What do we mean by 'minimalism' in phonology?

Harry van der Hulst

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1 Introduction

The need to reduce theories to their bare minimum is shared by all sciences. In this chapter, I will address the question as to what we (could) mean by a 'minimal(ist) phonology'. Perhaps the first thing that comes to mind these days is to say that a phonology theory is minimalist if it falls in line with the Minimalist Program (MP) that Chomsky launched in the 1990s for the study of language. The MP focuses exclusively on what is needed for syntax. It is thus reasonable to also ask, as I will do in section 2, what the direct implications are, if any, for phonology of the MP. In section 3, I then broaden the discussion, taking a historical perspective, by reviewing various developments within generative phonology that were, in part at least, motivated by making phonological (sub)theories more minimal. Of course, the idea that these new theories were claimed to be more explanatory, given the phonological facts of languages, also played an important role. I realize that limiting my attention largely to work in generative phonology cannot give us a full picture of the matter of minimalism in phonology. Many important developments that bear on this issue in both earlier and contemporary theories are discussed in the chapters in Dresher and van der Hulst (2022).

In section 4, I will then focus on the domain of phonological primitives, i.e., features or elements, as they are called in certain approaches. Here I will discuss my own contribution to phonological minimalism which comes in the form of a model (*Radical CV Phonology*) that limits the set of phonological elements to just two. This radical limitation lent its name to the model, but it certainly also deserved the label 'minimal'.

In section 5, I will discuss the perhaps most minimal perspective on phonology which is that human languages do not need any phonology at all. This claim has been made in the context of studying emerging sign languages. Assuming that externalization of syntactic structure is an essential part of human language (as I would say), rather than being an evolutionary afterthought, I will ask whether it is necessarily the case that the mental representations that underlie the perceptual form of utterances are composed of meaningless units, the combination of which make up words or morphemes that bear an arbitrary relation to meaning. It has been claimed that emerging sign languages may lack such a compositional phonology, with signs being holistic, iconic, only somewhat conventionalized gestures, which, if that is the case, does not mean we would deny such system a human language status. Hence the idea is that a human language can exist without having a phonology. Taking issue with that bold statement, I will suggest that we must broaden our understanding of what phonology is about, making a distinction between compositional phonology and iconic phonology. My basic point is that accounting for the iconic mapping of a conceptual structure onto a perceptual form is just as much a part of phonology as it is to account for a compositional organization that may emerge only later. In all 'mature' sign languages, compositional and iconic phonology go hand in hand.

Section 6 offers some of my conclusions.

2 Phonology and the Minimalist Program

The Minimalist Program (launched in Chomsky 1995) has pursued the centrality of the syntactic module of the mental grammar to its logical end point by declaring this module to be the sole content of Universal Grammar (also called the Narrow Language Faculty, NLF; Hauser, Chomsky and Fitch 2002), proposing that this innate faculty consists of one operation, called Recursive Merge.[1] With this radical reduction of the content of UG/NLF, much of what used to be thought of as syntax is no longer rooted in UG/NLF. Various former syntactic 'mechanisms' have been delegated to other cognitive systems that underlie the human capacity for language. These other systems contribute to what is called the Broad Language Faculty (BLF). Notably, many parameters, that account for crosslinguistic syntactic variation, have been relocated in the lexicon (already in Borer 1984), while all other former or alleged parameters are said to be emergent (Roberts 2021). What is important for our purposes here is that phonology has been made responsible for the linearization of the terminal units of syntactic trees that are like 'mobiles'. While separating hierarchical from linear structure can be defended (as it has been done in other syntactic theories; see Dik 1981), it seems to me that making phonology responsible for the linear order of morphemes and words, just because these objects cannot be pronounced simultaneously, is not reasonable, given that linearization depends on syntactic information and (with rare exceptions) not on phonological information.[2] Given that the nodes in syntactic mobiles are

[1] Recursive merge has two variants, External Merge (which combines two independent units) and Internal Merge (which combines a unit with a unit taken from inside of it). Arguably, internal merge and external merge are different operations, the former echoing the notion of transformation. Also, syntacticians often include agree-type operations in the narrow language faculty and perhaps some other things as well, such as a rich set of morpho-syntactic features. The precise (and still debated) content on NLF is not my concern here.

[2] It is reasonable to say that linear order is a consequence of the externalization system, which is why linearization takes on different form in sign languages to some extent. However, this does not mean that externalization limitations (and possibilities) do not impact the syntactic system, as argued in Sandler (to appear). Phonologists cannot be held responsible for something that syntacticians do not want to be bothered with anymore just because they want to keep

syntactic features and abstract 'roots', it has also been proposed (in the Distributed Morphology model; Halle and Marantz 1993) that providing the terminal nodes with phonological form is also somehow part of the phonology (while providing meanings is part of the semantic leg of the grammar). This view differs from the traditional idea that syntactic structure organized morphemes and words together with their phonological form and meaning. Another consequence of the minimalist program for phonology relates to phonology having been 'kicked out' of UG/NLF. This implies that the organization of phonology (which now includes new tasks) is not subject to innate and thus universal, specifically linguistic principles, leading to the conclusion that phonology must, and allegedly can, be fully explained in terms of so-called 'third factors' (which results in what I call 'the bird song theory of human phonology').[3] A detailed discussion of how everything about phonology can be reduced to third factors is offered in Samuels (2009), the idea being that a lot of what is needed for phonology can also be found in communication or general cognitive systems of other animals.[4] A defense of the idea that phonology is merely an externalization system for purposes of communication is also defended in Burton-Roberts (2000). Albeit not directly inspired by the MP, the belief that phonological knowledge is not rooted in phonology-specific innate principles but instead emerges from general, cognitive principles of learning is developed in great detail in Archangeli and Pulleyblank (2022) in their Emergent Phonology. The idea that phonology is entirely rooted in set theory and logic, defended in Bale and Reiss (2018) (and as such substance-free), is another example of reducing phonology to theories that have nothing to do with phonology (let alone phonetics) as such. These are recent examples of views that sharply deviate from the nativist views on phonology that were mainstream in the early decades of generative grammar. However, it should be obvious that such empiricist views on the acquisition and organization of phonology have long been held by linguists who were never onboard with Chomsky's nativist claims, most of whom extend their empiricist stance to the whole of language, including syntax. For phonological empiricism, see for example Tobin (1997) and various books on Cognitive Phonology (such as Nathan 1986, 1994, 1996 and later work), Välimaa-Blum (2005ab), Nesset (2008), Taylor (1998), Lakoff (1993) and Goldsmith (1993).

The elimination of phonology from NLF/UG has undermined the expectation that phonology and syntax are 'structurally analogous' (i.e. displaying shared overall organization and being governed by a shared set of structural principles) and the claim that 'phonology is different' has been reinforced by the idea that whereas syntax deals with unordered hierarchical, recursive structures, and not with linear order ('structures and not strings'; Everaert et al. 2015), phonology is all about 'flat' strings. But it is important to see that this claim that does not follow from the MP which only speaks about syntax. In this chapter I will *not* focus on the question as to whether syntax and phonology are grammatical systems that are structurally analogous; I think they are and I refer to van der Hulst (to appear a) for an extensive review of that issue. In van der Hulst (to appear b) I consider the view that phonology like syntax is hierarchical, and thus not 'flat' and just string-like. I even suggest that phonology might include self-embedding recursion (admitting that this is not a widely accepted view; see also van der Hulst 2010a). As discussed in van der Hulst (to appear a), claims about structural analogies between syntax and phonology have a long history. More often than not, the belief is that analogies are not co-incidental or merely play a heuristic role when new proposals are developed in one or the other domain. The belief that deep analogies

their syntactic module minimal. Or are we just dealing with a naming issue? Are we calling linearization 'phonological' while we could just as well call it 'syntactic'?

[3] A general discussion of the third factor notion is chapter 5 in van der Hulst (to appear c).

[4] For comparisons of human and non-human phonology, also see Yip (2013).

are at play stems from the view that phonology and syntax together characterize *the form of language*, as such being subject to a shared set of innate cognitive principles. In that view, both phonology and syntax are systems that are responsible for the externalization of conceptual structure. Whether what drives the workings of syntax and phonology is partly due to language-specific universal principles, or fully due to more general cognitive principles, is an independent matter that I wish to stay mostly neutral about, albeit leaning toward a significant role for the latter.

