The separation of accent and rhythm: Evidence from StressTyp

Harry van der Hulst, University of Connecticut
Rob Goedemans, Leiden University

1 Introduction

This chapter offers a demonstration of various applications and uses of the StressTyp dataset (Goedemans and van der Hulst 2009). Drawing on previous studies, the first part of this chapter presents overviews of the major types of stress systems as these are represented in StressTyp, both in tabular form and plotted in maps. In the second part of this chapter we focus on the use of StressTyp in providing support for a particular theoretical claim, namely the separation of (primary) stress and rhythm. Many languages display stress patterns that involve a distinction between one primary stress and one or more non-primary stresses (or rhythmic beats). Approaches to the formal analysis of stress patterns differ in various ways, one being whether primary stress and non-primary stress are derived in terms of a single algorithm or two separate algorithms. Van der Hulst (1996, 2009, 2010, 2012, this volume b), for example, presents a formal theory of word stress that separates the representation of primary stress (called the accent) from the representation of syllables that are rhythmically strong. The basic idea is that accent is calculated first, while rhythmic beats are accounted for independently (at a later derivational stage), although 'with reference' to the accent location.[1] This approach, which dates back to van der Hulst (1984), has been called 'a (primary) accent first theory' ([P]AF), e.g. in van der Hulst (1996, 2009). The theory was developed as an alternative to standard metrical phonology (Liberman and Prince 1977, Vergnaud and Halle 1978; Hayes 1980, 1995; Halle and Vergnaud 1987; Idsardi 1992) which develops a unified account of primary and rhythmic stress.

In previous work, we have supplied several arguments that support 'the separation theory'. In this article we review these arguments, this time with the specific goal of providing quantitative evidence for them with data from StressTyp, a typological database containing information about word accent and rhythm in 511 languages (Goedemans and van der Hulst 2009). Some of the StressTyp query results reported here have been taken from Goedemans and van der Hulst (2009) and Goedemans (2010a).[2]

1 In a non-derivational approach we would say that rhythmic structure is governed by constraints that are subordinate to the constraints that govern accent (as is possible in the approach presented in Prince and Smolensky 1993).

2 Goedemans and van der Hulst (2009) contains a detailed description of the history, goals and record structure of StressTyp. We note here that developments are underway for the development of StressTyp2 which will be a merger of StressTyp(1) and the *Stress Pattern Database* (SPD), constructed by Jeff Heinz (Heinz 2007). We believe that the approach taken in the present article underscores the usefulness of databases of this sort. Other useful applications of the StressTyp database can be found in *The world atlas of linguistic structures* (edited by Martin Haspelmath, Matthew Dryer, David Gil and Bernard Comrie) for which the present authors prepared several maps (Goedemans and van der Hulst 2005a-d), in Goedemans

2 StressTyp: background and use

2.1 Background

Before we embark on our presentation of the arguments supporting the separation claim, let us first briefly review the tool that we use to lend quantitative credibility to these arguments; see also van der Hulst (this volume a) . StressTyp was developed in the 1990's as a tool to aid researchers in the study of metrical phenomena. First and foremost, it was meant as a key to the literature on this topic. The database contains descriptions of stress systems, taken from descriptive grammars and mostly stated in the form of quasi parameters which are regarded as theoretically neutral; for a complete overview of the fields contained in a StressTyp record we refer to Goedemans & Van der Hulst (2009). These descriptive statements allow students of stress to use StressTyp to generate lists of languages that have certain characteristics in common. In other words, StressTyp is a tool for finding languages that are worth looking into when developing theories of stress. Since various aspects of stress systems have been coded (edge for primary stress, quantitity-sensitivity, boundedness etc.), it is also possible to search for correlations, or narrow down searches to systems that have or lack various combinations of properties. Given the intricate nature of many stress systems, and the fact that second hand representations of such systems may contain errors, or "facts" that are colored by interpretations of the author (often guided by theoretical motivations), users of StressTyp are recommended to always consult the primary sources (if not speakers) before making hard and fast claims about a certain language. This is basically what we mean when we say that StressTyp is a "key to the literature".

However, as StressTyp grew over the years, from a database containing a random set of about 170 languages to a more balanced sample of over 500 languages, its use as a reliable source for typological studies became more and more apparent. In various recent publications (Goedemans & Van der Hulst 2005a,b,c,d, Goedemans & Van der Hulst 2009; Goedemans 2010a), we have used StressTyp to generate actual percentages of occurrence for various aspects of stress systems. In many cases, rough assessments had already been proposed in various studies (based on smaller data sets or on the linguist's personal experience and knowledge of the field) but by using StressTyp it was now possible to provide more reliable percentages. Moreover, we have employed StressTyp to provide quantitative support for several theoretical claims. In the second part of this chapter, we will present some examples of the ways in which StressTyp has or can be used to reveal the 'numerical face' of stress phenomena or the theoretical claims regarding them.

Arguably, the comment made above about the accuracy of the descriptions of individual stress systems remains valid. And indeed, when using StressTyp to generate typological backup for the claims one wishes to make, it is imperative to proceed with caution. Many stress systems are rather complicated, and hence, difficult to describe in a preset format, no matter how a-theoretical. False positives can easily appear in any list

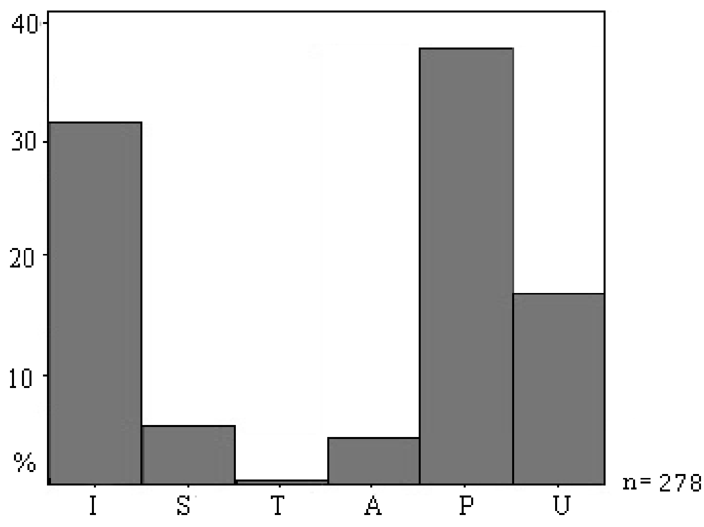
---

and van der Hulst (2009), Goedemans (2010a) and van Zanten and Goedemans (2007) and in van der Hulst, Goedemans and van Zanten (2010).

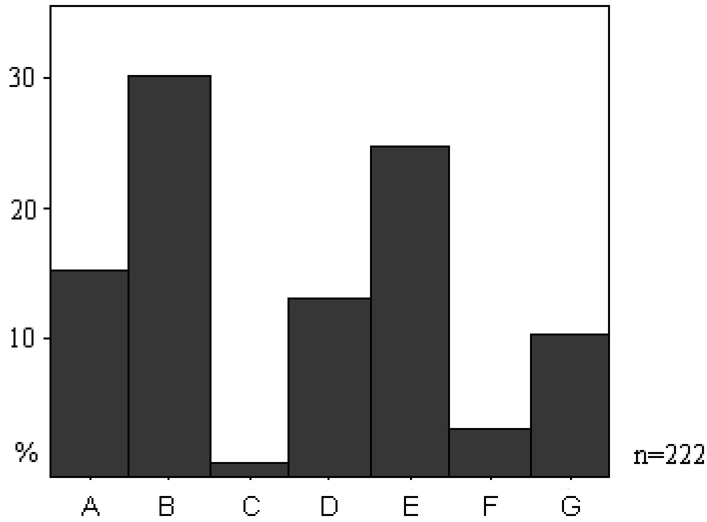
generated from the database. Therefore, all searches need to be compiled carefully, after in-depth study of all the database parameters and their usage. Even then, when dealing with complicated searches (or parameters for which *we* may have devised some unorthodox settings) it is necessary to check the output for languages that do not seem to fit the bill. For any remaining errors the law of 'big numbers' will make it unlikely that reported patterns are inaccurate as such. Given the number of uncertain factors that a descriptive record in a linguistic database depends on, one simply cannot expect to be 100% accurate all the time. Fortunately, when a database is large enough, the correct cases will heavily outweigh the false positives (see Goedemans 2010a).[3] With these various caveats in mind, let us consider some examples of how StressTyp has been put to use.

