure: consonants in strong position are in onsets, but this is also the case for weak intervocalic consonants).

The first two challenges set by the strong position are thus met: the disjunction is reduced (to $\emptyset$ __), and this phonological identity is the exact reverse of the one characterizing the coda ($_\emptyset$). Finally, the combined effect of government and licensing brings home the third challenge. Consonants in strong position are strong because they experience maximally comfortable conditions: they are backed up by licensing while escaping government (and thus remaining unspoiled). The three weak positions are in less favourable situations: coda consonants are neither helped (licensed) nor spoiled (governed), while intervocalic consonants are both supported (licensed) and attacked (governed). Significantly, though, the two weak positions, coda and intervocalic, are distinct: there are two ways of being weak (Szigetvári, 2008).

Section 4.5 inquires on how challenge number three is dealt with elsewhere. For the time being, the argument is only about the fact that the empirical existence of the strong position calls for the presence of an empty nucleus in the midst of what is traditionally considered as coda-onset clusters (as in (10)c, when compared to (9)c). This move eliminates arboreal structure, which as we have seen is unable to capture the strong position disjunction, let alone the mirror effect or the causality involved. By contrast, government and licensing offer a lateral solution.

⁷ Being both governed and licensed is the identity of the intervocalic position in the original version of the Coda Mirror. For reasons that are exposed in Scheer and Ziková (2010) and Scheer (2012a, §223), intervocalic consonants are only governed in the current version. This amendment has no bearing on the argument.

4.4. Syllable structure is lateral in essence: it encodes linearity

Uncontroversially and in all theories (but in Anderson's, see Section 2.5), syllable structure is a projection of two properties of sound: sonority and the linear order of adjacent segments.⁸ Sonority is an inherent, i.e. lexical property of each segment, but it is not sufficient to determine syllable structure: an intervocalic cluster made of a T and an R will produce opposite syllable structure according to its linear order: (in languages that provide for branching onsets), a VTRV sequence is syllabified as V.TRV, while a VRTV sequence projects VR.TV. That is, syllable structure is a function not of sonority, but of the *relative* sonority of adjacent, i.e. linearly ordered consonants: this is what is known as *sonority sequencing* (e.g. Selkirk, 1984; Clements, 1990).

Hence there is no syllable structure without linear order of segments. Or, in other words, syllable structure encodes lateral relations among segments. Arborescence only enters the picture when the analyst translates this primary lateral reality into a representation that is different in kind. This lateral-to-arboreal translation that is undertaken in all syllabic theories but never made explicit, discussed or motivated, is arguably due to the fact that trees are the default representation of hierarchical relations, which for example is used in syntax.

Linearity, however, is entirely irrelevant for syntactic tree-building: no syntactic generalization, pattern or principle enforces the linear sequence of syntactic primes.⁹ This is true pre-theoretically speaking. As a consequence, reference to linearity is banned from current syntactic theory: syntax is about hierarchical relations, not linear order (Chomsky, 1995a, p. 334).

Therefore the analogy between syntactic and syllabic trees overlooks a fundamental difference: syllable, but not syntactic structure, is a projection of linearity. The tree-based analogy may have scored some credit in GB-times when linearity was directly encoded in syntactic structure and the linear order of syntactic primes (morphemes) was a necessary input to the tree-building mechanism (phrase-structure rules). As syntactic primes were more and more atomised and today are simple features, though, linearity in syntax does not make sense anymore anyway, since only bundles of features (morphemes), not features alone, eventually appear in a linear order on the surface.

If there is any analogy with syntax at all, then, it needs to be updated. Extending the current syntactic situation to phonology means to build syllable trees in the latter without reference to linearity. This, we have seen, is impossible. Alternatively, there are no trees in phonology, and syllable structure is the result of lateral relations. In other words, syllable structure is lateral because it encodes linearity.

4.5. Lateral relations do more than trees: they define positional strength

Beyond empirical issues and those related to linearity as well as to their competition, a relevant question is whether arboreal and lateral structure are notational variants of one another. The answer is no, since in CVCV (but not in Standard GP) lateral relations are multifunctional: they kill two birds with just one stone.

