# Representing Accent

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**ABSTRACT.**
In this article I present a formal theory of word accent. The theory separates the representation of primary accent and 'perceptually strong' syllables that are due to rhythm (sometimes in combination with syllable weight), the idea being that the rhythmic beats are accounted for independently, although 'with reference to' the primary accent location.

**Keywords:** Word accent, rhythm.

## 1. Introduction

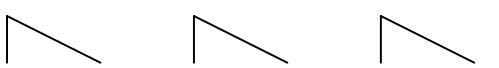
In this article I present a formal theory of word accent. The theory is non-metrical in that the account of *primary* accent location is not based on (iterative) foot structure. The theory separates the representation of primary accent and 'perceptually strong' syllables that are due to rhythm (sometimes in combination with syllable weight), the idea being that the rhythmic beats are accounted for independently, although 'with reference to' the primary accent location. This means that rhythmic structure is either assigned later (in a derivational sense), or governed by constraints that are subordinate to the constraints that govern primary accent (as is possible in the approach presented in Prince and Smolensky 1993). The present approach, which dates back to van der Hulst (1984), has been called 'a primary-accent first theory' (PAF), 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).

Section 2 will recapitulate the essential properties of standard metrical theory and then mention many reasons why an alternative is needed. In section 3 I propose a formal theory for accent placement, while section 4 offers some concluding remarks.

## 2. Why standard metrical theory needs to be replaced

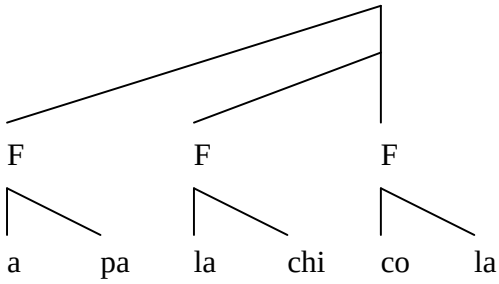
The key insight of standard metrical theory is that syllables (or perhaps subsyllabic constituents such as skeletal positions, rhymes or moras) of words are organized into a layer of *foot structure*, each foot having a *head*. Primary accent is then derived by organizing the feet into a *word structure* in which one foot is the head. The head of the head foot, being a head at both levels, expresses primary accent. In this view, rhythmic beats are assigned first, while primary accent is regarded as the promotion of one of these rhythmic beats:

(1) STEP 1 F F F Group from R-to-L




into bounded
left-headed foot

STEP 2




Group feet into an unbounded right-headed word tree

Metrical theory thus integrates the rhythmic and primary word accent into one structure, albeit that in this structure there are two levels which directly correspond to this distinction. Primary accent corresponds to head marking at the word level, whereas rhythmic beats are heads at the foot level.

Henceforth I will often use the bare term *accent* as referring to *primary* accent and *rhythmic beats* to syllables that are prominent due to rhythmic alternation or syllable weight. The prominence of the latter syllables is also commonly referred to with the term secondary (or non-primary) accent. Here I completely avoid the term 'stress' which I regard as designating the *phonetic realization* of accent in particular kinds of language (like, for example, English, which is a *stress-accent language*).

### 2.1. Some historical background of 'primary accent first' (PAF)

In van der Hulst (1984), and subsequently in a number of other articles (see van der Hulst 1996, 1997, 1999, 2000, 2009), I proposed a different approach. Rather than building primary accent on the basis of rhythm, I suggested reversing the process and assigning primary accent first, making the assignment of rhythmic beats a truly secondary matter. A similar claim has been made in other studies, usually with reference to specific systems (Harms 1981, Roca 1986, Hurch 1995). Harms (1981) called this method a 'backward approach'. Hayes (1995) refers to primary accent first mode as 'top-down parsing,' suggesting that the word tree is built first while foot structure is 'tucked in' later. He acknowledges that top down parsing is sometimes necessary (cf. below). 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 accentual 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 accent is fixed on the initial syllable, irrespective of its weight, a constraint which demand that the head of the word is 'left-aligned' would outrank the constraint expressing weight-sensitivity.[1] McGarrity (2003), adopting an OT-approach, offers support for the idea to separate primary accent and rhythm by discussing numerous cases in which the constraints bearing on accents and rhythm differ in one way or another (cf. below). Bailey (1995), apparently unaware of my earlier proposals, also proposes a non-metrical approach to primary accent assignment.