2.2 Using the database

In the past we have used StressTyp to visualize the numbers belonging to stress patterns and their properties in various ways. The most direct form is to simply show in a diagram how many languages the database contains for certain basic patterns. In Goedemans (2010a), such diagrams were presented for Quantity Insensitive and Quantity Sensitive stress systems. For the former, single stress locations were presented, while for the latter multiple locations were conflated because stress locations vary and pattern types are too numerous to put in one graph. These graphs are reproduced in figure 1.



3 We refer to de Lacy (this volume) for problems that surround the accuracy of the sources that StressTyp (and typological studies in general) relies on.



A: stress located on one of the leftmost two syllables
B: stress located on one of the rightmost two syllables
C: stress located on left word edge, but not restricted to leftmost two syllables (2 languages only)
D: stress located on right word edge, but not restricted to rightmost two syllables, or stress located on either penult or antepenult (never final).
E: stress may be located on any syllable in the word (unbounded).
F: combination of C or D and E.
G: stress location is not predictable/cannot be determined, it is either lexical, completely irregular, or there is no primary stress (all stresses are equally prominent).

Figure 1. Stress Types in QI (top) and QS (bottom) languages (taken from Goedemans 2010a)

To get a comprehensive overview of "edge preferences" in properties of stress systems that are related to edges we might group even more types into single categories. We do that in figure 2, at the same time combining the basic graphs from figure 1 and adding rhythm and extrametricality edge information. We observe that rhythm fails to adhere to the general preference for right edges in that it quite clearly prefers to start at the left edge.

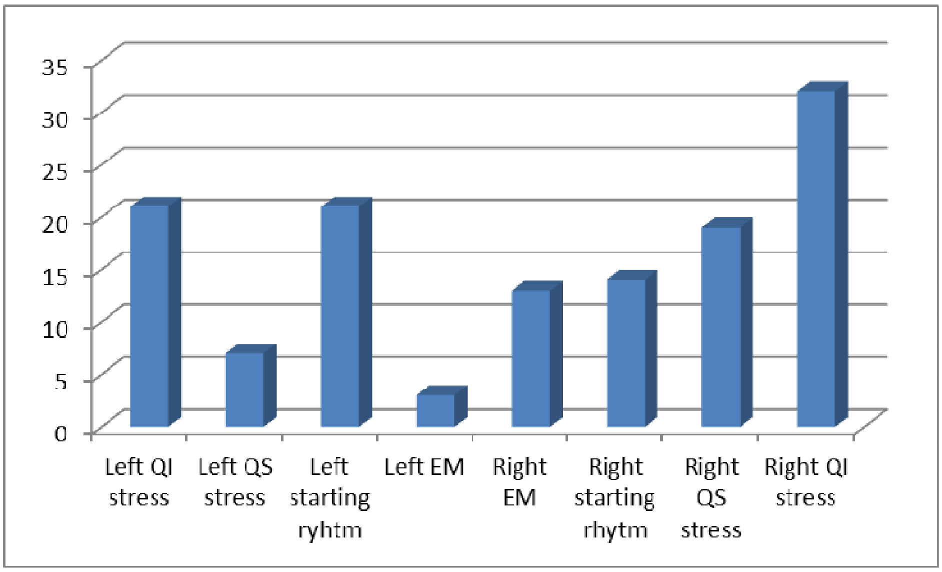


Figure 2. Edge preferences in stress systems, relative to total number of languages in StressTyp (i.e. 511 languages)

Alternatively, visualization could take the form of maps. Quite often, just plotting the values of a certain parameter on a map for a good sized sample of the world's languages will reveal striking areal patterning. This enterprise was undertaken on a large scale by the World Atlas of Language Structures project, in which StressTyp was the source for four chapters (maps) on stress patterns (cf. Goedemans & van der Hulst 2005a,b,c,d). The areal distribution of QI and QS systems was shown there, as well as rhythm types and the various types of quantity sensitivity that may feature in stress systems. Later, in Goedemans & van der Hulst (2009) we included a map showing which languages use iambic and which use trochaic feet in the placement of (default) primary stress, while in Goedemans (2010a), a map showing just the division between QI and QS systems was presented. As an illustration of the areal patterning that such maps may reveal, we present two additional maps here. The first shows the distribution of bounded and unbounded systems in the QS realm.

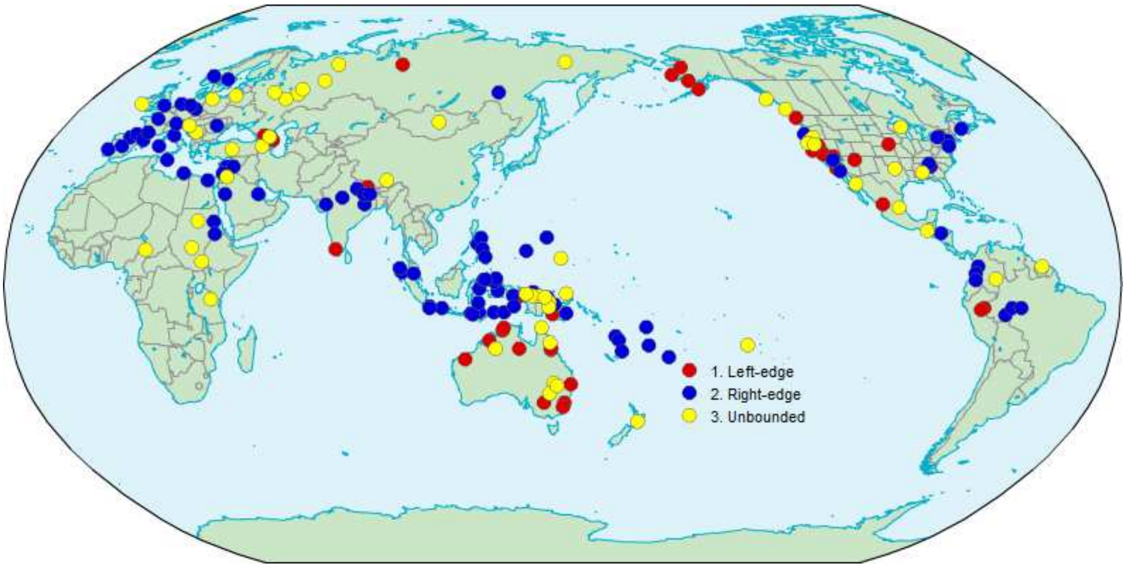


Figure 3. QS systems, broken down by boundedness. Map created with the off line version of WALS. © H-G Bibiko.

The second map may serve as an illustration for chapter 11 in this volume. This map presents the division between iambic and trochaic stress systems in North America.

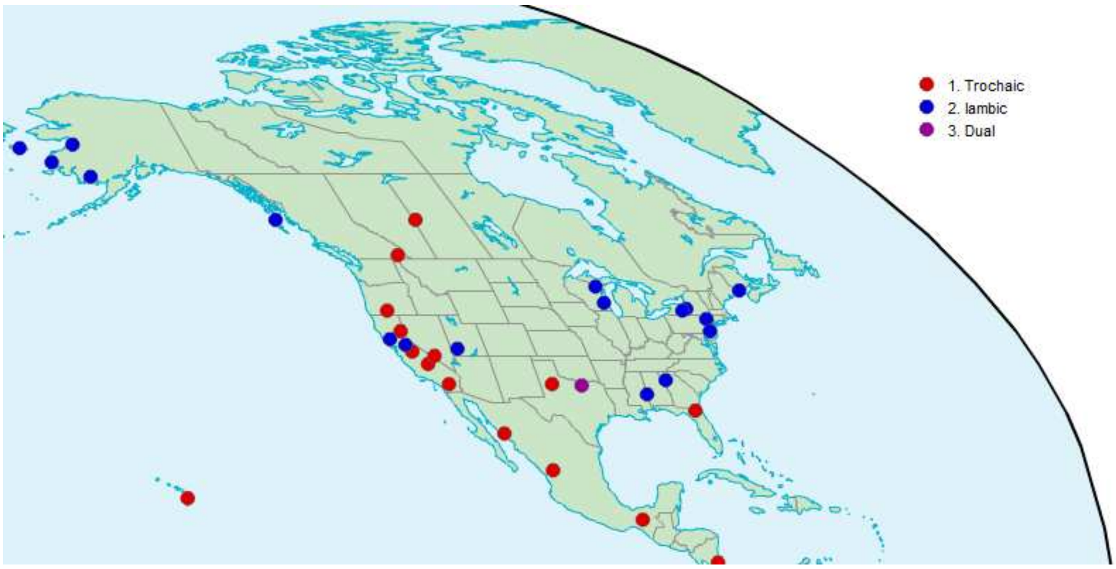


Figure 4. Rhythm types in North America. Map created with the off line version of WALS. © H-G Bibiko.