While the MP is minimal in terms of its approach to syntax (some would say too minimal), it is important to repeat that other than barring phonology from the UG/NLF, thus undercutting the expectation of structural analogies, the MP has nothing to say about the organization of phonology, apart from encouraging to look for 'third factors', especially factors that relate phonology to non-human cognitive systems to explain this externalization system. One could perhaps argue that an impact of MP for phonology has been that phonologists might feel 'inspired' to try and make phonology maximally simple as well. But attempts to make phonology as simple as possible do not have to be inspired by the MP because the goal to make theories as simple as possible is what guides all scientific endeavors. Nevertheless, the MP had several consequences for how phonology is 'understood'. Firstly, MP has given phonology a new task which is to take care of the linearization of the terminal units in syntactic trees, the idea being that linearization is a consequence of realizing these units in speech or signs, part of which necessarily must occur in a linear order. Secondly, if we may subsume DM under the MP, phonology is responsible for not just operating on the phonological form of expressions, but for actually providing these phonological forms. Taken these two points together, it would seem that a broad implication (although not a logical consequence) of the MP is that everything that has to do with the external side of language (including the mental representation involved) is somehow a matter of phonology. Thirdly, giving phonology the new task of linearization has led to the idea that phonology *as a whole* is about characterizing linear strings of units, including the segments (or phonemes) that form the building blocks of words, even though I stress once more there is nothing in the MP that necessarily leads to that conclusion. As discussed in van der Hulst (to appear b), there have in fact been several independent trends, not necessarily dependent on the MP, that have led to the belief that phonology is only about strings, which I will briefly review in section 3.4.

3 Which parts of phonology are or can be more (or less) minimal?

In this historical section, I review developments in generative phonology since Chomsky and Halle (1968)'s *The Sound Pattern of English* (SPE) that bear on making phonology more minimal; see also van der Hulst (2004). From the start we must realize that all phonological theories have a representational aspect and a derivational aspect. As we will see, promoting minimalism in one part of the phonology may entail complications in other parts.

3.1 Changing the phonology I: Various routes to and away from derivational minimalism

Arguably, the theory proposed in SPE was as minimal as it gets with respect to the structure of representations, which consisted of a linear string of unordered feature bundles, with hierarchical structure and boundary symbols provided by the morphology and syntax. Notably, there was no syllable grouping whether in terms of boundary symbols or hierarchical structure. The only way

in which this minimal approach could be improved, preserving its minimality, was to reduce the number of the commonly used binary features or even develop a set of unary features, although that move would usually come with additional machinery, such as adopting dependency relations between such unary features (Anderson and Jones 1974; see section 3.5 and 4).

Counterbalancing the minimalism of phonological representations, SPE contained a powerful derivational mapping function that regulated the derivation from underlying to surface representations, comprising a partially extrinsically ordered set of phonological 'transformations'. Also powerful was the format of the phonological transformations/rules, with few limitations set of what could be a phonological rule. Additionally, various notational conventions for collapsing rules could be invoked. Another problem was that there were no principled constraints on the distance between the input and the output of phonological derivations which prompted the 1968 paper by Kiparsky 'How abstract is phonology'. Answers to this question led some phonologist to argue that in case of allomorphic variation, underlying representations must be identical to one of the allomorphs (Vennemann 1974).

While the syntactic module in early versions of generative grammar were analogous to the phonological module (and in fact inspired by its organization), the question 'how abstract is syntax?' was not raised, albeit perhaps Chomsky's rejection of proposals to make deep structure semantic (in Generative Semantics) can be seen as an attempt to prevent very abstract underlying syntactic representations. More importantly, Chomsky sought to reduce the transformational module in various steps (which need not be reviewed here; see Lasnik and Lohndal 2009). Via the postulation of a single transformation ('move alpha'), the logical endpoint was achieved when the syntactic module no longer contained any transformations, although, arguably, Internal Merge is a remnant or perhaps a mere renaming of a general raising transformation (see footnote 1).

Morris Halle did not think that phonology could ever work which such derivational minimalism (see Bromberger and Halle 1989), despite many attempts during the 1970s to reduce or completely eliminate the use of extrinsic rule ordering; see Koutsoudas, Sanders and Noll (1974) and Hooper (1976). Somewhat later, 'no-rule phonologies' were pursued in several rivalling approaches. Both Lakoff (1993) and Goldsmith (1993) developed models that distinguished various levels that were mediated by 'constraints'. Both articles appeared in a book edited by John Goldsmith with the provocative title *The last phonological rule*. The increasing appeal to representational (surface or output) constraints formed the basis of the constraint-and-repair approach which sought to reduce the rule system to very general repair operations that language could choose from to remove constraint violations (Calabrese 1995, 2005; Paradis 1998; van der Hulst 2011 for a review). Appealing to constraints had the added advantage that conspiracies of apparently unrelated rules could be circumvented (see Kisseberth 1970). Constraints on representation also moved centerstage in Government Phonology (Kaye, Lowenstamm and Vergnaud 1985, 1990) and Declarative Phonology (Scobbie 1991; Scobbie, Coleman and Bird 1996). All these modules rejected the derivational richness of SPE. I will discuss Optimal Theory, a theory that claimed to completely eliminate derivationalism, in section 3.3.

Another powerful factor that drove reducing phonological derivations came from the view that much of what was thought to be a major task of phonology in the SPE-model should be relegated to other grammatical components. This is of course a way to achieve phonological minimalism: making the task of phonology more minimal. How was this done? It is well-known that Chomsky and Halle's model had broken with traditional views that divided the class of 'phonological rules' into three, sometimes more, different types. The founding fathers of phonology (starting with Kruszewski, Baudouin de Courtenay and Trubetzkoy; see Chapters 9, 10

and 11 in Dresher and van der Hulst 2022; also see S. Anderson 1982) distinguished between several different kinds of 'alternations': those that are governed by morphological factors, those that seem 'truly phonological' and those that are automatic (perhaps 'phonetic'). SPE was a holistic theory that had folded all phonological rules into one module (although admitting a class of 'late phonetic rules' that converted the discrete, binary feature values into gradient phonetic exponents). Notable was their attempt to replace morphological and lexical-idiosyncratic factors by 'phonological' ones, which was one reason, perhaps the most important one, that made phonology more 'abstract' in terms of its underlying representations. Following the founding fathers' pluralism, proposals were made to replace the holistic view of SPE by relegating 'phonological' rules to different submodules of the grammar, claiming that the phonology is not 'responsible' for alternations that are either morphologically-driven or phonetically-driven. Indeed, the aforementioned no-rule phonology models would typically assume that a lot of allomorphic variation could be located 'in the morphology' and with that 'in the lexicon'. An influential proposal to restore pluralism was splitting up the phonology into a lexical and a post-lexical module, put forward in Kiparsky's lexical phonology model (Kiparsky 1982, 1985).[5] Prior to that we also saw a similar idea in Natural Generative Phonology (Hooper 1976) which reduced phonology to surface-true rules, while placing rules for allomorphic alternations in the lexicon. Interestingly, another development 'nibbled' away parts of the SPE-type phonological derivation on the other end of the derivation by arguing that rules for automatic alternations could find a place in an 'implementation module' (Pierrehumbert 1980; Liberman 2018). The literature on these various developments and models is vast, revealing many models that differ in various ways, while sharing the general idea of splitting up the holistic phonology of SPE.

A very different angle on eliminating SPE-type derivationalism has been the proposal to put the burden of explaining patterns in the synchronic phonology entirely onto theories of phonological change (Blevins 2000). What then remains for the synchronic phonology is a learning theory that explains that people can simply account for all the patterns that diachrony delivers, no matter how 'crazy'. More often than not such learning theories would not assume that learners need to have a priori knowledge of phonology, the trend being that there is nothing learners need to know in advance that is specific to human phonology. For such a view, see works that pursue the approach called Cognitive Phonology and the Emergent Phonology of Archangeli and Pulleyblank (2022) that was already mentioned. It would seem that analyzing opaque phonological patterns in terms of abstract underlying representations and ordered rules has totally gone out of fashion, despite claims to the contrary; see for example Dresher (to appear).