1 This kind of situation can be found in, for example, Germanic (and some of its daughter languages) and Finnish.

The crucial claim of the approach suggested here is that accent assignment and rhythm, perhaps more often than not, simply cannot be captured in terms of a single algorithm which essentially sees the primary accent as a promoted rhythmic beat. This suggests that in these cases there will have to be two independent algorithms. The fact that primary accent assignment in some sense precedes rhythm assignment is, in retrospect, a separate issue. Separation of accent and rhythm could simply imply that these aspects of the prominence profile of words are represented 'simultaneously' *in different planes*. However, in addition to being separated in different algorithms, both aspects are not *independent*. What PAF theory tried to capture in terms of ordering accent before rhythm was that a crucial aspect of the rhythmic structure is dependent on the location of accent: *rhythmic beats do not clash with accents*. The dependency of rhythm on accent falls out naturally if accent assignment is indeed first, but, in a non-derivational model, it could also be accounted for by stipulating the dependency that holds between the accent plane and the rhythm plane. The notion of 'dependency' here captures what in OT is expressed in term of ranking (cf. van der Hulst, to appear).

Although, I will maintain here that accent assignment often indeed precedes the assignment of rhythm, what I will focus on first is the notion that accent and rhythm often have different properties which prevent the unification that metrical theory was trying to capture.

The initial (and, in retrospection, perhaps not the crucial) motivation for my proposal (in van der Hulst 1984) was that primary accent in most systems seems to fall on the foot that is assigned first in the classical metrical account.[2] Formally, this means that in systems that assign feet from left-to-right, the word tree would often be left-headed, while it would often be right-headed in right-to-left systems. Assuming, on the basis of the available surveys at the time, that this correlation established more than just the 'unmarked' case, I boldly suggested that this pattern was the only possible one if we assumed that primary accent is *universally* assigned first, with rhythm typically 'echoing' (or rippling away); cf. Garde's 1968 apt phrase 'echo accent' for rhythmic beats.[3] However, even if systems in which the edge of iteration and the edge of primary stress coincide form a majority, it is nonetheless the case that in some systems this is not how things seem to work. If for example, accent is initial in words consisting of an even number of syllables, while it lies on the second syllable when the number of add, it would seem that the syllables have to be parsed into left-headed feet (from right to left), with the leftmost foot being selected as the word head. Crucially, in this type of case footing has to be done first, because it is not possible to locate accent locally at the left-edge of the word.[4]

After having presented many case studies or language with accent and rhythm, Hayes (1995: 116-117) states:

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

3 It was also noted in van der Hulst (1984) that sometimes rhythm, rather than echoic the accent, would approach accent from the other edge. I termed this situation 'polar rhythm'. We also find terms like *bidirectional or dual systems* (see, e.g., Kager 2005 and Gordon 2002). In this article, I will not discuss the details of rhythm, referring to van der Hulst (in prep.).

4 This case is shown in MalakMalak, discussed in Goldsmith (1990: 173-177).

> "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 main 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 (Bruce 1984), it is clear that primary stress must be assigned before secondary stress, since primary stress assignment is lexical, secondary post-lexical."

He then refers to Tiberian Hebrew, Cahuilla, Tümpisa Shoshone, Czech, Mayi, Old English, Cayuvava and Estonian as other cases where he himself has adopted a 'primary stress first' analysis. He then also refers to cases such as Malakmalak (which I have called count systems) where a main stress first approach would yield "an extremely complex main stress rule […] For these languages the bottom-up analysis is far more straightforward". [5] Hayes continues saying that for "the majority of languages, it is apparently impossible to determine the answer, because main stress usually falls on the point of origin of the alternating count […] For concreteness, I 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 accent first' systems require a treatment that deviates from the default method. I adopted the opposite view by taking the primary accent first mode as the default which, then, entails that count systems need a special treatment.

In this article, building on my earlier ideas (and especially van der Hulst 2009) I will propose how the primary accent first mode can be implemented, which I continue to see as the default mode. Here I will not deal with count systems (cf. van der Hulst 1997 and in prep.). However, before addressing these issues, let us step back and review some additional, and perhaps better argument for the PAF approach.

### 2.2. Additional argument for PAF

The original idea for the primary accent first mode was, as mentioned, that systems in which the rhythm can be interpreted as rippling away from the primary accent (manifested in metrical theory in that the starting edge of footing and the edge of head foot correlate) seem to form a majority over systems as found in MalakMalak (a 'count system'). At this point, I am not convinced that frequency differences can be used to decide on competing theories. However, once the primary accent first approach was around, additional (and perhaps better) motivation for it emerged. Several *types* of motivation need to be distinguished. (a) On the one hand, we find many cases in which we note differences in how accent and rhythm are assigned (e.g., one is weight-sensitive, while the other is not). (b) On the other hand, asymmetries between accent and rhythm

5 Here I do not propose a treatment for count systems (cf. van der Hulst 1997, in prep.). Al-Mohanna (2007) applies the idea of separating primary accent 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 dubious 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.

exist in terms of the properties or processes that are associated with either one (e.g., accented vowels lengthen, rhythmically strong vowels do not).