As a final example of how StressTyp can be used, let us look at a case that is less straightforward than the direct visualisations of parameters and their values presented in figures 1-4. We can also use StressTyp to lend support to hypotheses concerning linguistic implications. Such cases were discussed in Goedemans & van der Hulst (2009) and Goedemans (2010a). Let us, for the sake of the argument, test the hypothesis (which turns out to be false) that the location of primary stress in quantity-sensitive, bounded systems in any given language is always the same when the two syllables in the primary stress domain are equal in weight. Thus, whether both syllables are light or both heavy, the hypothesis says that we get stress on either the first or on the last of a sequence "LL" or "HH" (L= light syllable; H = heavy syllable). We need four queries to get the answer, one for each combination of domain type and edge (LL=left + HH=left; LL=left + HH=right, etc.) The results are as follows:

	Stress heavy-heavy	
Stress light-light	Left	Right
Left	23	68
Right	16	6

Table 1. Preference for stress location in HH domain, broken down by default (LL) stress.

So, there are 23 cases in which stress is always on the left-hand syllable, whether the domain is LL or HH. However, we can clearly see that our hypothesis is falsified. In fact, the data show that the number of cases that do not conform to the hypothesis is rather high. In no less than 68 cases, stress is on the right-hand syllable in the HH domain, while it is on the left-hand syllable in the LL domain (as opposed to the 23 harmonic left-left cases, and only 6 harmonic right-right cases). Had the hypothesis been 100% correct, we should have found no such disharmonic cases. If we look a little further, we realize why it is logical that our hypothesis was falsified. Let us check the values of the Stress heavy-heavy parameter in comparison with the location of the bisyllabic stress domain.

	Stress heavy-heavy	
Domain	Left	Right
Left	30	7
Right	10	68

Table 2. Location of primary stress in HH domain, broken down by domain location.

The real dependency seems to be the one between the location of the stress domain in the word and the preference for which heavy syllable receives stress within that domain: stress likes to land on heavy syllables near the edge, ignoring completely what would happen in case there are no heavy syllables. This edge preference explains why the hypothesis we tested turned out to be false.

Since StressTyp contains quite a few fields, one could easily provide figures for many more parameter combinations. In the next section we will present the results of a set of queries that were performed to provide support to the theoretical claim mentioned in section 1, namely that primary stress and rhythm are independent phenomena that should not be unified within a single stress algorithm.

2 Two views on the relation between primary stress and non-primary stress(es).

As an example of the unified approach, let us briefly review how stress patterns are derived in standard metrical theory (Liberman and Prince 1977); see also van der Hulst, this volume a. First, syllables of words are organized into headed feet. Second, primary stress is derived by organizing the feet into a *word structure* in which one foot is the head. The head of the head foot expresses primary stress. In this view, then, rhythmic beats are assigned *first*, while primary stress is regarded as the promotion of one of these rhythmic beats. Metrical theory, clearly, views primary stress as being dependent on the factors that determine the rhythmic structure of the word. Rhythm and primary word stress are represented in terms of one structure, albeit that in this structure there are two levels which directly correspond to this distinction.

In van der Hulst (1984), and subsequently in a number of other articles (see van der Hulst 1996, 2009, 2010, 2012, this volume b), a different approach is developed. Rather than building primary stress on the basis of rhythm, it is suggested to reverse the relationship and assign an accent first, making the assignment of rhythmic beats a truly secondary matter. A similar claim has been made in other studies, sometimes only with reference to specific systems (Odden 1979[4], Harms 1981, Roca 1986, Goldsmith 1990, Hurch 1996, Bailey 1995). Harms (1981) called this method a ‘backward approach’. McGarrity (2003), adopting an OT-approach, offers support for the idea to separate primary and non-primary or rhythmic stress by discussing numerous cases in which the constraints bearing on both differ in one way or another (cf. below).

We regard the primary stress as a correlate of accent (in terms of phonetic properties such as duration, hyperarticulation etc.) which may or may not be accompanied by overall word rhythm in which the accented syllable is the strongest rhythmic beat. A language can have an accentual system without having stress, in which case the accent may interact with some other aspects of words, such as the tonal system (a tone accent language) or a specific pitch pattern (a pitch-accent language). A language may also have a stress module that is not ‘fed’ by an accentual module, in which case stress is fully predictable. We assume that as soon as a language allows for exceptional stress locations, *all* stress locations are dependent on an accentual algorithm. The separation theory says that stress in stress-accent languages is separated from and prior to rhythm. The relationship between non-accentual (i.e. automatic) stress[5] and rhythm

4 Odden clearly demonstrates that the account of stress in Chomsky and Halle (1968) was also unified, and, in this sense, metrical theory continues that view. He presents arguments to separate the treatment of primary stress and non-primary stress that are similar to the ones discussed in this chapter. Odden concludes that both aspects of word prominence should perhaps always be separated, even in case where, perhaps accidentally, the two could be collapsed into one rule. Again, that is also the position taken here.

5 It should be noted that fully automatic word stress is often very elusive, sources being uncertain as to its precise location or phonetic properties; see Goedemans and van Zanten (2007) on the case of Indonesian.

remains to be established. For a detailed discussion of these matters, we refer to van der Hulst (2012, this volume a, b, in prep).

The crucial claim of the accent approach suggested here is that primary stress (or rather accent) assignment and rhythm, perhaps more often than not, simply cannot be captured in terms of a single algorithm which essentially sees the primary stress as a promoted rhythmic beat. This suggests that, in these cases, there will have to be two independent algorithms. The fact that primary stress assignment (in the form of accent assignment) in some sense *precedes* rhythm assignment is, in retrospect, a separate issue. It is one way of explaining that accent and rhythm, while captured in separate algorithms, display a one-way dependency that precludes accent being dependent on rhythm.[6] This dependency takes two forms (see van der Hulst, this volume b). On the one hand, the most common form of rhythm appears to be one that starts at the location of the accent and moves to the other edge from there; below we call this *echo rhythm*; cf. Garde's 1968 apt phrase 'echo accent' for rhythmic beats. Another possibility, identified in van der Hulst (1984), in which rhythm comes from the opposite edge, is called a *polar rhythm*. Systems with polar rhythm have been called polar, dual and directional. Van der Hulst (this volume b) and Moskal (to appear) propose that polar rhythm results from two steps, one assigning a beat to the syllable that lies at the edge opposite to the primary stress and a second step in which this polar beat itself triggers a rhythmic wave moving away from it. Of course, by recognizing the polar beat as an independent ingredient of word prosodic patterns, we also need to reckon with the possibility of rhythm moving away from the primary stress toward the polar beat.[7]

Polar beats are captured under the notion Edge Prominence, as developed in Moskal (2011). An interesting possibility is to hold this mechanism responsible for 'primary stress' in non-accentual stress languages. Like rhythmic alternation, we would assume that edge prominence is an automatic process and we would locate both mechanisms at the post-lexical level, accent assignment being a lexical mechanism. The dependencies between accent on the one hand and edge prominence and rhythmic alternation on the other hand fall out naturally if accent assignment comes first in a derivational sense, which is naturally expressed by locating these phenomena at the lexical and post-lexical level, respectively. We refer to van der Hulst (this volume b) for a detailed discussion of these matters.

In a non-derivational model, this relationship would have to be accounted for by simply *stipulating* the one-way dependency that holds between the accent and the rhythmic plane (assuming that edge prominence *and* rhythmic alternation are both located in this plane). Note that, here, the notion of 'dependency' captures what is expressed in terms of ranking in OT (cf. van der Hulst 2011). For those working within an overall dependency approach, it comes as no surprise that dependency relations hold everywhere, not just between units within a plane, but also between planes. In that sense,

---

6 While saying this we are of course aware of what we have called 'count systems' in which this type of dependency seems to hold; see van der Hulst (1997, 2012, this volume b) for a discussion of these kinds of systems.