We now need to ask whether reducing the complexity of phonology by relegating an account of 'phonomena' (here proposing a blend of 'phonological phenomena') to other parts of the grammar is a significant achievement. The price that is paid is that derivational complexity *within* the phonology is replaced by a different kind of derivational complexity, namely by an accumulation of extrinsically ordered (sub)modules, each of which would make no appeal to extrinsic ordering of the rules contained in them. Conceptually, assigning rules for phonomena to different levels and submodules is warranted if the phenomena are truly different *kinds* with the result that rules to account for them have significant different properties. This was the view of the founding fathers of phonology. Explanation overrules simplicity. A complete phonological theory must account for the relationship between meaning and the mental representations that underlie

[5] Long before, there had been an analogous proposal in syntax, which involved distinguishing between lexical and post-lexical transformations. As discussed in Kiparsky (1978), this development paralleled the development of his lexical phonology model.

the external signal. Having reviewed attempts to minimize the phonological derivation aspect of phonology directly, we will see that reducing derivational complexity can also be achieved by elaborating the phonological representations.

3.2 Changing the phonology II: Abandoning representational minimalism

As noted in S. Anderson (2021), the history of phonology from its beginning, and also during the generative period, has alternated between paying specific attention to derivations or to representations. Focusing on the generative period, we have seen in section 3.1. that the immediate post-SPE decade focused on derivational issues, trying to reduce the derivational complexity that SPE was 'accused of'. Firstly, there were proposals to directly forbid postulating properties of underlying representations that never reach the surface. Secondly, proposals were made to reduce the need for parochial extrinsic ordering (sometimes proposing universal ordering principles). Thirdly, various proposals were made to remove all rules from phonology. Fourthly, the idea that phonological rules could be parceled out over different (universally ordered) modules allowed for a reduction in the number, format and ordering of rules in each module.

During the 1980s, these important derivational issues and proposals were pushed to the background by focusing on the nature of phonological representations, which, rather than trying to make them simpler (which was hardly possible), were enriched with suprasegmental and intrasegmental structures. These developments have been reviewed in many places, as early as in van der Hulst and Smith (1982); also see van der Hulst and van de Weijer (1995). After bringing back the syllable (either in terms of boundary symbols, Anderson 1974 and Vennemann 1974, or in terms of some sort of hierarchical structures, as in Kahn 1976), metrical phonology (Liberman 1975; Liberman and Prince 1977) introduced a full-blown hierarchical structure up to the level of the maximal syntactic unit, the sentence. Autosegmental phonology (Goldsmith 1975) and Feature geometry (Clements 1985; Sagey 1986) broke up the segment into a multitiered, hierarchical organization.[6] While the general motivation was to achieve a more explanatory account of phonomena, the cost of making representations less minimal was claimed to be counterbalanced by the possibility of making the rule component simpler, restricting rule formats and being able to formulate them as natural responses to structural configurations. John McCarthy (1988) famously stated: "If the representations are right, the rules will follow".

As always, every innovation, after a period of enthusiastic embrace (of course with some tinkering here and there), is followed by a critical stance, asking: do we need all this? Several phonologists questioned the need for syllables (Steriade 1999; Blevins 2003), while even architects of the new Metrical approach questioned significant aspects of this model (Prince 1983). A more extreme response to representational richness, essentially getting rid of all of it, came later and will be discussed in section 3.4.

[6] I have pointed out elsewhere that these various MIT-guided developments had been anticipated in the proposals of John Anderson's Dependency Phonology (most fully detailed in Anderson and Ewen 1987) to which I return in section 4.

3.3 Changing the phonology III: Another take on derivational minimalism

In line with the dialectic history of generative phonology, following the attention to representational issues during the late 1970s and 1980s, the 1990's pushed the pendulum back to derivational issues.

Optimality Theory is a constraint-based theory that was proposed in Prince and Smolensky (1993) which from that point on became tremendously influential in the field of phonology. With ingenuity, this model dispenses with rules, while selecting the so-called optimal output for a given input from a candidate set of outputs in terms of checking all candidates against a universal set of constraints that would be extrinsically ordered for any given language. The model is said to be non-derivational although it does embody one derivational step, namely from input to output. Derivational minimalism is counterbalanced by needing a module that generates a candidate set of outputs and an evaluation function of each candidate against an extrinsically ordered set of constraints.

Overall, the OT model inherited various elements of the SPE model (see van der Hulst and Ritter 2000), notably by replacing extrinsic rule ordering by extrinsic constraint ordering and also being holistic in that constraints are not divided in different subsets (reflecting the different types of rules in post-SPE developments). We should note that OT did not include a theory about phonological representations. The idea was: do OT with whatever your favorite theory of representation is. In fact, OT is not a theory of phonology per se, since its basic design can be applied in other domains (such as syntax and semantics), and to any domain where conflicting forces determine outcomes. While analogies have been suggested between minimalism in syntax and OT, the basic idea of OT has been criticized by Noam Chomsky.

It has meanwhile become apparent that OT in its original form could not be maintained, being unable to account for classical opacity cases that precisely had motivated the SPE model's use of extrinsically ordered rules which entailed appealing to intermediate levels between the input and the output of derivations. While the phenomenon of opacity could be 'denied', proponents of OT who had been 'raised' during the SPE-dominated era, felt that OT must be altered to deal with it. The problem was that opacity involved phonological generalizations that are true of intermediate representations and not of outputs. That implied that such generalizations could not be captured in terms of constraints on outputs.

It seemed inevitable that viable versions of OT had to restore an appeal to extrinsic ordering in terms of derivational steps that each involve a separate evaluation function, possibly containing partly distinct constraints (as in Kiparsky's Stratal OT, 2015) or being a reapplication of the same evaluation function (McCarthy 2000; Hermans and van Oostendorp 2000).

3.4 Changing the phonology IV: Restoring representational minimalism

I review a general trend toward representational minimalism in van der Hulst (to appear b) and I will be brief here. There are various other strands of proposals. As was already mentioned, early on, the need for syllable structure as a domain for phonotactic constraints was questioned (Steriade 1999; Blevins 2003). It was also mentioned that Prince (1983) eliminated metrical foot structure which was not said to be needed if we focus our attention on rhythmic beats.

As for hierarchical, prosodic structure at higher levels (i.e. which involve expressions that have morphological or syntactic structure, especially the latter), the need for different sizes of

prosodic domains (such as the phonological phrase, the intonational phrase and so on) that are dependent on, but not necessarily isomorphic with, morphosyntactic structures (as proposed in Selkirk 1978; Nespor and Vogel 1996 and much other work), has been questioned in so-called direct reference (or direct syntax) approaches. Here the argument is that the morpho-syntactic structures themselves provide the domain needed for phonological rules. Of course, the problem here is that proponents of such approaches assume that morphosyntactic structures are not 'God-given', which means that they can arrange for structures that do the job of serving as domains for phonological rules, while, hopefully, also being independently motivated on morphosyntactic grounds that follow the syntactic flavor of the day.

But even if domains are needed that are distinct from the morphosyntactic structure, it does not follow that such domains must be identified in terms of constituent structure. As was proposed early on for the representation of syllable structure (cf. Vennemann 1971, 1974; Hooper 1976), domains can be delimited by means of 'boundary symbols' which are phonological objects of some kind. Scheer (2004) called the prosodic hierarchy 'diacritic' and proposed that domains that are relevant for phonology can be delineated in terms of silent CV units on the skeletal tier, thus 'phonologizing' the idea of boundary units. However, if feet also serve other functions than accounting for rhythm, such as forming a domain for phonotactic restrictions, segmental rules and conditioning allomorphy, the question does arise whether an alternative to invoking the foot as a constituent is required. It has been proposed that if phonology is not hierarchical, domains can be delimited by returning to the concept of boundary symbols (e.g., Neeleman and van der Koot 2006; Reiss 2008).

The idea that phonology is hierarchical, displaying a degree of structural analogy with syntax (see van der Hulst, to appear a), has come under scrutiny, especially in an approach known as Government Phonology (GP; Kay, Lowenstamm and Vergnaud 1985, 1990) which, paradoxically, started out as an attempt to show that phonology and syntax have a lot in common. However, from the start GP did not recognize the syllable as a necessary structural unit.[7] Subsequently, Lowenstamm (1996) eliminated onsets and rhymes as structural units in his 'strict CV' model (see Scheer 2004) with the logical end point conclusion that phonology is 'flat' (see Scheer 2004, 2013, 2023). What holds the units in the CV-string together is a set of lateral, head-dependent relations that are separated into licensing relations (that permit for example empty V-slots licensed by a following or preceding non-empty V-slot) and government relations (that permit contentful units in the local context of other contentful units). In Scheer's words, these head-dependency relations completely replace constituents and with that any form of hierarchical organization, here understood as an organization that involves different layers of representation that can be represented with a tree graph of some sort (see also Takahashi 1996). Imposing a set of lateral relations onto a string of C's and V's that can be contentless or contentful functions as a 'check' on its phonological wellformedness, must like syllabification rules function as a check on wellformedness in syllabic theories. I refer to van der Hulst (to appear b) for the suggestion that perhaps Scheer's theory of phonological representations falls within the class of dependency models, comparable to Dependency Phonology (DP, Anderson and Ewen 1987; van der Hulst and van de Weijer 2018). In the next section, I will briefly discuss DP as an example of a principled, minimal phonology. This section will then be followed by a brief exposition of my own version of Dependency Phonology, which is called *Radical CV Phonology* (RCVP).