*(a) Asymmetries in assignment*

i. As discussed with reference to Hayes (1995: 116-117), the standard theory acknowledges the need for a primary accent-first mode. This involves cases which were referred to as having 'top down' parsing. We saw that Hayes mentions the case of Swedish in which, he says, the assignment of primary accent is clearly 'lexical'. However, secondary accent is entirely predictable and thus, he says, post-lexical. This argument suggests not only that accents and beats are separated, it also points to the fact that accent come first (being lexical).

All the usual criteria for distinguishing between lexical and post-lexical rules seem to square with the differences between locating primary and secondary rhythmic beats. A consequence of being lexical is that accent can be sensitive to *lexical exceptions* (however these are formally marked), specific *word classes*, *morphological structure* and *'stratal differences'* (classes of words with different origins, such as being imported from another language). It is indeed very common for accent to have exception, despite the fact that there is a clear majority rule. The limiting case of exceptionality is, of course, a lexical accent system in which most individual morphemes must be marked for accent which is said to be unpredictable. We also see that accent can be sensitive to a difference between e.g. nouns and verbs (which might be the case in Rumanian; cf. McGarrity 2005) and in fact, in English extrametricality rules differ for different word classes (Hayes 1982). Finally, accent 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 ad being accented, or 'pre-accenting').

The strongest claim, following from its post-lexical (post-grammatical) status would be that rhythm cannot be sensitive to any of these factors. Obviously, we need to address various kinds of counter examples, although space limitations prevent me from doing that here.

The idea that rhythm is automatic and blind to morphological structure runs into a specific apparent problem that sometimes complex words have 'rhythmic' beats that are not rhythmically distributed, but rather are reflections of primary accents of embedded words. Such cyclic beats require our attention and I in van der Hulst (in prep.) I propose to treat cyclic beats as resulting from 'weight-sensitivity', i.e. syllables that carry cyclic accents will be analyzed as phonologically heavy (cf. Kager ms).

ii. PAF predicts that it is possible that the weight-criteria for accent and rhythm can differ. After all, in the primary accent first theory we have two distinct algorithms, one for primary accent, the other for rhythmic beats. Nothing, then, prevents one being quantity-sensitive, while the other is not, or both being quantity-sensitive in different ways. Clearly if such discrepancies exist, they are unexpected from the view point 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 accent either being non-

iterative or seeing most of its feet erased. One might suspect that the reverse situation (primary accent is WS, rhythm is WI) is also possible and one might plausibly argue that this, in fact, applies to languages such as English and Dutch.

iii. A third motivation involves languages in which different foot types appear to be necessary for primary accent and rhythm; see (2) below. From the viewpoint of classical metrical theory such systems again form an anomaly. It is not obvious whether this argument carries over into PAF theory in the sense that, in this approach, primary accent and rhythm assignment is not based on the feet. In any event, it is clear that metrical analyses that use different foot types for accent and rhythm point to the fact that 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.

iv. A fourth motivation comes from the fact that the edge-orientation of primary and rhythm can differ in that, for example, primary accent is on the right-edge (let us say the penultimate syllable), while the wave of rhythm seems to come from the left. Such a situation also forms an embarrassment for the standard theory. In this case too, it is of course possible to have two phases of foot assignment in the standard approach: 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.[6] Or one might suggest that a foot is assigned non-iteratively on the right edge, followed by an iterative application from left-to-right. One would expect to find case in which accent is placed on the left edge, while rhythm comes from the right, a situation that has indeed been suggested for Garawa (Hayes 1995: 2002-3). The point is that such derivations are not expected given the core design of standard metrical theory.

v. A fifth motivation is also related to foot type and involves the case that 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 accent combined with binary rhythm, one could construe this as the opposite situation.

vi. A sixth motivation relates to cases in which primary accent 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 Australian language Waalubal Bandjalang (Crowley 1978). In metrical phonology, such systems can be analyzed in terms of unbounded feet, but it also possible to interpret this case as combining bounded feet (for primary accent) and unbounded feet (to accommodate the rhythmic beats).

vii. 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

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

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 (2005) mentions Khalkha as a case in point. Here accent lies on the rightmost non-final heavy syllables. Yet, all heavy syllables, including one that is final, are said to have 'secondary stress'.