Like trees, lateral relations define syllabic positions (coda vs. onset, open vs. closed syllable, etc.), but in addition they also determine positional strength (as was shown in the previous section). The latter labour is not done by arboreal structure, though: there is no reason inherent to the coda constituent for being weak, and nothing predestines an onset (or a subset thereof, which arboreal syllable structure is unable to discriminate, as was shown in Section 4.3) for conferring strength. In the same way, nobody knows why vowels in closed syllables are weak, e.g. typically show curtailed inventories, while they exhibit full distributional latitude in open syllables. In the arboreal tradition, relative strength is merely observed and then attached to syllabic positions as a statement in prose.

At best, extra-grammatical reasons are sought, in phonetics (perceptual salience) or psycho-linguistics (lexical access and the like). The trouble is that either the strong position disjunction as an empirical object is simply ignored, or overlooked, or that it is described without any conclusion being drawn.

The OT literature on lenition, which has devoted quite some attention to lenition and is often typologically oriented, falls into the former case (Smith, 2008 is an exception). While word-initial strength is discussed in detail, the strength of post-coda consonants, although well documented since the 19th century, is simply absent from the record (e.g. Beckman, 1997, 1998; Kirchner, 1998, 2004; Steriade, 1999; Zoll, 2004; Vijayakrishnan, 2003; Smith, 2003, 2004). Kirchner (1998, pp. 8ff) for example has studied 272 languages; he mentions lenition in word-final position (14 languages), in coda position (5 languages), fortition or blocking of lenition in word-initial position (17 languages), in the onset of stressed syllables (6 languages), as well as phrase- or utterance-initial blocking of lenition (4 languages). But the post-coda position is simply absent from his cross-linguistic survey of positional influence on lenition.

Another case is Beckman's (1997, 1998) positional faithfulness (see Scheer, 2004, §132). Beckman establishes a descriptive list of contexts that enjoy a positional privilege, i.e. which have a preserving effect on melody: segments in these "faithful" positions (1) maintain contrast, (2) trigger processes and (3) resist processes better than others (Beckman, 1998, pp. 1f). A great many positions that are identified as being faithful to underlying representations may be described as "the beginning of X" where X can be the word, the syllable, the morpheme, the root, the stem, the foot, the prosodic word or any other rel-

⁸ Sonority appears in a number of different guises in phonological theories, and is encoded in various competing ways. All this is irrelevant for the argument: the only thing that matters is the fact that all theories (of syllable structure) somehow rank major classes of sounds (obstruents, liquids, nasals, glides, vowels) on a scale according to whether they are more or less vowel-like.

⁹ While it is of course true that syntactic generalizations are abstracted from the input to analysis, which is available only in linear order.

evant phonological unit. In addition, Beckman records stressed and long items as positionally privileged because they also display the conserving effects mentioned.

When it comes to the question why some positions, but not others, enjoy positional privilege, Beckman follows the “grounded” OT trend that expels causality from grammar: the reasons are either phonetic or psycho-linguistic, or both.

“Privileged positions [...] are those positions which enjoy some perceptual advantage in the processing system, via either psycholinguistic or phonetic prominence, over the complement of non-privileged positions. [...] Positions which are psycholinguistically prominent are those which bear the heaviest burden of lexical storage, lexical access and retrieval, and processing. [...] Phonetic prominence may be instantiated by many different physical cues, including increased duration or amplitude, pitch extrema, release bursts” Beckman (1998, p. 1).

The trouble, again, is that the post-coda position is absent from her empirical record, and that none of the psycho-linguistic explanations based on some “salience” is available for the strong position *disjunction*: what would be the burden of lexical storage, lexical access and retrieval, or processing, of a post-coda consonant? The hard fact is that the conditioning of positional strength is strictly syllabic, and does not respond to any extra-grammatical logic known to date. This is also an issue for Anderson (2011, vol. 3, p. 1), who holds (as was already mentioned) that “all aspects of linguistic structure are grounded in non-linguistic mental ‘substance’” (see also Anderson, this volume).