[7] One could take issue with this claim given that it was assumed that there is a universal licensing relation between Onsets and Rhyme, which as such formed a package of universally co-occurring constituents; see Ritter (2022) for a review of this model.

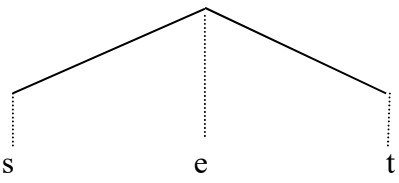
3.5 Dependency Phonology: A minimalist theory of phonology

DP is a model that displays several departures from the SPE-model that its developers take distance from (see Anderson 1969; Anderson and Jones 1974). The focus here was on representational matters. As for derivations, DP certainly took issue with the abstractness of permitted underlying representations and the use of extrinsically ordered rules in the SPE-model. In practice, analyses of data sets (which were and have not been abundant in the DP literature which is rather limited, given its modest number of proponents) deal with alternations between surface forms in terms of 'underlying' representations that are maximally underspecified. In this sense, DP pursues minimalism with respect to the information that needs to be stored in the lexicon. The kinds of allomorphic relations that are heavily dependent on morphological and lexical factors are generally not taken to fall within the domain of synchronic phonology. As we have seen, this viewpoint is shared with Government Phonology; see especially Kaye (1995), models like Natural Generative Phonology (Vennemann 1974; Hooper 1976) and Distributed Morphology (Halle and Marantz 1993). In DP and these other models, we see a maximal use of lexical storage of allomorphic alternations and distributional statements that relate allomorphs to the context in which they occur.

Combined with representation minimalism, DP adopted innovative structures in both the intrasegmental and suprasegmental domains. In both domains, the overarching structural 'first principle' was that whenever units are combined, one will be the head with the others (usually just one) are/is dependent on that head. In line with Dependency approaches to syntax, dependency relations are meant to replace constituency; see Tesnière (1959); Hays (1964); Hudson (1984) and the work of John Anderson, most extensively in Anderon (2011abc and 2022ab); for a historical perspective on dependency grammar, see Imrényi and Mazziotta (2020).

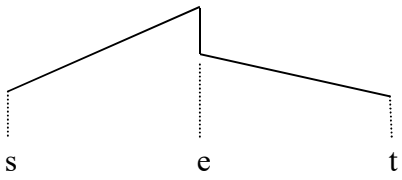
With respect to the basic idea that dependency relations replace constituency, it may be confusing that the set of dependency relations can be graphically represented with graphs that look a lot like constituent structures in which dependent units are 'adjoined' to another unit that is their head.

(1)



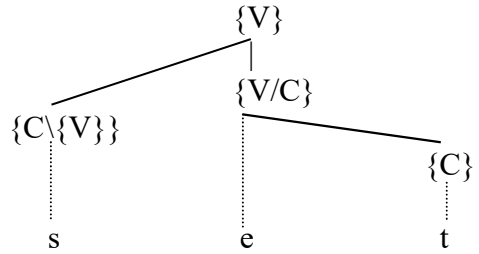
In this structure the onset and coda consonants are equal dependents of the head vowel. The resemblance between a constituent-based onset-rhyme approach to syllable structure and a dependency approach is especially close in the approach of Anderson in which dependency does not only involve *adjunction*, but also *subjunction*:

(2)



Here /e/ is dominated by two nodes, one subjoined to the other. The /t/ is taken to be directly dependent on the vowel, while /s/ is dependent on the vowel via the unit /et/ (see section 4 for what motivates this difference). Anderson (2011c: 83ff) offers a more elaborate notation to represent the various nodes:

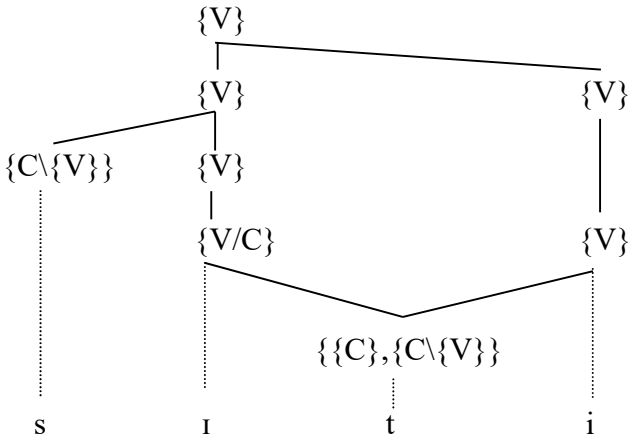
(3)



The '/' indicates 'looking for a complement', while the '\' notation stands for being an adjunct to what is to the right of '\'. At the same time, the labels that dominate the segments are in fact properties of these segments which means that nodes in the dependency tree are not independent labels such as 'onset' or 'rhyme'. This means that in comparison with constituent approaches, dependency representations eliminate the need for such labels. A similar view is embodied in the 'bare phrase structure' approach to phrase structure in Chomsky (1994).

A difference between *rooted* constituent graphs and dependency graphs is that the latter permit one daughter to be dependent on two heads, which creates a structure that appears to correspond to the notion of ambisyllabicity:

(4)



Here I have also included the dependency relation that represents 'foot structure'. Indeed, early work in DP anticipated the essence of metrical theory by representing 'stress' as an exponent of a dependency relation between two syllables.

We must of course not capitalize on the *visual* appearance of graphs for constituent structures and those for dependency relations, but chances are that theories that advocate constituent structures that are augmented with a head/dependency encoding (as is standard in generative syntax since Chomsky 1970 and in phonology since Metrical Phonology) and theories that appeal to non-constituent-based dependency relations allowing both adjunction and subjunction might come very close to being notational variants (see Osborne et al. 2011).

In addition to pursuing minimalism in the suprasegmental domain (using the single organizational principle of dependency and eliminating node labels), DP also pursues minimalism in the segmental domain. This is not only manifested in exploiting maximal underspecification, but also in the choice of phonological primitives which, rather than being a longish list of binary features, comprises a much smaller set of unary elements (called components) that by themselves or in conjunction with each other represent phonological segments. A signature property of DP's segmental model is not only the use of unary elements, but also a grouping of these elements into element groups (called gestures) which thus constitute a segment internal 'geometry', formally very similar to the Feature Geometry model that was proposed in Clements (1985) and Sagey (1986), the difference being that combinations of elements and gestures in DP display dependency relations, consistent with DP's 'first principle' of organization which helps further reduce the number of primes needed to minimally represent possible segmental contrast (see van der Hulst 2016). It is true that non-dependency models have also embraced the use of unary features and some kind of dependency (see Ewen 1995), but the credit must go to DP in the use of unary 'features' and dependency to the fullest degree rather than only when 'it seems useful'. As argued in Kaye (1988), theories that commit to the claim that all primitives are unary are more restrictive and more readily falsifiable than theories that can have it both ways.

As we have seen, the DP theory of phonological representations anticipated Feature Geometry, as well as Metrical Phonology, even though this approach became only known generally (or could have) in the comprehensive theory of segmental structure in Anerson and Ewen (1987).

3.6 How many phonological representations?

An independent question regarding prosodic organization is whether the formal properties of this organization are fundamentally different from the kinds of structures that are used for syntactic properties of linguistic expressions. As I hope to show, a discussion of this issue leads to the possible conclusion that we may need more than one phonological representation, a view that runs counter to the pursuit of representational minimalism. In this matter, we are not necessarily discussing the kinds of derivational levels that emerge in the mapping from underlying to surface representations. The different phonological representations that we here consider could be *co-phonologies* (Inkelas 2014) that account for representations that occupy different 'planes'. That said, as we will see, different representations, depending on how they are construed, could perhaps also be placed in a derivational order. To make the case for a need for more than one phonological representation, we need to once more delve into a bit of phonological history.