7 Liberman and Prince (1977) introduce a rule of Initial Beat Addition that accounts for the initial secondary stress, and which arguably is somewhat like the Edge Prominence rule. Note that this rule in their account follows rather than precedes the assignment of rhythmic alternation, whereas, as stated here, Edge Prominence precedes rhythm.

it could be said that a non-derivational approach appeals to a notion (dependency) that is available to grammars anyway.

In this article, we will not focus on these derivational issues nor on details of the accent and rhythm representations. Instead, taking edge prominence and rhythmic alternation to be included in the notion of rhythm, we will focus on the notion that accent and rhythm often have different properties, which prevents the unification that metrical theory was trying to capture.

3 Bottom-up and top-down parsing

The initial (and, in retrospect, perhaps not the crucial) motivation for the separation hypothesis (in van der Hulst 1984) was that primary stress in most systems seems to fall on the foot that is assigned first in the classical metrical account.[8] Formally, this means that in systems that assign feet from left to right, the word tree would almost always be left-headed, while it would be right-headed in right-to-left systems. This pattern would be non-surprising if primary stress is *universally* assigned first, with rhythm typically 'echoing' (or rippling away). However, although in the majority of systems the edge of iteration and the edge of primary stress coincide, it is nonetheless the case that in some systems the opposite situation obtains. If, for example, primary stress is initial in words consisting of an even number of syllables, while it lies on the second syllable when the number is odd, it would seem that the syllables have to be parsed into left-headed feet (from right to left) first, so that after that the leftmost foot can be selected as the word head. Systems of this kind were called *count systems* in van der Hulst (1996, 1997). Crucially, in such systems, footing has to precede primary stress assignment because it is not possible to locate accent locally at the left-edge of the word. We can find this pattern in Malakmalak, discussed in Goldsmith (1990: 173-177).

Quoting van der Hulst (1984), Hayes (1995) refers to the accent first mode as 'top-down parsing,' suggesting that the word tree is built first, while foot structure is 'tucked in' later.[9] He then refers to Tiberian Hebrew, Cahuilla, Tümpisa Shoshone, Czech, Mayi, Old English, Cayuvava and Estonian as other cases for which he himself has adopted a 'primary stress first' analysis. We will not discuss his specific reasons for coming to this conclusion here, but at this point only draw attention to the fact that Hayes recognizes the need for a primary stress first approach. Referring to cases such as Malakmalak for which a primary stress first approach would yield "an extremely complex primary stress rule", he concludes that for these languages "the bottom-up analysis is far more straightforward". Hayes (1995, 117) asserts that for "the majority of languages, it is apparently impossible to determine the answer, because primary stress usually falls on the point of origin of the alternating count […]. For concreteness, I

8 This correlation was independently noted in Hammond (1985).

9 Apparent top-down systems have been used in the early OT-literature (Prince and Smolensky 1993) as an argument against the possibility of accounting for all stress systems derivationally. If one assumes that metrical structures are generated randomly (by the so-called generator), the top-down 'syndrome' would exist when constraints bearing on the word structure outrank constraints bearing on foot structure. For example, in a system where rhythm is weight-sensitive, while at the same time primary stress is fixed on the initial syllable, irrespective of its weight, a constraint which demands that the head of the word is 'left-aligned' would outrank the constraint expressing weight-sensitivity.

express stress in bottom-up fashion here except where the facts require otherwise." Thus, Hayes decides that the 'rhythm first' approach is the "default mode, while the 'primary stress first' systems require a treatment that deviates from the default method". Here, following our earlier work, we adopt the opposite view by taking the primary stress first mode as the default, which entails that count systems need a special treatment. For a discussion of how these count systems can be analysed see van der Hulst (2012). [10] [11]

Although we do not want to claim that frequency differences can be used as proof to decide on competing theories, let us consult StressTyp with respect to the difference between count systems and non-count systems. We give both absolute numbers and percentages:

<u>Systems *with* rhythm</u>

non count	echo rhythm	126	70%
	polar rhythm	39[12]	22%
count		15	8%

Table 3: Results of Query 1 (Types of rhythm)

These results confirm that in 22% of the cases, primary stress is not dependent on rhythm, since rhythm comes from the other side. (This percentage would be higher if we were to include other reasons for why primary stress should precede rhythm.) More important is the asymmetry between echo rhythm systems and count systems. If rhythm always precedes primary stress assignment, there is no explanation for the fact that count systems are so low in number. The view that rhythm follows accent assignment *explains* the high frequency of the echo cases because the simplest way to respect accent is to anchor the rhythmic melody to it and 'spread it out' from there. In a standard metrical account where rhythm precedes the selection of primary stress, there is no *dependency* between the edge at which rhythm starts and the edge for primary stress. The fact that there are many more echo systems than count systems suggests, however, that such a dependency is likely to be real and this is precisely what the separation theory predicts. The theory simply rules out the dependency in the other direction (which raises the

10 It is possible that what is called primary stress in such a language is an intonational effect. It would not be reasonable to suggest that such systems result from applying edge prominence *after* rhythm, since the discussion of polar systems suggests that EP applies *before* rhythm. Count systems can sometimes be analyzed as *transitional systems* which in a temporal or geographical sense lie in between systems that have primary stress on opposite edges. See Goedemans (2010b) for this point with reference to count systems in Australia.

11 Al-Mohanna (2007) applies the idea of separating primary stress and rhythm in an OT-analysis of count systems that lack phonetic evidence for the iterative foot structure that is supposedly necessary to compute the location of primary accent. In earlier accounts (cf. Halle and Vergnaud 1987) such systems have been analyzed in terms of 'line conflation', a mechanism that perhaps casts doubt on the claim that count systems crucially motivate the necessity of a rhythm first method. See Crowhurst (2004) for another OT-attempt at systems of this sort.

12 This number includes cases with polar secondary stress with and without further alternating rhythm; see table 5.

question of how count systems should be dealt with), but perhaps it allows another dependency in which rhythm responds to a polar stress, while still respecting the stress corresponding to the lexical accent in not producing a clash in its spread towards the stress-accent.

In the next section we will discuss some more specific reasons for rejecting the metrical bottom-up approach as the default mode. But first, we will discuss one other more general argument.

After having presented many case studies on languages with stress, Hayes (1995: 116-117) states:

> "In all the analyses given so far, bracketed grids have been constructed from the bottom up. […]. Van der Hulst 1984, 178-82, suggested a less obvious procedure: assign the primary stress first. […] Which of these two options (bottom up vs. top down) is correct? The answer appears to be that it depends on the language in question. For example, in Swedish […], it is clear that primary stress must be assigned before secondary stress, since primary stress assignment is lexical, secondary post-lexical."

We would like to strengthen this argument by pointing out that is highly typical for primary stress and rhythm to display the kinds of properties that are generally associated with lexical and post-lexical processes. In fact, whereas the location of primary stress may, in principle, be post-lexical in those cases in which it is absolutely fully automatic, we believe that this is not at all typical. Even in languages that are said to have predictable primary stress more often than not descriptions will refer to *exceptions*. However, it would seem that non-primary stresses (polar beats, alternating rhythm) *are* typically fully automatic. In general, all the usual criteria for distinguishing between grammatical ('lexical') and utterance ('post-lexical') rules seem to square with the differences between locating accent (for primary stress) and secondary rhythmic beats. A consequence of being lexical is that accent can be sensitive to *lexical exceptions* (however these are marked), specific *word classes*, *morphological structure* and *'stratal differences'* (classes of words with different origins, such as being imported from another language). As said, it is indeed very common for primary stress to have exceptions. An extreme case of lexical exceptionality occurs in so-called lexical accent systems, in which most individual morphemes must be lexically marked for accent (Revithiadou 1999). We also see that primary stress can be sensitive to a difference between e.g. nouns and verbs (which might be the case in Rumanian; cf. McGarrity 2003) and in fact, in English, where we see a difference between nouns and verbs/adjectives. StressTyp reports more such cases (like Ghodoberi described in Kodzasov 1999). Finally, stress location can be sensitive to morphological structure in the sense that its location is determined with reference to the 'stem' rather than the whole 'word' (however these notions are defined). Another kind of morphological determination is found when specific sets of suffixes have specific accentual properties (such as being accented, or 'pre-accenting').