Let us now look at the other extra-grammatical cause for positional strength that is often invoked, phonetics (or more specifically perceptual salience). Steriade (1999) seeks to read off syllabic positions, as well as their relative strength, directly from the signal: she argues that in presence of this alternative there is no need for symbolic syllable structure in the first place. Interestingly, her article describes a number of phenomena where the word-initial and the post-consonantal location form a descriptively critical disjunction – but this recurrent pattern is never established as such, i.e. as an empirical fact that needs to be explained. Again, thus, the strong position is overlooked, this time even though all data necessary for the understanding of its existence lie on the table.

In the end, Steriade (1999) makes explicit the fact mentioned at the outset of this sub-section, i.e. that phonological theory to date has no explanation for why certain positions are strong, and others weak:

“we have presented arguments establishing that syllable position does not condition laryngeal neutralization. It would in fact be surprising if it did: there is no a priori reason why being in the onset is better for any feature than being in the coda or indeed somewhere outside of the syllable” Steriade (1999, p. 99).

Smith (2003) provides a correct summary of the overall situation:

“Beckman (1997, 1998; see also Casali, 1996, 1997) proposes that a particular position may qualify for special status as a strong position, and therefore have the potential to resist positional neutralisation effects, for one of two reasons. Either, as in Steriade (1993, 1995, 1999) proposals, the position has a special phonetic salience, or else the position has a special role in psycholinguistic processing. That is, its special status outside the domain of phonology proper that gives rise to special phonological status as a strong position” Smith (2003, p. 10).

The grammar-internal alternative for the definition of positional strength that is offered by CVCV and the Coda Mirror was presented in Section 4.3.

4.6. Lateral relations are phonological computation: the only structure is the CVCV skeleton

We have seen in the previous sections how lateral relations take over the function of arboreal structure. Syllabic trees are classically considered to be the result of online computation based on bare, i.e. unsyllabified and linearized strings, over which a syllabification algorithm erects syllable structure. As was mentioned in Section 4.4, syllable structure is thus a projection of lexical properties of segments (sonority), and of their linear order. A trademark of Government Phonology is to consider that lexical entries are fully syllabified, and that there is no such thing as resyllabification during phonological computation: a consonant born in an onset will always sit in an onset, and a coda consonant will never be able to come to stand in an onset (this is the goal of the phonological version of the Projection Principle, see Section 2.1).

The lexical presence of syllable structure in GP is often misunderstood as implying the absence of a syllabification algorithm. This is obviously not the case, since infants are not born with a lexicon, which therefore cannot be fully syllabified. Syllable structure must get somehow into the lexicon, and hence infants need to have a computational means to transform a chunk of the linear phonetic signal into a symbolic representation that includes syllable structure, which is then stored in long-term memory. This is what the construction of a lexicon is about. The same syllabification mechanism must also be available for adults, since everybody constantly adds new words to his/her lexicon, and hence is able to abstract a symbolic representation from the phonetic input.

In other words, if syllable structure is present in the lexicon, it represents the result of “old” computation that was stored in long-term memory. The same process is known from syntax, where idiomatic expressions such as *kick the bucket* also identify as a lexicalized snapshot of previous computation (e.g. Svenonius, 2005; Caha, 2009).

In CVCV, syllable structure is a function of lateral relations, and lateral relations are (part of) phonological computation. It follows that they are (re)calculated whenever phonology interprets a string of lexical items that was pieced together by morpho-syntax. The input string to phonological computation is then scanned from right to left, and lateral relations are succes-

sively established. This is why the status of the first item to be computed, the final nucleus of a computational domain (a phase in current syntactic terms), needs to be determined by parametric choices in case it is empty, i.e. when it does not possess any phonological properties by itself (contentful nuclei do: they are pronounced and able to both govern and license). Since final empty nuclei are thus phase-initial, it needs to be parametrically set (1) whether or not they are pronounced themselves (i.e. they are parametrically governed or not) and (2) whether or not they are good lateral actors (i.e. are able to license and govern) (Scheer and Ziková, 2010, pp. 427ff; Scheer, 2012a, §239).