The theory of prosodic organization proposed in Selkirk (1978) and developed impressively in Nespor and Vogel (1986) appealed to a hierarchical, strictly layered structure, with units at each layer directly dominating and grouping units of the layer beneath it. While each layer corresponds in some way to syntactic constituents, the prosodic structure cannot mimic the

recursive structure of syntactic structure due to its strict layering which prevents recursivity. The flatness of each layer captures the rhythmicity of linguistic expressions, given that a metrical Strong/Weak labeling for each grouping was postulated. As Nespor and Vogel show, this prosodic theory proposes a structure that mirrors syntactic structure to some extent while at the same time catering to the rhythmicity of the speech signal, thus providing domains for phonological rules that the syntax does not provide.

As pointed out in Kager and Zonneveld (1999), at the time Selkirk made her proposal, there already was a theory of phonological structure that far more directly mirrored syntactic structure, namely the theory proposed in Liberman (1975) which proposed a metrically-interpreted copy of the morphosyntactic structure as the representation of linguistic phrasal stress and stress for morphologically complex words. While this S/W labelled structure necessarily provided a constituent structure, the focus here was not on providing domains for phonological rules, which was precisely the motivation for Selkirk's approach. What then accounts for rhythmicity in Liberman's theory? In the original Liberman theory, a second phonological representation was proposed, the metrical grid, which was meant to account for rhythmicity in terms of principles that militate against lapses and clashes. The grid, while forming a separate plane, was not built independently from the metrical constituent structure. Instead, it was projected from the strong/weak-labelled nodes in the metrical structure, while avoiding mirroring the depth of embedding that resulted from copying the recursive morphosyntactic structure. However, to account for rhythmicity, rules that alter the grid were allowed. In retrospect, the idea that two different phonological representations were needed did not seem like a bad idea, although as I will point out below, the precise desired properties of two phonological representations are likely not exactly those that Liberman envisioned.

Before we discuss the motivation of postulating more than one phonological structure, we note that henceforth, the literature splits in two streams. Some propose to abandon the hierarchical metrical constituent structure, putting all the work on grids (Prince 1983), and ignoring segmental evidence for constituency, while others get rid of the grid (Kiparsky 1979; Giegerich 1985), arguing that rhythmicity can be handled in terms of metrical transformation that alter and 'flatten' the metrically-interpreted hierarchical structure in order to account for rhythmicity. Meanwhile, an entirely different line of work promoted the Selkirkian strictly layered approach, with or without an added grid structure.

Arguably, the split between Liberman's approach and that of Selkirk was the result of trying to account for a different set of phonomena. As mentioned, Liberman wanted to develop an account of word and phrasal stress in terms of a metrical structure that closely aligns with the morphosyntactic structure and a second structure, the grid, to represent rhythm. Selkirk's focus was on providing domains for segmental rules in terms of a strictly layered metrical structure that deviates from the syntactic structure, while at the same time representing the relative prominence of domains. Selkirk's theory dominated the field, especially after the brilliant development of it in Nespor and Vogel (1996). Much literature appears that tries to establish how syntactic structure maps to prosodic structure, taking into account both the geometry of syntactic structure and the syntactic labelling of nodes (see Inkelas and Zec 1990 for various views).

But various other strands of thinking developed simultaneously. On the one hand, there are voices that simply deny the need for any kind of phonological/prosodic structure, advocating the direct reference or direct syntax view that the syntactic structure provides sufficient basis for accounting for phonological rules as well as stress (see Seidl 2001; Odden 1990). Here the catch is always, as already mentioned, that there are many different views on the relevant syntactic

structure. Is it the underlying or an intermediate or surface structure, and what is the actual structure at the level that is deemed relevant?[8]

In van der Hulst (2009) I review a different strand of work which argues for the need of two different hierarchical phonological structures (see especially Rischel 1982, 1987, and Fudge ms). I also discuss a proposal to replace the Selkirkian prosodic structure by a very different kind of structure. The latter view is presented in Lahiri and Plank (2010, 2022) who argue in favor of a kind of prosodic structure that has a long history. The basic unit of this structure is what has come to be known as the Abercrombian foot which comprises a word stressed syllable and all following syllables up to the next word stressed syllable. This kind of prosodic organization is thus primarily rhythmic, being not dependent on the morphosyntactic structure, although the authors allude to the fact that syntactic structure may come into effect in more deliberate and careful speech. This suggests to me that the prosodic structure that they propose is a property of utterances and thus, in a different terminological tradition (e.g. Kiparsky 1982, 1985), 'post-lexical' (although we should perhaps say: 'post-grammatical'). These authors do not ask whether the input structure to this prosodic structure is a purely syntactic structure or a metrical structure of some kind (possibly the metrically-interpreted structure that Liberman proposed), but given that the input contains stress we must assume the latter.

The conclusion of this discussion is that adopting a single phonological structure, while minimal, may not be desirable from an empirical standpoint. Indeed, striving for minimalism should never overrule empirical coverage. To make the issue more complicated, I have argued in van der Hulst (to appear c) that in between a metrically-interpreted structure and the surface rhythmic structure, we seem to need a structure that creates (what I call) a phonotactic structure that deviates from the metrically-interpreted structure in terms of 'coherence' or 'cliticization' which, in the approach of Nespor and Vogel (1996) is arguably the main factor for a regrouping of the units in morphosyntactic structure. If this is warranted, but even if we need just two hierarchical, phonological representations, we may, in the end, arrive at a theory that combines the various proposals that were thought to be in competition, which is not exactly minimal. As mentioned, if more than one representation is warranted, these can be seen as co-existing in different planes (co-phonologies) or as derivational steps, moving from a representation that closely aligns with morphosyntax to a representation that accounts for utterances (via a representation that creates domains for a subclass of (phrasal) phonological rules).

3.7 Interim summary

While it may seem that a pursuit of minimalism in phonology should try to design a phonology that conforms to the Minimalist Program, the preceding sections have shown that seeking for minimalism is an inherent aspect of developing scientific theories in general. Phonologists are aware of this and while some developments were inspired by reducing syntactic complexity, proposals were essentially independent of developments in syntactic theory. Today, phonological theorizing does need guidance from the MP which has essentially dismissed phonology from linguistic theorizing. Specifically, the idea that phonological representations are 'flat' does not follow logically from the MP, although it has been popularized by proponents of this program.

[8] The proposal that prosodic structure may mirror syntactic structure more closely than originally assumed is Selkirk's (2011) Match Theory, which, maintaining the idea of a single phonological hierarchy, accounts for the conflicting demands of mirroring syntax and accounting for rhythm in terms of ranked constraints.

The short history of generative phonology, and even the longer view which takes us back to the beginning of phonology, reveals a dialectic alternation between attention for theories of representations and theories of derivations. A minimal theory of representations (such as SPE) calls for a rich theory of derivations, while an enriched view of representations and invoking a role for constraints bearing on these, may lead to a simpler rule component. Reviewing various proposals that try to minimize either the representational or the derivational side of phonology, I made a case for the Dependency Phonology Program (DPP), which, in my view, offers the best and most principled approach to phonology. Interestingly, the program adopts a non-nativist position in attributing the whole of grammars to general cognitive principles, which as such, are of course part of the human innate endowment, leaving open the possibility that some cognitive principles may be relevant in non-human minds as well. Anderson's dependency approach does not assign a privileged position to syntax, adopting the so-called Structure Analogy Assumption, which has a long tradition in linguistics (see Anderson 1982).

After having reviewed the dialectic development of generative phonology, I ended with a discussion of how many phonological representations we need. In this case, the developments since the 1980s have introduced several models of phonological representations that in my view are not mutually exclusive. Rather, taking a non-minimalist stance, I have suggested that we need not one, not two, but perhaps even three distinct levels: a metrically interpreted morphosyntactic structure, a phonotactic structure and a prosodic structure.

In the next section, focusing on my own contribution to phonological minimalism, I will discuss a proposal for a minimalist theory of phonological primes.