The strongest claim, following from its post-lexical status, would be that rhythm can*not* be sensitive to any of these factors. This claim strikes us as generally correct. Obviously, various kinds of apparent counterexamples need to be addressed, including claims that different word classes have different rhythmic patterns and the need for specifying unpredictable rhythmic beats; we refer to van der Hulst (in prep.) for such matters.[13]

As for rhythm, it would seem that the usual criteria for post-lexical status certainly apply. Details of rhythmical structure can be dependent on speech rate and formality (see Hualde and Nadeu, this volume) as well as on larger phrasal context (see Roca 1986).

Concluding, both the fact that languages in which the location of primary stress is crucially based on a prior layer of footing (i.e. count systems) are rare and the fact that rhythmic stress has all the properties of a post-lexical process suggest to us that a model in which primary stress (i.e. accent) is assigned prior to non-primary stress such that the former is lexical, while the latter is post-lexical, is superior to the standard metrical bottom-up approach. Finally, we might ask whether this approach explains why an echo rhythm (in which accent is the direct anchor for rhythm) is more likely than a polar rhythm. To explain this we would point to the fact that accents are more robust anchor points for rhythm which is subject to post-lexical variabilities.

4 Additional arguments for AF

Once the accent first approach had been proposed, additional motivation for it emerged. From the viewpoint of metrical theory, there are several situations in which a unified algorithm simply cannot account for both primary and non-primary stress.

In the following survey of arguments, the reader must bear in mind that we state the differences between primary stress and non-primary stress *in terms of standard metrical terminology* to make the point that *within this approach* different algorithms would be required. Here, we will not focus on how we would analyse all the systems mentioned in terms of the AF theory (for in depth discussion see van der Hulst 2012, this volume b, in prep.).

4.1 Accent and rhythm can differ in terms of extrametricality

In metrical theory, extrametricality is a device that accounts for the fact that a peripheral syllable (usually the one on the right edge) is unavailable for 'stress'. If accent and rhythm are separated we expect that extrametricality could apply to only one of these or even to both in different ways (given that different entities such a syllable or final segments can be extrametrical). It would seem that cases in which accent is subject to an extrametricality requirement, while rhythm is not, certainly exist. McGarrity (2003) mentions Khalkha as a case in point. Here accent lies on the rightmost *non-final* heavy

13 Chuck Cairns pointed out to us that the proposed separation of accent and rhythm, the former being lexical, the latter implementational, predicts that morphological processes are more likely to be dependent on accent than on rhythm. An interesting challenge to this prediction (brought to our attention by Carlos Gussenhoven) is that the allomorphy of the diminutive suffix in Dutch is sensitive to the presence of a stem final beat, whether accentual or rhythmic. See van der Hulst (2012, in prep.) for a discussion of this and other cases.

syllable. Yet, all heavy syllables, including one that is final, are said to have 'secondary stress'.

Extrametricality

EM (yes) for Primary stress and EM (no) for Rhythm	14 Languages

Table 4: Results of query 2 (Differences in Extrametricality)

Munsee and Unami (Goddard 1982) are prototypical cases. Both have EM on the right side of the word for primary stress, but not for rhythm.

4.2 Accent and rhythm can differ in choice of word edge

As discussed in section 2, rhythm can either echo away from the primary stress location or come from the other side. The second case, polar rhythm, provides a further argument for separating primary stress and rhythm. Such a situation forms an embarrassment for the standard theory because, clearly, two separate algorithms are necessary. In this case too, it is of course possible to have two phases of foot assignment in the standard approach. English qualifies as a language with right-edge primary stress and left-to-right polar rhythm. It is possible to analyze this with a first foot layer (right-to-left) of which we erase all but the rightmost foot and then a second assignment of foot structure, now from left-to-right.[14] Or one might suggest that a foot is assigned non-iteratively at the right edge, followed by an iterative application from left-to-right. One would expect to also find cases in which accent is placed at the left edge, while rhythm comes from the right, a situation that has indeed been suggested for Garawa, for which a two-step analysis is also possible. The point is, of course, that such derivations (designed to deal with primary stress and rhythm separately) are not expected given the core design of standard metrical theory.

The results of Query 1 (Table 3) show that polar systems are fairly common. We also find the same kind of duality in languages that do not have alternating rhythm and yet have polar secondary stress on the edge that lies opposite to primary stress. Thus the group with polar non-primary stress has two subclasses, those with alternating rhythm stresses and those with a single non-primary stress.

Starting edge for direction of footing

Polar Rhythm	Iterative	15
	Non-iterative	24
Total		39

14 This comes close to Halle and Vergnaud's (1987) account of English, a language with right edge primary stress displaying polar rhythm, in that the initial syllable will typically be rhythmically strong (as long as primary accent is not on the second syllable).

Table 5: Results of query 3 (Differences in edge selection)

We conclude that for a significant number of languages it is not just the case that we can account for primary stress without assigning rhythm first. Rather in 39 languages assigning rhythm first will make it impossible to derive primary stress.

4.3 Accent and rhythm can differ in weight-sensitivity

We now turn to four queries that bear on the type of foot that is needed for primary stress and rhythm. Cross-linguistically, feet can differ in weight-sensitvity, 'arity' (binary, ternary), headedness (left, right) and boundedness. We will see that for all four parameters, the required foot type can differ. We start, in this section, with weight-sensitivity.

The AF theory predicts that the weight-criteria for primary stress and rhythm may differ from each other. After all, in the AF theory we have two distinct algorithms, one for accent, and the other one for rhythmic beats. Nothing, then, prevents one from being quantity-sensitive, while the other is not, or both from being quantity-sensitive in different ways. Clearly if such discrepancies exist, they are *un*expected from the viewpoint of the standard metrical account, which then needs to be amended by allowing two different phases of foot assignment, the one that accounts for primary stress either being non-iterative or seeing most of its feet erased. An example of such a discrepancy between accent and rhythm occurs in Tübatulabal, which assigns primary stress to the final syllable, irrespective of its weight. At the same time, the distribution of rhythm appears to be sensitive to syllable weight (Hayes 1995). The same point can be made for Finnish and Proto-Germanic (i.e. primary accent is QI, while rhythm is QS). One might suspect that the reverse situation (primary accent is QS, rhythm is QI) is also possible and one might plausibly argue that this, in fact, applies to languages such as English and Dutch. Thirdly, there are also cases like Meso Grande Diegueño (Couro and Hutcheson 1973) in which both accent and rhythm are weight-sensitive in different ways, i.e. in which the weight criteria for accent and rhythm differ.

Weight-sensitivity

Accent	*Rhythm*	
weight-sensitive	weight-insensitive	31 lgs
weight-insensitive	weight-sensitive	17 lgs
weight-sensitive A	weight-sensitive B	8 lgs
Accent	*Rhythm*	
weight-insensitive	weight-insensitive	102 lgs
weight-sensitive	weight-sensitive	52 lgs

Table 6: Results of query 4 (Differences in weight-sensitivity)

The results in table 6 clearly show that it is not at all uncommon for weight-sensitivity to differ for accent and rhythm.

4.4 Accent and rhythm can differ in 'arity'

In this section we consider cases in which the primary accent foot is binary, whereas rhythmic feet establish a ternary pattern, as in Chugach (Hayes 1995: 333). If there are languages that have antepenultimate primary stress combined with binary rhythm, one could construe this as the opposite situation.

Binary and ternary feet

Ternary rhythm and a binary primary accent foot:	6
Antepenultimate (QI) primary stress and binary rhythm:	3
Antepenultimate (QS) primary stress and binary rhythm:	9
Antepenultimate stress with binary rhythm as common exception:	3
Total	21

Table 7: Results of query 5 (Differences in arity)

We did not find cases with a binary foot for primary stress and ternary rhythm, but we see no reason why, in principle, a language showing this pattern could not be found.

4.5 Accent and rhythm can differ in foot headedness

A fifth motivation involves languages in which foot types necessary for primary stress and rhythm differ in headedness. From the viewpoint of classical metrical theory such systems again form an anomaly. If foot types for accent and rhythm differ in this way, again both aspects cannot be captured in a single metrical recipe. It is always possible to propose two algorithms, one non-iterative (for primary accent) and one iterative (for rhythm), but this, in itself, suggests that a separation of accent and rhythm is called for.