Like in the classical landscape, syllable structure is thus the result of phonological computation: the classical syllabification algorithm incarnates as the right-to-left scanning of the concatenated string by lateral relations. There is no need anymore to build fuses against resyllabification (such as the Projection Principle) into the theory since one effect of CVCV is that there is only one consonantal constituent left, the onset. Hence the issue of resyllabification simply does not arise.

However, there is a major difference with respect to the classical landscape: the CVCV skeleton. This is the only piece of structure that is enforced no matter what: in its absence lateral relations cannot apply, since they scan the string from nucleus to nucleus, starting with the rightmost item. This is reason to believe that the CVCV skeleton is present in the lexicon. Another is the fact that the relationship between segments and onsets/nuclei cannot be predicted and therefore must be recorded in the lexicon. For example, the *o*, but not the *e* of Czech *loket* under (10)a, is lexically associated with its nucleus: floating vowels alternate with zero, lexically associated vowels do not (Scheer, 2004, §76; Gussmann, 2007, p. 188). The same is true for floating vs. associated consonants (e.g. in French liaison).¹⁰

A final note is in order. It is sometimes claimed that regular OT-type constraints are an alternative to lateral relations, whose effects can be reproduced by constraint interaction. In this context, the constraint NoLAPSE is devised in order to mimic the effect of government. As was mentioned earlier, government is responsible for the ill-formedness of two empty nuclei in a row. NoLAPSE simply states this ill-formedness in prose: “Sequences of non-governor empty nuclei are prohibited” (Rowicka, 1999, p. 106, see also Polgárdi, 2009, pp. 147f).

It may indeed be technically possible to mimic all and only the effects of lateral relations by tailoring a number of constraints, one for each individual effect observed. The thing is that government does more than just ruling out sequences of empty nuclei. It is therefore incorrect to say that NoLAPSE and government are equivalent. It is precisely the multifunctionality described in this sub-section that makes lateral relations different from other types of computation such as ordered rewrite rules or output-oriented constraints. They do several things at a time, and these cannot be further atomised, as rules or constraints would have it.¹¹ The ambition is thus to capture both syllable structure and positional effects with just one device, rather than merely describing what we see with an amorphous set of unrelated individual rules or constraints, each devised for only one specific effect.

Finally, note that lateral relations are only responsible for syllabic matters: they define the positional pressure that segments experience, but are not an alternative to classical computation in terms of rules or constraints when it comes to describe processes such as spreading and the like.

5. Expression of asymmetry: a consequence of input conditions and design properties

5.1. Linearity is a consequence of interpretation and exists prior to phonological computation

Let us now gather the pieces of the puzzle. An important aspect of the analogy between phonology and morpho-syntax that emerges from the convergence-oriented work in DP is tree structure (as described in Section 2). The major contribution of Government Phonology to phonological thinking are lateral relations (government and licensing), which although being an incarnation of dependency inevitably lead to the elimination of arboreal structure from phonology. It thus looks like lateral relations are a strong violation of Structural Analogy: they destroy a central result, i.e. the sharing of tree structure across modules.

It may be the case, though, that deforestation is precisely licensed by Structural Analogy. Recall from Section 3.3 that differences are legitimate in regard of Structural Analogy if they follow from intermodular relationships. I argue that the absence of arboreal structure in phonology is the result of linearity and the absence of concatenation. Both of these properties follow from the interpretative relation that phonology entertains with morpho-syntax.

In generative work, linearity was long thought to be a property of syntax: up to and including GB, it was created by phrase structure rules. A leading idea of the minimalist programme is that linearity is absent from syntax: syntax is about hierarchy, not linearity. Linearity is imposed upon speech by interface conditions and thus must not be part of the computational system that creates hierarchical structure over lexical items by piecing them together (Chomsky, 1995a, p. 334). In current work, linearization is conceived of as occurring somewhere at PF, i.e. after (narrow) syntax but before phonological compu-

¹⁰ There may be a way, though, to have all this labour done by computation. There is reason to believe that segments may be lexically specified for (non-)association: this vowel associates no matter what (the *o* of Czech *loket*), while that vowel is sensitive to whether or not its host is governed (it associates only to ungoverned nuclei, i.e. the *e* of Czech *loket*). Cases of “association under control” are documented by Ziková (2008), Ben Si Said et al. (2009), and Scheer (2010b, pp. 154f).