4 Structures, not lists: A minimal theory of phonological primitives

Crucial to understanding the basic idea behind Radical CV Phonology (RCVP) is that, if we assume that the segmental structure involved different 'gestures' or 'class nodes', the question must be raised whether the features or elements in these structural units are totally distinct or whether perhaps elements can occur in more than one gesture, albeit with different, but similar phonetic correlates. The line of reasoning here is analogous to why we say that certain 'phones' are allophones of the same phoneme. We say that different phones are allophones of the same phoneme when (a) they are in complementary distribution (which means that they occur in different structural positions) and (b) they are phonetically 'similar'. The fundamental idea that RCVP is based on is that we can apply the same line of reasoning to phonetic properties that are captured in terms of features. When two phonetic properties correlate with features in distinct structural positions (like in either onsets or nuclei or in different, corresponding class nodes within the segmental structure) and are phonetically similar, we have to ask whether these properties are manifestations of one and the same feature/element. This idea is, in fact, extremely common in theories that propose that we can use the same place features for consonants and vowels. For example, where some theories might distinguish the feature [round] (for vowels) from the feature [labial] (for consonants), the idea that there is just one feature (call it [labial]) that can be used for both, with slightly different, but related phonetic correlates, became generally accepted in Feature Geometry theories (such as Clements and Hume 1995). Likewise, Halle and Stevens (1971) proposed that a single set of features could be used for tonal properties (vowels) and phonation properties (consonants).

The idea to adopt elements that generalize over vowels and consonants was a central aspect of DP theories from the early 1970s (as, in fact, it was in pre-SPE feature theories, such as Jakobson, Fant and Halle 1952).

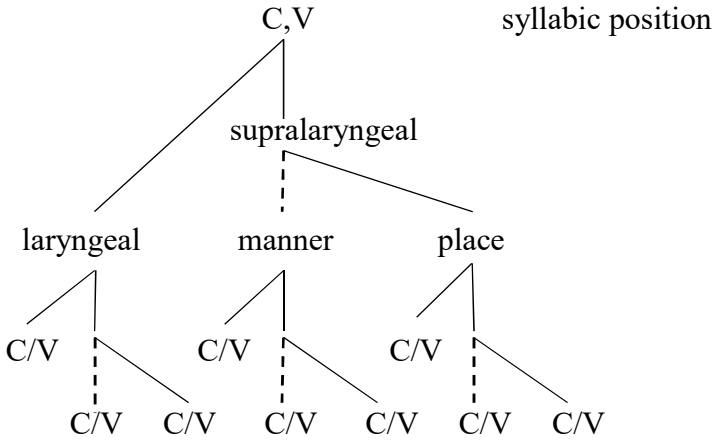
In their excursus on representations for tonal distinctions, Anderson and Ewen (1987: 273) made the intriguing suggestion that the components |i| and |u|, originally proposed for place distinctions in consonants and in vowels, could be employed for high and low tone, as part of the tonological gesture. What is most noticeable in this proposal is the idea to use the same components, viz. |i| and |u|, in two different gestures, this going beyond the idea that these elements generalize over place properties of consonants and vowels. To emphasize that this strategy is present in the DP proposals, we can also point out Anderson and Ewen's suggestion concerning the identity of the place component |a| and the 'manner' component |V| (1987: 215). In short, in two places, these authors suggested to employ the same 'components' in different (sub)gestures, while attributing the phonetic differences to the fact that the (sub)gestural location of a component has a bearing on the phonetic interpretation. This shows that DP offers two possibilities for reducing the number of primes. First, fewer primes are needed thanks to the dependency relation. Two traditional features can be replaced by the dependent and head occurrence of a single prime, e.g., |V| for [voice] (as a dependent) and [sonorant] (as a head); see (5); cf. van der Hulst (2016). Second, given that elements are grouped into gestures, fewer primes are needed: one particular component may occur in various groups, each time with a different phonetic interpretation and thus replace two or more features (|V| for sonorant or vowel and for low, open place). Again, I emphasize that this line of reasoning completely parallels the traditional and commonly accepted strategy to reduce allophones to phonemes. It is as if the different phonetic implementations of features are 'allofeatures'.

These reduction possibilities are pushed to their extreme in Radical CV Phonology (RCVP), developed by van der Hulst (1995, 1996, 2000, 2020, 2021). In these works, a variant of DP is developed that differs from standard DP by aiming at a precisely-defined, restricted set of segmental structures, needed for the expression of potential phonological contrast only. RCVP advanced a restricted 'syntax' for C/V combinations (both intrasegmentally and at the syllabic level), which uses just two components (more or less arbitrarily labeled |C| and |V|) for the representation of all phonological contrasts that are attested in the languages of the world. The structure in (5) expresses that the components C and V can occur multiple times in the three classes: Laryngeal, Manner and Place. I will return to the labelling of the top node that represents syllabic positions below).[9] We note the recurrence of an X-bar like organization in which the head can be combined with a 'first' and 'second' dependent (comparable to complements and specifiers in X-bar syntax):[10]

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

[10] I am not invoking the idea of X-bar syntax as (once) used in syntactic theory in support of the X-bar like structure in (5). However, I do believe that syntactic X-bar theory was correct in making a distinction between two types of dependent units, one close to the head and one more distant. Besides, despite the fact that X-bar theory has gone 'out of fashion', syntacticians still generally use the distinction between complements and adjuncts.

(5) The 'geometry' of elements in RCVP



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

The choice of elements resulting from the head element and the first dependent is subject to polarity which excludes CC or VV. Because of this restriction, we could call the first dependent the 'complement' even though it is not obligatory. This allows 4 possibilities:

(6) C C;V V;C V

Each of these four options can be provided with a second dependent, which can freely be C or V (we could call this the specifier). The dependent subclass is assumed to not allow for combinations of the two elements.[11] This adds up to the following set of possible structures for each class node:

(7)

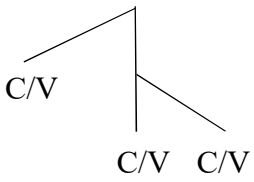
{C}	{C;V}	{V;C}	{V}
{C{C}}	{C{C;V}}	{C{V;C}}	{C{V}}
{V{C}}	{V{C;V}}	{V{V;C}}	{V{V}}

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

It is to be expected, as we have seen in our historical review, that the reduction in one part of a theory leads to more complexity in other parts. Hence reducing the set of *representational* elements to just two, comes with the need to invoke more 'structure', both in terms using 'class nodes' (as in 5) and appealing to a structure within class nodes, which was represented as follows:

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

(8)



I refer to van der Hulst (2020) where extensive typological evidence from phonemic inventories is given in support of the need for the structures in (7) *for each class node*. Of course, the full array of structural possibilities in (7) is unlikely to be exploited in any given language.

In Anderson and Ewen (1987), the elements C and V were used in the class node ('gesture') that accounts for manner and major class distinctions. The array of structures that they proposed in order to deal with the number of contrasts that needed to be represented was criticized in van der Hulst (1995) as being too liberal and 'ad hoc'. My goal was then to limit the C/V syntax in a principled way. The structure in (8) which allows the possibilities in (7) is what I eventually proposed in van der Hulst (2020). However, pushing the reduction strategy to its limits, I proposed that the structure in (8) with the same two elements, can account for the necessary contrastive option *in all three gestures*.[12]

Given the potential multiple structural occurrences of each element, a set of interpretation functions is needed that assigns a phonetic interpretation to each element in a specific structural position. These functions provide phonetic interpretations for each C and V, relative to three structural positions or roles:

(9) Interpretation of C and V is sensitive to whether:

a. The element occurs in a syllabic head or a dependent position
b. The element occurs in the head or in the first or second dependent position

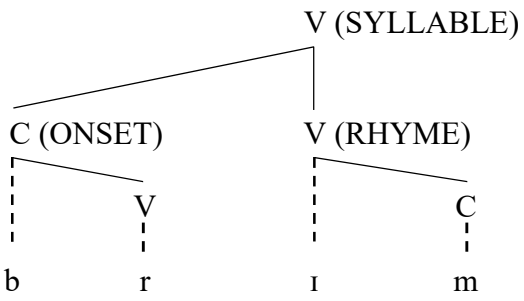
Factor (9a) has not been mentioned thus far, but the point is that the interpretation of elements is sensitive to occurring in the onset of rhyme and, in top of that, to occurring in the onset or rhyme head position or in the onset or rhyme dependent position.