Left-headed (trochaic) or right-headed (iambic) feet

Languages with foot type specification for Primary stress and Rhythm	163
Primary stress trochaic	138
Rhythm type trochaic	133
Rhythm type iambic	2
Rhythm type both iambic and trochaic	3

Primary stress iambic	25
Rhythm type iambic	15
Rhythm type trochaic	9
Rhythm type both iambic and trochaic	1

Table 8: Results of query 6 (Differences in headedness)

All in all, 7% of the languages in StressTyp show a mismatch of this type (disregarding the “both iambic and trochaic”-cases in the count). What strikes us further is the huge ratio difference between mismatches in which primary stress is trochaic and those in which it is iambic. Relatively, there are far more languages preferring trochaic feet while primary stress is iambic than there are languages preferring iambic feet while primary stress is trochaic. This, of course, reflects the general preference for trochaic feet in all languages (see Goedemans & van der Hulst 2005d).

4.6 Accent and rhythm can differ in boundedness

A fourth property of feet is their size, with the options of being bounded or unbounded. We find a difference of this sort when primary stress is fixed on, let us say the first syllable, while in the remainder of the word, only heavy syllables receive a ‘rhythmic’ beat, as in the Waalubal dialect of the Australian language Bandjalang (Crowley 1978). In metrical theory, such systems can be analyzed in terms of unbounded feet, but it is also possible to interpret this case as combining bounded feet (for primary accent) and unbounded feet (to mark the rhythmic beats).[15]

Bounded and unbounded feet

Primary stress bounded, rhythm QS unbounded	12
For comparison	
Primary stress bounded, rhythm QS bounded	38
Primary stress unbounded, rhythm QS unbounded	4

Table 9: Results of query 7 (Differences in boundedness)16

15 In fact, a language of this type would appear to have no rhythm at all, just syllable weight; all heavy syllables are marked on line one of the grid.

16 The “Primary stress unbounded – Rhythm bounded” type also exists and is exemplified by Yidin^{y} (Dixon 1977) which places primary stress on the first heavy or the first and secondary stresses on alternate syllables before and after the primary stress. This type also supports the separation of primary stress and rhythm. It is not represented in table 9 because we did not want to confound the picture by introducing QI rhythm. Descriptions for the handful of languages that seemed to have unbounded primary stress and QS bounded rhythm, a type that should have been in table 9, were too unclear on this point to allow for a reliable count.

Going back to the difference in edge selection, we note that non-iterative polar systems *could* also be analysed as combining bounded feet (for primary stress) and unbounded feet for the single polar secondary stress. Within standard metrical theory this would be a possible analysis, which would require different treatments for primary and non-primary stress.

4.7 Other problems for classical metrical theory

Our next two queries were not designed to reveal differences between primary stress and non-primary stress. Rather, the next two arguments in favor of AF that we will discuss rest on the claim that metrical theory cannot provide an adequate account of all instances of primary stress. In both cases we consider QS systems. We first look at *bounded* QS systems in order to show that the variety of systems attested in that category cannot be covered by any foot theory that we have seen, neither the original standard symmetrical inventory (proposed in Vergnaud and Halle 1978), nor the asymmetrical revised theory in Hayes (1995). Then we turn to *unbounded systems* which, by Hayes' own admission, do not fall within the scope of metrical theory, although this claim is not shared in all versions of metrical theory (see Halle and Vergnaud 1987 or Idsardi 1992).

4.7.1 Not enough bounded foot types

In some cases, the standard theory simply cannot handle the location of primary accent in terms of its foot inventory, no matter what variant of foot theory one adopts, at least not without postulating additional 'movement rules'. These problems always seem to involve primary stress location. To illustrate the problem, let us consider bounded weight-sensitive systems, both on the left and right edge. The next two tables demonstrate that four types of systems at both edges are attested. The last column indicates how these systems could be analysed and shows that, in several cases, movement rules are required:

(1) *Weight-sensitivity in bounded systems*

Right-edge

I	x	x	x	x	**Rotuman**
	(h l)]	l(h)]	h(h)]	(l l)]	*WS trochee*
II	x	x	x	x	**Yapese**
	(h)l]	(l h)]	h(h)]	(l l)]	*WS iamb*
					QD trochee[17]
					WI iamb + R: h<l][18]

17 Hayes, originally, treated Yapese with the use of a special foot type, the obligatory-branching trochaic feet (Hammond 1986), called quantity-determined (QD) in van der Hulst (1984), which was originally proposed in Vergnaud and Halle (1978). Here the head *must* be heavy.

					Mor. iamb[19]
III	x x) (h) l]	x x) (l h)]	x<< x x) (h)(h)]	x x) (l l)]	 **Aklan** *WS iamb + R: h<h]* *WI iamb + R: h<σ]*
IV	x h l)]	x>> (l h)]	x (h h)]	x (l l)]	**Awadhi** *WI trochee + R: l>h]* *Mor. trochee*
	Left-edge				
I	x [(h)l	x [(l h)	x [(h) h	x [(l l)	**Ossetic** *WS iamb*
II	x [(h l)	x [l(h)	x [(h)h	x [(l l)	**Malayalam** *WS trochee* *QD-trochee* *WI trochee + R [l>h* *Mor. trochee*
III	x (x [(h l)	x (x [l(h)	>>x (x x [(h)(h)	x (x [(l l)	 **Capanahua** *WS trochee + R [h>h* *WI trochee + R [σ>h*
IV	<< x [(h l)	x [(l h)	x [(h h)	x [(l l)	 **Archi** *WI iamb + R [h<l* *Mor. iamb*

In each case the first analysis is the standard metrical analysis.[20] There is support for each of these eight cases, albeit sparse for some of them:

<u>Bounded weight-sensitive feet</u>

Left edge		Right edge	
Type Ossetic	11	Type Rotuman	62
Type Malayalam	13	Type Yapese	5
Type Capanahua	6	Type Aklan	5
Type Archi	1	Type Awadhi	10
Total	31		82

18 This notation means: We need a Rule that shifts accent from a final light syllable to a penultimate heavy syllable.
19 Strictly moraic feet are proposed in Kager (1993).
20 One can of course adhere to versions that would disallow some of these analyses, but it is obviously not in favor of metrical theory that so many alternatives are, in principle, available.

Table 10: Results of query 8 (Bounded weight-sensitive systems on either edge)

Clearly, a full account of possible accent locations falls outside the reach of the foot typologies that have been developed in metrical theory. AF theory constructs a separate module for accent location that can handle these complexities (see van der Hulst 2009, 2012). Rhythmic stresses do not require such complexities and, in this case, metrical foot typologies overshoot what is necessary. Once accents have been located, rhythm can be accounted for in a quite simple fashion, perhaps needing only a trochaic grid algorithm (see van der Hulst, this volume b). Accent seems to be symmetrical, allowing left and right options within the accentual domain. Rhythm, on the other hand, is asymmetrical, strongly favouring or perhaps only allowing a trochaic pattern. In conclusion, the holistic metrical toolkit is underqualified to deal with accent and overqualified to deal with rhythm.

4.7.2 Unbounded systems

Additional motivation for AF comes from the treatment of so-called unbounded systems. Various approaches to unbounded systems, employing bounded or unbounded feet, have been proposed over the years. Hayes (1995: 33) eventually concludes that such systems *are* non-metrical because there is no need for rhythmic foot structure in order to derive the location of primary stress. Nonetheless, such systems require an algorithm to derive primary stress and in some cases an acknowledgement that all heavy syllables are prominent. Hayes remarks that “because the facts in this area are quite simple and fill out all the logical possibilities it is hard to develop a theory that goes much beyond just describing the facts.” This, in a sense, is disappointing because the original theory, at least, managed to express a kind of parallelism between bounded and unbounded systems (see Vergnaud and Halle 1978). The two differed in foot size, but otherwise fell into the same types.