¹¹ Like unary primes with respect to distinctive features in infrasegmental representation, lateral relations are “bigger objects” with respect to rules or constraints.

tation (e.g. Richards, 2004, 2007; Bobaljik, 2002; Embick and Noyer, 2001, 2007; Idsardi and Raimy, 2013; an overview is available in Scheer (2011, §741)).¹²

This means that linearity is a consequence of the interpretative function of phonology: given the properties of the physical world that surrounds us, and given the five senses that we have to interface with it, there is no way not to linearize morpho-syntactic structure when it comes to its interpretation.

While nobody doubts that phonology experiences linearity, the question whether or not it creates linearity. This issue divides Anderson's (2011, vol. 3) revised model and more or less the rest of phonological thinking since the 19th century. That is, phonologists believe that segments occur in linear order in lexical entries, and that phonological computation neither creates nor manipulates their sequencing: linearity is established prior to phonological action, i.e. it is part of its input conditions.

The issue is critical for the argument: trees presuppose concatenation, and concatenation, in Anderson's view, has the exclusive purpose of creating linear order (recall Section 2.6). Hence if there is no such order to be created because it exists in the lexicon, there is no concatenation and, in turn, there are no trees.

The intrinsic problems that Anderson's total non-sequencing encounters are discussed in Section 2.5. It is not the case that this perspective merely removes linearity from the lexicon: it replaces it with something else, bundle-affiliation. But more devastating is the fact that the latter is redundant, since we know for sure that speakers run a regular syllabification algorithm upon lexicalization of new morphemes. Hence they do have a computational means of transforming linear order into syllable structure anyway.

5.2. Phonology does not concatenate anything

Everybody agrees that phonology does not concatenate pieces of the morpho-syntactic alphabet, i.e. features in current minimalist syntax, items as big as morphemes in Anderson's view of the matter. Phonology merely interprets a string that was pieced together elsewhere. Therefore the absence of concatenation in phonology is a direct consequence of the fact that phonology interprets morpho-syntactic structure. This means, in turn, that eventual intermodular dissimilarities which follow from this absence are covered by SA.

Now the question is whether phonology has its own concatenative mechanism, independent of the one that is used in morpho-syntax, and working with the items of the phonological alphabet. We have seen in Section 2.6 that Anderson (2011, vol. 3) has introduced such a phonological Merge into his revised model of syllable structure. But we have also seen that the (only) reason for the existence of this mechanism, the creation of linearity from lexical entries where segments lack linear order, is no good reason: we know that speakers run a regular syllabification algorithm when new morphemes are lexicalized. This makes the shuffle redundant whereby first lexical entries are de-linearized upon lexicalization, just in order to be re-linearized by phonological computation.

My conclusion is that there is no phonology-specific concatenation either, since linear order exists prior to phonological computation: linearity is an input condition of phonology. Phonology interprets, but does not concatenate anything, and for that reason has no tree-building device. We know that syntactic hierarchical structure, trees, are a consequence of concatenation: Merge adjoins two independent items and decides which one is the head.¹³ While Anderson's phonological Merge creates linear order but does not build any hierarchical structure, it is also true in his system that there could not be any arboreal structure without the prior action of the concatenative device.

The idea, then, is that arboreal structure is always a consequence of concatenation and cannot exist in its absence. Anderson would disagree with this statement, but applaud its motivation, which is substantive in kind: linearity as a substantive input condition to phonology leaves no place for concatenation, which means in turn that hierarchical relations in this module cannot be arboreal.

5.3. Why are there different means of expressing asymmetry, and why are they distributed as they are?

Let us now consider the consequences of the absence of trees in phonology. We have seen in Section 2.4 that there are (at least) three distinct dependency relations in the dependency literature: with and without mutual dominance, plus regular feature-geometric trees. We have also seen that there are at least two different ways of expressing a dependency relation: by trees or by the "X over Y" notation that uses "·;" and "·:" (Section 2.4).