In RCVP, the syllable is generated by the same structure that applies to class nodes, i.e. the structure in (8), minus the specifier position. This allows for four syllabic positions, two for the onset and two for the rhyme, the choice for C or V also being subject to polarity in this case:

[12] Developments in DP are not exclusively found in the early modifications that we have mentioned and the RCVP model. In Anderson (2011abc, 2022ab), various modifications have been explored, in part inspired by RCVP and other proposals, and critical of some aspects of RCVP.

(10) Syllable structure in RCVP[13]

a.



b. EDGE BRIDGE NUCLEUS CODA

The labels 'onset' and 'rhyme' are not primitives in this model. Thus, the onset is labelled C, while the rhyme is labelled V.[14] While the syntax of RCVP allows for four syllabic positions that are either C-headed (onset) or V-headed (rhyme), it does not deliver the grouping of both units into a syllabic unit. What then gives us the syllable grouping in (10) that prevents sequences of onsets and rhymes? We have to assume that building structure from bottom (starting with the elements) upwards (to the highest structural nodes) is subject to another instance of 'merge' that combined onsets and rhymes into a syllabic unit which is universally fixed in that the V unit is always the head. Subsequent merge will then deliver (trochaic, i.e., left-headed) 'feet', which seems to indicate that the edge orientation of the head switches as we climb up in the hierarchy.[15]

An important aspect of RCVP is that each occurrence of the two elements must be correlated with a phonetic interpretation. As an example, in (11) I provide the interpretation functions for the two elements in the manner class node:

(11) Interpretation Functions in RCVP for manner elements as heads

PI (C, manner head, onset head)	=	⟦stop⟧
PI (C, manner head, rhyme head)	=	⟦high⟧
PI (V, manner head, onset head)	=	⟦fricative⟧
PI (V, manner head, nucleus head)	=	⟦low⟧

[13] I here do not invoke the slash notation that Anderson uses; see (3-4).

[14] The possibility of adding a specifier element for both onsets and rhyme could be considered. For the onset if would allow for tri-consonantal onset and for the rhyme if would allow so-called superheavy rhymes. I will not discuss that possibility, which I did not explore in van der Hulst (2020), here.

[15] I am aware of the fact that elsewhere I have proposed that trochaic feet are recursive syllables, i.e., syllables that contain a syllable in the coda position (van der Hulst 2010a). If I maintained that idea, I would have to say that such structures are 'in competition' with the traditional understanding of trochaic feet. In this context, let me add that so-called iambic feet can be analyzed as trochaic structures that have a specifier added to them, as suggested by Marc van Oostendorp. Reference needed.

PI (C, place head, onset head)	=	⟦palatal⟧
PI (C, place head, nucleus head)	=	⟦front⟧
PI (V, place head, onset head)	=	⟦labial⟧
PI (V, place head, nucleus head)	=	⟦round⟧
PI (C, laryngeal head, onset head)	=	⟦tense⟧
PI (C, laryngeal head, nucleus head)	=	⟦high tone⟧
PI (V, laryngeal head, onset head)	=	⟦voiced⟧
PI (V, laryngeal head, nucleus head)	=	⟦low tone⟧

The phonetic details of interpretations are, to some extent, language-specific, which means that the interpretation function as stated here are only a rough approximation, here symbolized with traditional articulatory feature names. Indeed, here we focus on articulatory interpretations, but there are also (psycho-)acoustic interpretations. The '⟦…⟧' indicate 'phonetic interpretation/implementation', the use of double brackets being borrowed from a common use for the representation of meanings that are assigned to syntactic objects. It cannot escape our attention that the labels for these phonetic interpretations look a lot like traditional feature labels. It is precisely in this sense that RCVP provides a *meta-theory* of phonetic features that are potentially contrastive.

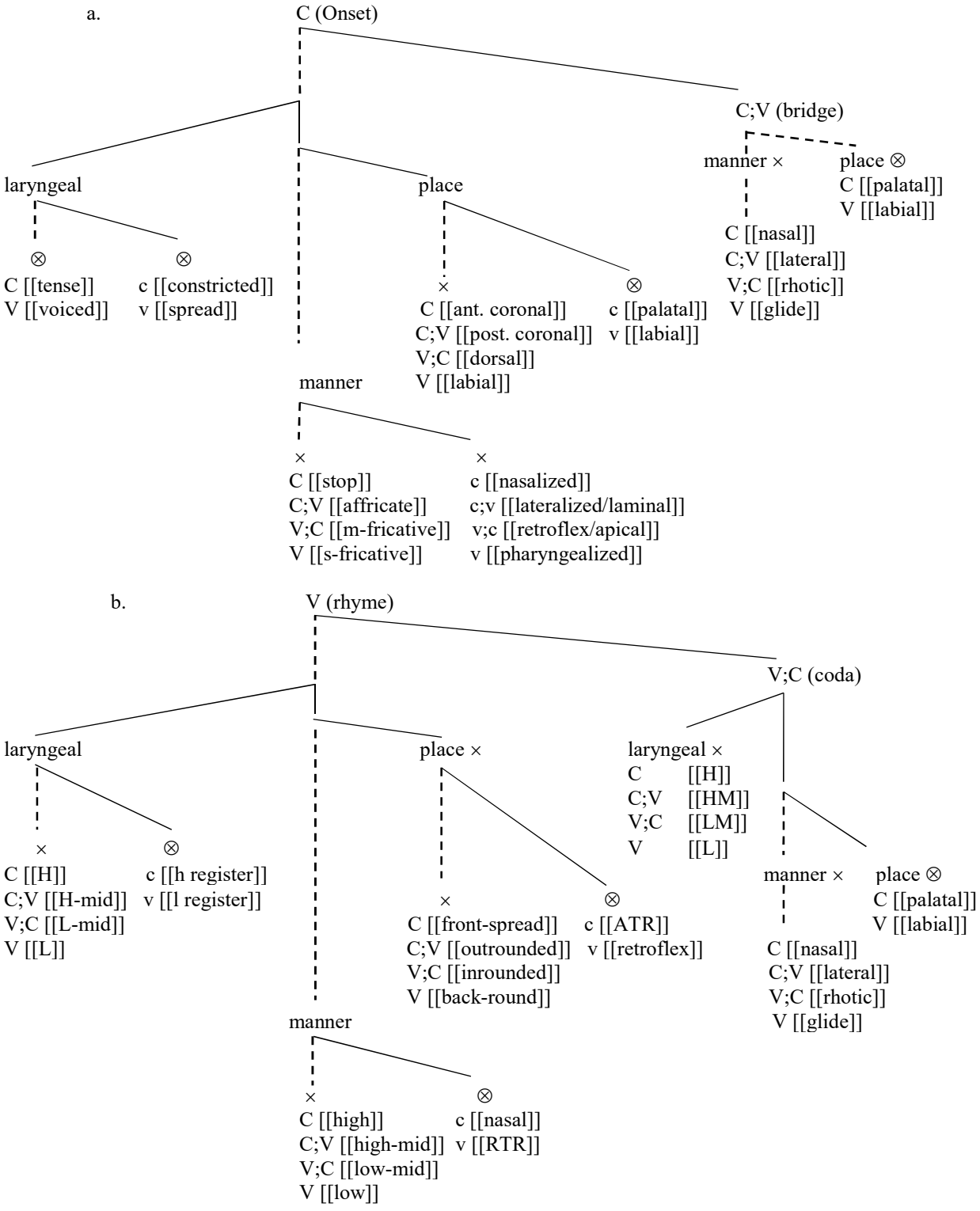
I must emphasize that invoking interpretation functions is nothing new. When phonologists propose that a feature such a [labial] applies to both consonants and vowels, such functions are required to account for the different phonetic implementations of this feature in the 'consonant' or 'vowel' domain. While one can subscribe to a so-called substance-free phonology (which means that the phonology does not make direct reference to phonetic implementations), it is nonetheless necessary to specify the phonetic correlations of phonological units and structures.

We also need a set of I-functions for elements in the head subclass as dependents, a set for the elements in the dependent subclass and a set for the elements when occurring in syllabic dependent positions. As expected, in syllabic dependent positions we do not need the array of structures in (7). Specifically, we do need a dependent subclass. Indeed, we expect that dependent positions show simpler structures than head positions.