Unbounded systems

F/F: Stress the first heavy syllable, or the first syllable if there are no heavy ones	22
F/L: Stress the first heavy syllable, or the last syllable if there are no heavy ones	8
L/F: Stress the last heavy syllable, or the first syllable if there are no heavy ones	11
L/L: Stress the last heavy syllable, or the last syllable if there are no heavy ones	5
LEX: Stress is lexically determined and can occur anywhere in the word	21
Unique: Stress my occur anywhere in the word, governed by intricate rules	15
Total	82

Table 11: Results of query 9 (Unbounded systems)

In AF theory the four types of unbounded systems parallel the four types of bounded systems that we find on each edge (see query 8), so in this sense AF recaptures an original insight of standard metrical theory that got lost along the way. The four logical possibilities can be derived in terms of two rules that van der Hulst (2012) called Select and Default, both of which have two values (Left, Right). In (4) bold sigmas represent heavy syllables. In weight-sensitive systems each heavy syllable gets an accent. The stress domain can be bounded (bisyllabic) or unbounded. If this domain contains only one heavy syllable, there is nothing further to say. If there is more than one heavy syllable Select picks out the accent that 'wins' and if there are no heavy syllables Default assigns an accent. This, as shown in van der Hulst (2012) is all the apparatus we need to derive four types of bounded systems (both for the left and right side of the word) and four unbounded systems:

(2) *Bounded and unbounded systems*

Weight-sensitive	Bounded (right/left edge)				Unbounded	
	x	x	~~x~~ x	x	~~x~~ x	x
Sel(R);Def(R)	(**σ**σ)	(σ**σ**)	(**σσ**)	(σσ)	(σσ**σσ**σσσ)	(σσσσσσ)
	x	x	x ~~x~~	x	x ~~x~~	x
Sel(L);Def(R)	(**σ**σ)	(σ**σ**)	(**σσ**)	(σσ)	(σσ**σσ**σσσ)	(σσσσσσ)
	x	x	x ~~x~~	x	x ~~x~~	x
Sel(L);Def(L)	(**σ**σ)	(σ**σ**)	(**σσ**)	(σσ)	(σσ**σσ**σσσ)	(σσσσσσ)
	x	x	~~x~~ x	x	~~x~~ x	x
Sel(R);Def(L)	(**σ**σ)	(σ**σ**)	(**σσ**)	(σσ)	(σσ**σσ**σσσ)	(σσσσσσ)

A theory, such as the one offered in van der Hulst (2012) which rejects the idea that primary stress is based on bounded feet (as defended in Hayes 1995) has no problem generalizing over bounded and unbounded systems.

5 Conclusions

In this chapter, it was our aim to provide some examples of how a database such as StressTyp can be used. We provided some straightforward examples and then proceeded to a more complex application in which our aim was to use data from StressTyp to investigate to what extent primary stress and non-primary stress can*not* be unified in one algorithm. What got us started on this pursuit is the huge difference in the number of systems in which rhythm can be seen as responding to primary stress being there first (whether echo or polar) and systems in which rhythm must crucially be established first. This was supported by our first query:

Q1: echo/polar systems versus count systems

Thus having established the grounds for a separation theory, we performed 6 queries which directly reveal cases in which there cannot be a single foot algorithm for primary stress and non-primary stress. We essentially established that with respect to all so-called metrical parameters such differences can be found:

Queries that show difference between primary and non-primary stress

Q2: differences in extrametricality
Q3: differences in edge selection
Q4: differences in weight-sensitivity
Q5: differences in arity
Q6: differences in boundedness
Q7: differences in foot types

Finally, we supported the now well-established AF theory by performing two queries that reveal cases of weight-sensitive stress in which metrical theory cannot deliver an adequate account of primary stress locations:

Q8: bounded systems
Q9: unbounded systems

Our queries pretty much exhaust the list of parameters that have been proposed in the metrical literature, starting with Vergnaud and Halle's (1978) seminal paper. We suspect that if additional parameters have been proposed, it would always be possible to again locate systems in which accent and rhythm require different settings.

An anonymous reviewer expresses the view that our results are eminently descriptive, as opposed to aimed at explanations. In addition, the reviewer observes (correctly, we believe) that there are properties that cut across primary and secondary stresses, pointing to the fact that in English the two swap without any further recalculation in pairs like *ábsolùte/ àbsolútely*. Also, primary stresses can be preserved as secondary stresses in word formation as in *medícinal/medìcinálity*. Such correlates, it is claimed, are said to be mysterious if both types of stresses are regarded as unrelated phenomena. A further remark, bearing on what we have called Edge Prominence, regards the fact that patterns of secondary stress assignment are weignt-sensitive as in *Monòngahéla* (**Mònongahéla*), just as the pattern of primary assignment is, e.g. agénda (**ágenda*) again suggesting a close relationship.

Firstly, we would like to claim that the proposed separation theory explains the observed discrepancies between primary and non-primary stress in the sense that this theory leads on to expect that such discrepancies are going to occur regularly. Cases in which the location for primary stress 'shifts' (*ábsolùte/ àbsolútely*) are in our view possible because both the primary stress (based on accent) and secondary stress (based on Edge Prominence) can function as anchor points for intonational pitch accents. For a discussion of cases like *medícinal/medìcinálity*, which involve so-called cyclic effects we refer to van der Hulst (this volume a). Finally, it is of course true that both accent and rhythm (including Edge Prominence) can both be weight-sensitive. But as we have seen, there are numerous cases where the two differ in weight-sensitivity. It is simply a logical possibility that both can be sensitive to weight in the same way (although it remains to be established that in English both are in fact sensitive to *the same* weight properties).

We conclude that there is good empirical support for our decision to separate the treatment of primary stress (accent) and rhythm. In this chapter, we have not proposed specific theories for accent and rhythm. For the latter we refer to van der Hulst (this volume b) and for the former to van der Hulst (2012). We do not doubt that especially bounded accent location is perhaps grounded in rhythmic principles or tendencies, or indeed in functional factors that relate to edge demarcation, but this does not mean that, synchronically, accent location is rhythm-based. Gordon (this volume) in fact suggests that penultimate or second syllable stress may have nothing to do with foot structure, but rather finds its rationale in the avoidance of tonal crowding when complex intonational tones associated to the edges of words. However, no matter what the historical causes are, when natural phonetic or functional factors are conventionalized (or 'grammaticalized') they get divorced from their phonetic or functional bases and can thus acquire properties that are different from that which they are grounded in, either simply because they are now independent and free to develop in their own way or because the computational machinery that is available to the mental grammar stipulates certain kinds or properties that aren't grounded in phonetics or functional factors.

Relevant Websites:

StressTyp: http://www.unileiden.net/StressTyp/
Stress Pattern Database: http://phonology.cogsci.udel.edu/dbs/stress/
Stress System Database: http://www.cf.ac.uk/psych/ssd/.

References

Al-Mohanna, Faisal M. 2007. An optimal alternative to iterative footing. *California Linguistic Notes*, Volume XXXII, No. 1,

Bailey, T.M. 1995. *Nonmetrical constraints on stress.* Doctoral Dissertation, University of Minnesota, Ann Arbor.

Chomsky, N. and M. Halle. 1968. *The sound pattern of English.* New York: Harper and Row.

Couro, T. and C. Hutcheson. 1973. Dictionary of Mesa Grande Diegueño. Malki Museum Press, Banning, California.

Crowhurtst, Megan. 2004. An optimal alternative to conflation. *Phonology* 13. 409-424.

Crowley, T. 1978. The Middle Clarence Dialects of Bandjalang. Australian Institute of Aboriginal Studies, Canberra.

Dixon, R.M.W. 1977. *A Grammar of Yidin*. Cambridge: Cambridge University Press.

Garde, Paul 1968. *l'accentuation*. Presses Universitaires de France, Paris.

Goddard, Ives. 1982. The historical phonology of Munsee. *International Journal of American Linguistics* 48. 16-48.

Goedemans, Rob. 2010a. A typology of stress patterns. In: Harry van der Hulst, Rob Goedemans and Ellen van Zanten (eds.). *A survey of word accentual systems in the language of the world*. Berlin: Mouton de Gruyter, 647-666.

Goedemans, Rob. 2010b. An overview of word stress in Australian Aboriginal languages. In: Harry van der Hulst, Rob Goedemans and Ellen van Zanten (eds.). *A survey of word accentual systems in the language of the world*. Berlin: Mouton de Gruyter, 55-85.

Goedemans, Rob and Harry van der Hulst. 2005a. Fixed stress locations. In: Martin Haspelmath, Matthew Dryer, David Gil, and Bernard Comrie (eds), *The World Atlas of Linguistic Structures*, 62–65. Oxford: Oxford University Press.

Goedemans, Rob and Harry van der Hulst. 2005b. Weight-sensitive stress. In: Martin Haspelmath, Matthew Dryer, David Gil, and Bernard Comrie (eds), *The World Atlas of Linguistic Structures*, 66–69. Oxford: Oxford University Press.