Arguably, then, GP's lateral relations are but another way of implementing dependency. Saying that linguistic structure is about asymmetry is quite trivial (e.g. Di Sciullo, 2003). If there are a number of formal ways to express asymmetry, though,

¹² Under Kayne's (1994) antisymmetry and Linear Correspondence Axiom, linear order is a direct consequence of asymmetric syntactic relations (see also Raimy, 2003, on this issue). Anderson globally agrees with that: "word order is often largely determined by the dependency relations between words" (2011, vol. 3, p. 132), and even more categorical in this volume, "linearization is now determined exhaustively by the categories and syntactic dependencies." Only that for him linearity is not a product of spell-out but present in the syntax itself: lexical items are first hierarchized (creation of dependencies) by one syntactic sub-module, and then linearized by another one (Anderson, this volume). The development of minimalism and hence the expulsion of linearity from (narrow) syntax has marginalized Kayne's LCA, though, which places linearisation at the end of (narrow) syntax.

¹³ In minimalist syntax, a more recent move is to consider hierarchy and labels entirely different things: Merge only creates the former (Chomsky, 2011). This is evidently akin to the old dependency idea that syntactic trees are unlabelled – but quite ironically Anderson's (2011, vol. 3) revised view on syllable structure precisely introduces labels as a consequence of (phonological) Merge (see Section 2.6).

the question arises, and is quite pressing in the minimalist perspective, why grammar bothers having all these different means for expressing the same thing. And in case these different means can be justified, the question arises how they are distributed, i.e. why there are trees in syntax, lateral relations in syllable structure and eventually “X over Y” in infrasegmental structure.

The answer suggested by the preceding is that different means of expressing asymmetry are due to different environmental conditions and design properties of modules. In syntax, trees are the result of the fact that syntactic computation is meant to concatenate (a design property): there is no grammar in absence of the concatenation of pieces that are independently stored in long-term memory. There are no trees in phonology because phonological computation does not concatenate anything. As was shown in Section 4.4, lateral relations are the product of linearity. They could not exist in syntax because linearity is irrelevant in this module.

5.4. The absence of recursion in phonology follows from the absence of trees

The absence of recursion in phonology is a long-standing observation: people have always wondered how come that there is such a fundamental difference between morpho-syntax and phonology (e.g. Nespor and Vogel, 1986, p. 2; Pinker and Jackendoff, 2005; Hauser et al., 2002; Carr, 2000, p. 90). Neeleman and van de Koot (2006) make the same observation from a different perspective: trees have certain formal properties that make predictions regarding the type of phenomena that should be found in a tree-bearing environment. These include projection, long-distance dependencies and recursion. They show that phonological phenomena do not display any of these properties. Therefore, they conclude that the presence of trees in phonology overgenerates: arboreal structure predicts things that are absent from the record. Relevant in this context is also Carr (2006, pp. 642ff), who argues against the existence of recursion in syllable structure, based on phonology-internal considerations.

If phonology is flat as proposed by CVCV, the absence of recursion in this module is straightforward: recursion supposes the existence of trees. It occurs when an item dominates another item of the same kind (e.g. a CP dominates another CP). In an environment without trees, this kind of domination cannot exist (Scheer, 2004, §2, 2011, §§45f, p. 803).

Note that we are talking about the existence of a *phenomenon*, not about the *analysis* thereof. Recursion is a phenomenon of natural language, and as such has a pre-theoretical definition. In syntax and morphology, there are cases where you can keep repeating the same type of item indefinitely until grammar-external limits regarding performance (memory, etc.) are reached. That is, speakers will get confused upon the third or fourth level of embedding. Examples are *Peter thinks [that John says [that Amy believes [that. . .]]]* from syntax, or recursive *re-* prefixation in French (*faire* “to do”, *re-faire* “to do again”, *re-re-faire* “to do with two repetitions”, *re-re-re-. . .-faire*, etc.) from morphology.