Specific proposals for all the necessary I-functions are provided in van der Hulst (2020). Following van der Hulst (2020), with some changes proposed in van der Hulst (2022), these interpretations are shown in (12) for the onset and rhyme positions (× = allows combinations; ⊗ = does not allow combinations). To simplify the structures, where a class allows combinations between the head elements and the first dependent (the 'complement'), the four resulting structures are simply listed. Where a second dependent can occur (the 'specifier'), this is represented as a dependent:[16]

[16] Note that only for secondary manner for consonants, I entertained combinations of secondary elements (van der Hulst 2020). Whether this is truly required depends on whether languages will show these multiple contrastive options. Also, for laryngeal for consonants, in van der Hulst (2020) I excluded combinations in the head subclass; note further that the structures for the rhyme dependent position are more elaborate than for the onset dependent position.

(12) The full segmental structure for onsets and rhymes



A first impression that the RCVP model of segmental and syllabic structure might cause is: “this is not minimal” or “too much structure”. I therefore stress that the theory is restricted in the kinds

of structures that are invoked and we must not lose track of the fact that these structures recur in all class nodes and use only two elements.

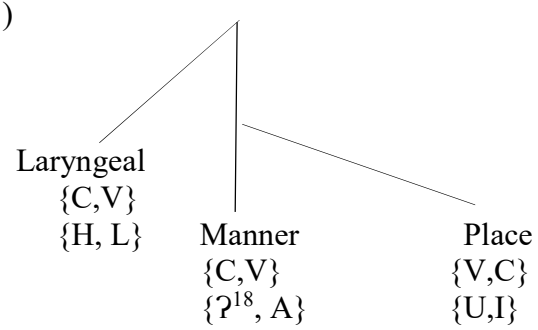
I must also stress that using the same elements in all class nodes is not a 'trick'. Rather, as mentioned earlier, the strategy to use the same elements in all class nodes is completely parallel to the strategy that phonologists use to reduce allophones to phonemes. The reader can check that the interpretations of the C and V elements across syllabic positions, class nodes and roles as head or dependent display phonetic similarity in many cases. For example, while C as a head in the manner subclass in the onset head 'means' [[stop]], it means [[high]] (or [[closed]]) as a head in the manner subclass in the rhyme. In the laryngeal class, C means either tense or constricted, again implying maximal closure for consonants and high tone and high register for vowels. The phonetic 'similarity' is all these cases (from an articulatory point of view) is 'maximal closure or stricture'. The weakest similarity is that between laryngeal and manner instances on the one hand and place instances of the elements on the other. In particular, one might ask why in the place gesture C means coronal/front, while V means labial/round. For discussion of this issue, see van der Hulst (2020).

In the RCVP model, the two primes of phonological structure are emergent. The structures in (12) are not part of some sort of innate language system. The basic principle of the current model is that learners are driven to parse 'phonetic spaces' (or different dimensions of the speech signal) into polar categories. As proposed in van der Hulst (2015ab, 2020), a basic principle of categorization called categorical perception causes the emergence of a basic C/V opposition in each phonetic space. Subsequently, when more than two categories are need for contrast, two intermediate categories emerge by combining C and V, with a dependency relation if two intermediate categories are needed. This is all we need to explain how the learner arrives as a set of structures that express contrast.[17] One might ask how learners conclude that there are three gestures. I will here speculate that the ability to parse the signal into three simultaneous layers must be anchored in distinct neuronal circuits in the auditory cortex that are specialized in detecting them. General cognitive principles of dependency then organized these layers into an X-bar like structure.

As noted in van der Hulst (2020), there is a family resemblance between Dependency Phonology and Government Phonology (Kaye, Lowenstamm and Vergnaud 1985, 1990). Both models share the use of unary elements and asymmetric relations between them. As noted in van der Hulst (2020), after the initial proposals for a set of elements, subsequent work has aimed at reducing this set. A concrete proposal for a set of six elements can be found in Backley (2011). The six elements employed in that work line up with the RCVP model as follows:

[17] This parsing strategy bears a resemblance to the *Successive Division Principle* in the theory of Dresher (2009) which is also meant to account for contrastive specification as needed for a specific language, given the set of phonemes that the learner has established. As in Dresher's approach, RCVP assumes that the learner first determines phonemic categories (based on frequency asymmetries between phones in the speech signal; see Edwards, Beckman and Munson 2015).

(13)



The manner in which these six elements are used to represent phonological contrast do not need to concern us here. What I draw attention to is that the idea to do everything with six elements converges with the idea to express a six-way distinction by using only C and V in three different class nodes. Indeed, Government Phonology does not recognize class nodes as primitives of the theory, although Backley suggests that a three-way distinction may be detected by the auditory, perceptual system. But by placing this three-way distinction outside the realm of phonology, GP is forced to the conclusion that the six elements have to be *enumerated*. Enumeration in the form of a list was also the hallmark of the SPE feature theory and mostly maintained in feature geometry models.[19] What makes RCVP superior to other models is that the set of 'features' (i.e., the phonetic interpretations of the C/V structures) is derived from general principles. Lists can be shorter or longer, but the set of contrastive options that is predicted in RCVP could not be different, unless we change the basic principles from which they are derived. The list-approach is replaced by an approach that uses a principled set of structures.[20]

My presentation of the RCVP model does not do justice to all aspects of it, nor does it suffice to motivate its design. I must therefore refer to van der Hulst (2020, with an update in 2021) for a book length defense of this model, using a rich array of empirical facts. As usual, the devil is in the details. Over the past couple of decades, I have proposed refinements and changes. This is to be expected, but despite such 'tinkering', I have stayed loyal to the 'minimalist program' that I have tried to follow which is to derive rather than list the set of categories that are potentially contrastive in the world's languages.

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

[18] In van der Hulst (2020) I use the symbol '∀' instead of the glottal stop symbol as the 'closed' counterpart of 'A' which means 'openness'.

[19] Van der Hulst (2020, Chapter 7) reviews a number of feature theories that rival RCVP.

[20] More recent work in Government Phonology has likewise explored the possibilities for reducing the set of elements and increasing the structures they enter into. See for example Pöchtrager (2006, this volume) and Nasukawa (2017).

5 Epilogue: Is phonology necessary?

Being on the subject of sign language phonology, I will in this section address the claim that emerging sign languages have been claimed to do not need to have 'a phonology'. Just to be clear, here I am ignoring, and in fact rejecting, the MP idea that phonology is an (evolutionary) afterthought (see Fitch 2018) and thus as such not an essential part of human language. I have here argued that both phonology and syntax constitute the form of language, being together necessary for the externalization of conceptual structure.

Sandler et al. (2011) analyze the signs in the emerging language called Al Sayyid Bedouin Sign language (ASBL), finding no evidence for a compositional phonology in terms of distinctive features. The phonetic form of the signs is highly variable, subject to interpersonal and cross-personal variation, and being highly iconic. They suggest that the phonetic form of signs has not (yet) been subjected to a phonological analysis (by the signers) in terms of representations that use contrastive features as has long been proposed for 'mature' sign languages (see Sandler to appear; Brentari 2007; van der Hulst 1993). What I will question here is the claim that the emerging language ABSL does not have a 'phonology', even though signs correlate with holistic, iconic representations in the minds of the signers.

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

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

We should not be surprised that iconic phonology precedes symbolic phonology in the emergence of a new language, especially in the visual domain. When seeking for a form to represent a concept, people naturally come up with an iconic gesture whenever possible. My point here is that phonology is about the perceptible form of mental, linguistic expressions. The bias toward symbolic, compositional phonology is the result of a long exclusive focus on spoken languages in which iconicity pays much less of a role than in sign languages, even though the role of iconicity in spoken languages has come to be recognized (see Perniss et al. 2010). The agenda for phonology is to develop theories about iconic mapping, based on early and important contributions (such as Boyes-Braem 1981; see also Brennan 1990).

6 Conclusions

In this chapter I have tried to show that phonological minimalism is a natural consequence of phonology being a scientific endeavor. There is no impact of the Minimalist Program on phonology. Attempts to minimize phonology come from within phonological theorizing. The idea

that phonological competence arises from third factors is not new. It has long been argued that phonological knowledge arises from general learning strategies. Linguistic nativism, even in the domain of syntax, is no longer a dominant idea.

I have reviewed the historical development of generative phonology, showing how the question of phonological minimalism must consider the interplay between theories of representations *and* derivations. My own attempt to contribute to phonological minimalism led me to summarize the RCVP model which reduces the number of phonological primitives to two elements. Finally, I have argued that phonology cannot limit itself to accounting for compositional structures in the form of language (in terms of *meaningful* units and structures). The lesson of taking sign languages seriously is that phonology also needs to explain how people map conceptual structures onto iconic perceptible forms.

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