(2)

| | *Primary accent* | *Rhythmic accent* | |
|---|---|---|---|
| i. Level | lexical | post-lexical | (Swedish, English) |
| ii. Weight | weight-insensitive | weight-sensitive | (Finnish) |
| | weight-sensitive | weight-insensitive | (English) |
| | weight-sensitive A | weight-sensitive B | (Chugach) |
| iii. Foot type | left-headed | right-headed | (BigNambas, Marind) |
| | right-headed | left-headed | (Taga, Dari, Uzbek) |
| iv. Word | right-edge | left-edge | (English) |
| | left-edge | right-edge | (Garawa) |
| v. Foot size | binary | ternary | (Chugach) |
| | ternary | binary | (???) |
| vi. Foot size | bounded | unbounded | (Waalubal Bandjalang) |
| vii. Extrametricality | yes | no | (Khalkha) |

It is interesting to see that three of these arguments might apply to English, the language that was first used to develop the standard metrical approach.

*Asymmetries in correlating phonotactic properties or processes*

It is well-known that various phonotactic and phonetic 'cues' differentiate accented from non-accented syllables. We should now entertain the idea that these same cues differentiate between primary accented and lesser accented (i.e. rhythmic) syllables, although the 'lesser accented' syllables need not behave differently from unaccented syllables in this respect. In other words, if asymmetries exist between the accented syllable (here taken to be the primary accented syllable) and all other syllables, rhythmic syllables would simply be included in this set. They are literally unaccented (if this term is restricted to *primary* accent), even when rhythmically strong. This being said, we must also recognize the case in which a properties (phonotactic or process) correlates with all strong syllable (accented and rhythmic) as opposed to all weak syllables. For example, in English, all strong syllables are exempted from vowel reduction. Here, then, the accented and rhythmic syllables are treated symmetrically in sharing a property. Full vowel articulation is a cue of both accented and rhythmically strong syllables. What is of

interest for us here is to note that there are properties that differentiate accented syllables from all other syllables. Such properties do not generalize over all 'foot heads' but only apply to the head of the head foot and as such they might be said to further motivate the idea to see accent and rhythmic beats as different kinds of entities.

One such asymmetry exists when accented syllables have specific phonotactic properties such as allowing more syllabic complexities (e.g. syllable closure, branching onset), or allowing contrastive specification of length[7] or tone. Dresher and van der Hulst (1997) identify a difference oft his kind as a fundamental asymmetry between heads and dependents. They say that dependents can be less, but not more 'marked' than heads. A typical instance of this asymmetry, one that Dresher and van der Hulst single out, is that dependents display neutralization of contrast. This does not only play out in terms of syllabic complexity (when, for example, accented syllables allow branching onsets, whereas unaccented syllables do not), it also affects the content of phonemes. We often see that the array of vowels in the accented syllables is greater than that in unaccented syllables. Since rhythmic beats stand in contrast with weak syllables, asymmetries can exist here too and, as stated, in English we note that the difference between full vowel articulation and schwa correlates with this opposition. Accented vowels, being rhythmically strong, necessarily side with the rhythmic beats. However, a three-way opposition could then also exist in which accented syllables allow more complexity than rhythmically strong syllables, which, in turn, allow more than weak syllables. This could apply to the case of Brazilian Portuguese where accented syllables have a 7-way vowel contrast, while 'pretonic' and post-tonic syllables have a 5- and 3-way contrast, respectively (Cristófaro-Silva 1992). Here we could perhaps construe the relevant pretonic syllables as bearing an initial rhythmic beat, while the post-tonic syllables would be weak.

Cases of neutralization can involve effects that are apparently at odds with the head-dependent asymmetry, proposed in Dresher and van der Hulst (1998). It is very common to find a process of vowel lengthening which neutralizes the distinction between long and short vowels in *accented* syllables only. In other words, neutralization of contrast may hit both heads or dependents, or both. What this demonstrates is that the desired differentiation between accented and unaccented vowels can be achieved in two ways, both serving the polarization between heads and dependents. However, the case of vowel lengthening in accented syllables creates a situation in which dependents allow a greater array of contrast than heads. This paradox is lifted if a system with lengthening under accent would also have shortening under lack of accent:

| (3) | | head | dependent | |
|---|---|---|---|---|
| | a. | long & short | long & short | heads and dependents are equal |
| | b. | long & short | short | heads allow greater complexity |
| | c. | long | long & short | dependents allow greater complexity |
| | d. | long | short | heads and dependents are polarized |