Goedemans, Rob and Harry van der Hulst. 2005c. Weight factors in weight-sensitive stress systems. In: Martin Haspelmath, Matthew Dryer, David Gil, and Bernard Comrie (eds), *The World Atlas of Linguistic Structures*, 70–73. Oxford: Oxford University Press.

Goedemans, Rob and Harry van der Hulst. 2005d. Rhythm types. In: Martin Haspelmath, Matthew Dryer, David Gil, and Bernard Comrie (eds), *The World Atlas of Linguistic Structures*, 74–7. Oxford: Oxford University Press.

Goedemans, Rob and Harry van der Hulst. 2009. StressTyp: A Database for Word Accentual Patterns in the World's Languages. In: Martin Everaert, Simon Musgrave and Alexis Dimitriadis (eds.). *The use of databases in cross-linguistics research*. New York/Berlin: Mouton de Gruyter, 235-282.

Goedemans, Rob, and Harry van der Hulst. 2010. StressTyp Data. In: Harry van der Hulst, Rob Goedemans and Ellen van Zanten (eds.). *A survey of word accentual systems in the language of the world*. Berlin: Mouton de Gruyter, 669ff.

Goedemans, Rob, Harry van der Hulst, and Ellis Visch. (1996a. The organization of StressTyp. In: Rob Goedemans, Harry van der Hulst, and Ellis Visch (eds.), *Stress Patterns of the World*, 27–68. (Holland Institute of Generative Linguistics Publications 2.) The Hague: Holland Academic Graphics.

Goedemans, Rob, Harry van der Hulst, and Ellis Visch. 1966 (eds.), *Stress Patterns of the World*. (Holland Institute of Generative Linguistics Publications 2.) The Hague: Holland Academic Graphics.

Goedemans, Rob, Harry van der Hulst, and Ellis Visch. 1996b. *StressTyp Manual*. Leiden: Holland Institute of Generative Linguistics.

Goedemans, Rob, Harry van der Hulst, and Ellis Visch. 1996c. StressTyp: A database for prosodic systems in the world's languages. *Glot International* 2 (1/2): 21–23.

Goedemans, Rob & Ellen van Zanten. 2007. Stress and accent in Indonesian. In Vincent J. van Heuven & Ellen van Zanten (eds), *Prosody in Indonesian languages*. *LOT Occasional Papers, Series 9*, 35-62. Utrecht: Netherlands Graduate School of Linguistics.

Goddard, I. 1982. The Historical Phonology of Munsee. *International Journal of American Linguistics* 48:1, pp 16-48.

Goldsmith, John. 1990. *Autosegmental and metrical phonology*. Oxford: Basil Blackwell.

Gordon, Matthew. 2002. A factorial typology of quantity insensitive stress. *Natural Language and Linguistic Theory* 20: 491–552.
Halle, Morris and Jean-Roger Vergnaud (1987). *An essay on stress*. MIT Press.
Hammond, Michael. 1985. Main stress and Parallel metrical planes. *Proceedings of the Annual Meeting of the Berkeley Linguistics Society* 11, 417-428.
Hammond, Michael. 1986. The obligatory branching parameter in metrical theory. *Natural Language and Linguistic Theory* 4, 185-228.
Harms, R.T. 1981. A Backwards Metrical Approach to Cairo Arabic Stress. *Linguistic Analysis* 7, 429-51.
Hayes, B.P. 1980. *A Metrical theory of stress rules*. Doctoral dissertation, MIT. (distributed by the Indiana University Linguistics Club, Bloomington, Indiana). Published by Garland Press, New York.
Hayes, B.P. 1982. Extrametricality and English stress. *Linguistic Inquiry* 13.2, 227-276.
Hayes, B.P. 1995. *Metrical stress theory: Principles and case studies*. Chicago: University of Chicago Press.
Heinz, Jeffrey. 2007. The inductive learning of phonotactic patterns. Doctoral dissertation, University of California, Los Angeles.
Heinz, Jeffrey. 2009. On the role of locality in learning stress patterns. *Phonology,* 26(2):303-351, 2009.
Hulst, Harry van der. 1984. *Syllable structure and stress in Dutch*. Dordrecht: Foris Publications.
Hulst, Harry van der. 1996. Separating primary accent and secondary accent. In: R. Goedemans, H. van der Hulst and E. Visch (eds.). *Stress Patterns of the World*, 1-26. HIL Publications 2. The Hague: Holland Academic Graphics.
Hulst, Harry van der. 1997. Primary accent is non-metrical. *Rivista di Linguistica* Linguistica 9.1, 99-127.
Hulst, Harry van der. 1999. Word accent. In: H. van der Hulst (ed.), *Word Prosodic Systems in the Languages of Europe,* 3-116. Berlin and New York: Mouton de Gruyter.
Hulst, Harry van der. 2000. Issues in foot typology. In: M. Davenport and S.J. Hannahs (eds.), *Issues in Phonological Structure*, 95-127. Amsterdam: John Benjamins Publishing Company. [Also appeared in *Toronto Working Papers in linguistics* 16, 1997, 77-102]
Hulst, Harry van der. 2009. Brackets and grid marks or theories of primary accent and rhythm. In: E. Raimy and C. Cairns (eds.), *Contemporary views on architecture and representations in phonological theory,* 225-245. MIT press.
Hulst, Harry van der. 2010. Representing accent. *Phonological Studies* 13, 117-128
Hulst, Harry van der. 2011. Constraint-based phonologies. *Mirror Lake Papers*: *University of Connecticut Working Papers* #15, edited by Nilufer Sener, Carlos Buesa García & Tsuyoshi Sawada. Distributed by *MIT Working Papers in Linguistics*.
Hulst, Harry van der. 2012. Deconstructing stress. *Lingua* 122, 1494-1521.
Hulst, Harry van der. In prep. *Word accentual systems*. Ms. University of Connecticut.
Hulst van der, Harry, Rob Goedemans and Ellen van Zanten. 2010. *A survey of word accentual systems in the language of the world*. Berlin: Mouton de Gruyter.

Hurch, B. 1996. Accentuations. In: B. Hurch and R. Rhodes (eds.), *Natural Phonology: The state of the art on natural phonology.*, Berlin and New York: Mouton de Gruyter, 73-96.
Idsardi, William J. 1992. *The Computation of Prosody*. MIT Ph.D. dissertation, distributed by MIT Working Papers in Linguistics.
Kager, René. 1993. Alternatives to the Iambic-Trochaic Law. *Natural Language and Linguistic Theory* 11, 381-432.
Kodzasov, S. 1999. Caucasian: Daghestanian Languages. H. van der Hulst (ed.) *Word Prosodic Systems in the languages of Europe*. Mouton de Gruyter: Berlin & New York, 995-1020.
Liberman, Mark and Alan Prince (1977). On stress and linguistic rhythm. *Linguistic inquiry* 8, 249-336.
McGarrity, L. W. 2003. *Constraints on patterns of primary and secondary stress*. Doctoral Dissertation, Department of Linguistics, Indiana University.
Moskal, B., To appear. Edge prominence. In: Connecticut Working Papers in inguistics.
Odden, David. 1979. Principles of stress assignment: a crosslinguistic view. *Studies in the Linguistic Sciences* 9(1). 157-176.
Prince, Alan and Paul Smolensky (1993). *Optimality Theory; Constraint Interaction in Generative Grammar*. [Technical Report #2 of the Rutgers Center for Cognitive Science]. Rutgers University, Piscataway, New Jersey.
Revithiadou, Anthi. 1999. *Headmost accent wins. Head dominance and ideal prosodic form in lexical accent systems*. LOT Dissertation Series 15 (HIL/Leiden Universiteit The Hague: Holland Academic Graphics.
Roca, I. 1986. Secondary stress and metrical rhythm. *Phonology Yearbook* 3, 341-70.
Vergnaud, Jean-Roger and Morris Halle (1978). Metrical structures in phonology. Unpublished ms, MIT, Cambridge, Massachusetts.
Zanten, Ellen van, and Rob Goedemans. 2007. A functional typology of Austronesian and Papuan stress systems. In: Vincent van Heuven & Ellen van Zanten (eds.) *Prosody in Indonesian Languages.* LOT: Occasional Series 9, 63-88, Utrecht: Igitur, Utrecht Publishing and Archiving Services.