Nothing of the kind has ever been reported in phonology: there are no phonological phenomena that correspond to this pre-theoretical description. This hard fact is entirely independent of eventual *analyses* that use recursive constructions: having a prosodic constituent such as the prosodic word ω and the “prosodic word prime” ω' where the latter dominates the former (e.g. Truckenbrodt, 1999) does not make the *phenomenon* at hand recursive. Beyond intonation, which is the classical area where recursive analyses are found, Hulst (2010) has gathered analyses using recursion in other areas such as the internal structure of segments. He argues that they document the existence of recursion in phonology (also Anderson, 2011, vol. 3, pp. 294ff). This is not the case: the only thing that they document is the existence of analyses that use recursive structure in order to account for non-recursive phenomena.

6. Conclusion

Those who emphasize that phonology is different (like Bromberger and Halle, 1989) as much as those who insist that it is the same (like Hulst, 2005 and the literature in the SA tradition) know that phonology is different in some respects, but the same in others. Unlike its structuralist predecessor, Structural Analogy is aware of the existence of dissimilarities, and does not mind they occur: the point is simply to devise a tool for getting a handle on them. It is no doubt reasonable to try to develop this kind of guiding light when a new field, or a new theory of a known matter, is developed and unfolds with great pace: the goal is to limit the continental drift of subfields. Also, the two criteria by which candidate discrepancies are assessed, respective alphabets and intermodular relationships, seem perfectly sound to me when the heuristic ambition of SA is to be run against the empirical record.

Once with the help of SA a set of differences between morpho-syntax and phonology is identified that is legitimate, a further step is certainly to try to explain why these differences exist (rather than ones that are not on record). This is the direction that Anderson (2011, vol. 3, this volume) takes much more than in previous writings, and this is what the present article has attempted to contribute to. Flat phonology and the expression of dependency by lateral relations are licensed by SA on account of its second proviso, intermodular relations: the absence of trees is a direct consequence of modular design properties (absence of concatenation in phonology, presence in syntax) and input conditions (presence of linearity in phonology, absence in syntax).

These reasons may as well be termed functional, a word that formalists traditionally obviate. They are functional in an entirely inoffensive sense, though, since they simply recall that the (morpho-)syntactic computational system was designed for a specific task: gluing together pieces that are retrieved from long-term memory (communication would be an offensive

goal). In the same way, phonology is designed for the specific purpose of making the linguistic structure that was built by morpho-syntax ready for being produced and perceived by one (or more) of the five senses that humans use in order to exchange with the world around them. This task implies linearity, which is thus a necessary property of phonology.

The idea that (functional) design properties and input conditions shape grammatical systems is inoffensive in a formalist perspective because it defines constraints on Saussurian *Langue*, or Chomskian competence, from the outside, rather than from the inside: once syntactic computation does the job of concatenation, and once phonology copes with linearity, there are still many different ways in which this all can be done in complete disregard of grammar-external pressure. Evolution has chosen an arbitrary subset of these alternatives, and this is why grammar is self-contained in the Saussurian sense.

Finally, it does not take long to see that grammar-external constraints such as concatenation and linearity identify as what is known as third factors when they are used to explain grammar-internal properties. Chomskian minimalism and biolinguistics (Chomsky, 2005) as much as anti-chomskian “Cognitive” Grammar” (e.g. Taylor, 2002) converge in the effort to explain properties of grammar by more general properties of the cognitive system (of the species or beyond). A third factor explanation is one that draws on some property that is not language-specific (see Carr, 2000, 2003, 2006 for discussion). Anderson’s (2011) three-volume summary of his view of language is also on this track, mainly through the notion of “cognitive salience”, which Anderson holds to be the ultimate source of dependency (“[d]ependency is a simple grammaticalization of cognitive salience”, Anderson, 2001 vol. 3, p. 12, see also Anderson, 2006, p. 616, this volume and Carr, 2005).

The more general language-unspecific cognitive properties that everybody is after are often called for but less often named. And understandably enough, when they are, people end up with notions that are so general that one wonders in which way they could be considered in scientific terms, let alone be inspected with scientific instruments. Can we hope, for example, 1 day to understand what “figure/ground relations” or “cognitive salience” are? Fodor (1983, p. 107) says that “the more global [...] a cognitive process is, the less anybody understands it.”

Historically, 18–19th century physician Franz-Joseph Gall, who first argued that the cognitive system falls into a number of distinct computational systems, identified broad and (as we know today) highly composite cognitive functions in what was called phrenology then (e.g. Marshall, 2001; van Wyhe, 2004). Objects of inquiry in phrenology were things like combativeness, destructiveness, firmness, benevolence, veneration, cautiousness, love, wit and hope. Fodor (1983) calls these horizontal faculties, and shows that cognitive science could only make any progress at all because they were progressively abandoned and replaced by more humble objects of inquiry, which are smaller and more homogeneous (vertical faculties in his terms). These are the fields of scientific inquiry that contemporary cognitive science (and also neuroscience) is after: among others, attention, vision, audition, and also language.

Fodor (1983 and following) has established a division in kind between these vertical faculties, which are accessible to human intelligence and inquiry, and Gall’s complex and composite faculties which Fodor believes are resistant to scientific theorising and ultimately to human understanding (a point also repeatedly made by Chomsky, e.g. Chomsky, 1975, chap. 4., 1984, pp. 6f, 23f, 1995b, pp. 2f). The former are called modules, the latter (the) central system(s). The position that central systems are impenetrable for human intelligence shares an important aspect with the cartesian view on the mind–body pattern: Descartes holds that the mind, or the soul, exists, but will forever be a mystery to humans. The opposite position is held by so-called massive modularity, which holds that central systems are also ultimately modular, if in a more complex way that we do not understand yet (Sperber, 2001; Pinker, 1997; Plotkin, 1998; Smith and Tsimpli, 1999). This is what Fodor (1987, p. 27) calls the “modularity thesis gone mad” (also Fodor, 2000, a competent overview of the debate is provided by Gerrans (2002)).

In this context, concatenation and linearity may well count as third factors, but they appear to be a little different in kind from familiar candidates: Fodorian, rather than Gallian. We know what they mean and how to characterize them. On the other hand, they are not really cognitive (though this word has a strong polysemic record these days): linearity is enforced by the “real world” and the properties of the five senses that humans are gifted with by evolution. Concatenation is probably found elsewhere in the cognitive system (of humans or beyond: in vision for example), but in case it is it is out of necessity, i.e. because some pieces need to be concatenated. This is rather not what is currently understood as a “more general cognitive property” in the relevant literature.

In any event, if concatenation appears to be absent from the more-general-cognitive-property literature (or maybe it is so trivial that nobody mentions it), linearity is central among the interface demands that everybody quotes (also Anderson, 2011, vol. 3, p. 2). There may be a difference, though, between a more general cognitive property and restrictions due to real-world properties. Anderson (2011, vol. 3, p. 1, this volume) holds that there is not, i.e. that the former (which he calls “mental substance”) are but the cognitivized versions of the latter. Whether the human is more than just a machine that responds to external pressure is Descartes’ mind–body question, which non-continental European scholars have ever since thought of as a result of speculative philosophy.

But even in Anderson’s view, there is space for self-contained decisions of the cognitive system that are entirely disconnected from real-world pressure: he only claims that “the categories of phonology are phonetically grounded” and that “the categories of syntax are semantically grounded” (Anderson, 2011, vol. 3, p. 10). This leaves space for implementing the relationships among these categories in various ways: nothing is said about the properties of the computational system. The present article has tried to show that real-world properties bar logically possible ways of expressing asymmetry: trees are unavailable in phonology because nothing is concatenated. On the other hand, lateral relations are one way to cope with linearity, but not the only one. To the extent that they are indeed responsible for syllable structure (and positional strength),

the question still remains why evolution has chosen this means of expressing asymmetry, rather than some other. And also, why lateral relations work the way they do.

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Items followed by the mention WEB are available at www.unice.fr/scheer.

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