7 Of course, length can also be construed as involving syllabic complexity, i.e. branching of the nucleus.

In motivating their head-dependent asymmetry syndrome, Dresher and van der Hulst (1998) focuses on case (3b), where neutralization hits the dependent. Case (3c), however, involves neutralization in head.To capture both cases, I propose to state the HAD as follows:

(4) HDA (revised)
The maximal complexity of dependents cannot exceed the maximal complexity of heads

This allows for all for cases, but not, crucially a case in which the head must be short, while the dependent allows long vowels.[8]

Concluding, it would seem that the asymmetries between accented and unaccented syllables just considered (involving *phonotactic* differences and differences in triggering processes) further support the separation of accent and rhythm.

There are two additional arguments that can argue against the standard metrical approach.

*Additional reasons for preferring PAF over metrical theory*

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' (cf. below). These problems always seem to regard primary accent location. Feet needed for rhythmic alternation are much less problematic. In fact, here it would seem that the full array of foot types is not necessary. For example, the so-called 'obligatory branching feet' that have been proposed (cf. Hammond 1986) are always motivated by the location of primary accent. For rhythmic beats this foot type is not necessary. As we will see, for primary accent we indeed need apparatus that goes beyond what feet can do, which then perhaps allows us to get away with a fairly simplified machinery to deal with rhythm. The holistic metrical toolkit is underqualified to deal with primary accent and overqualified to deal with rhythm.

Another argument could perhaps be that while there are systems that have primary accent and no rhythm, systems that have rhythm and no primary accent seem to be absent, despite the fact that sometimes languages are described as having multiple accent none of which is primary (cf. Al-Mohanna 2007, van der Hulst 1997).

Finally, additional motivation comes from the treatment of so-called unbounded systems. Various approaches to unbounded systems, employing both bounded and unbounded feet, have been proposed over the years. Hayes (1995: 33) eventually concludes that such systems *are* non-metrical. He 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

8 McGarrity (2005) actually suggests that the asymmetry can involve such a case and mentions Fijian as a case in which, she says, accented vowels must be short, while unaccented vowels can be long or short. It is not true, however, that all accented vowels must be short. There is shortening of accented long vowels only when this 'saves' an otherwise unfooted syllable. See Hayes (1995: 142-147) for an analysis of Fijian.

bounded and unbounded systems. The two differed in foot size, but otherwise fell into the same types.

In summary, there are many reasons for exploring an alternative framework, i.e. one in which primary accents and secondary accent are assigned more independently, possible non-metrically.

**3. Primary accent theory: How does it work?**

In van der Hulst (2009) I formalize the PAF idea in terms of the notions End Rule (ER) and Perfect Gridding (PG) which were proposed in Prince (1983). Contrary to Prince, though, who followed the standard 'rhythm first' approach in applying the ER to the output of PG, I proposed to apply the ER independently from rhythm. Let us examine the use of the ER more closely:

(5) The End Rule (ER)

The left-most or rightmost element in the domain is the head

The ER will pick out the left- or rightmost syllable in the domain, and this would give us initial and final accent. However, other peripheral locations occur as well such as second-syllable, and penultimate syllable, as well as antepenultimate syllable. Putting aside the latter option for the moment one could imagine the following simple extension of our basic procedure. We could get all four peripheral options by invoking the notion of *extrametricality* (EM) saying that the edge referred to by the ER can be moved *in* by one unit. In essence, extrametricality results from a slight misalignment of the morphological word (indicated by square brackets) and the accentual domain (indicated by parentheses):

| (6) | ER(L) | ER(R) |
|---|---|---|
| a. Unbounded | [(σσσσσσσσ)] | [(σσσσσσσσ)] |
| b. Unbounded + EM | [σ(σσσσσσσ)] | [(σσσσσσσ)σ] |

Following an elegant aspect of the theory proposed by Idsardi (1990), we could say that the instruction to form the accentual domain takes the following form:

(7) Align an unbounded domain with the {right, left} edge of the {rightmost, leftmost} syllable

If the setting of the edge choice is opposite, we get the result of extrametricality, as in (6b). Let us write a specific instance of rule (7), which would create the domain in (8a), as (8b):

(8) a. [(σσσσσσσ)σ]

b. D (u/rlr) 'Domain (Unbounded/RLR)'

c. D (u) / EM (r) ‘Domain (Unbounded) / Extrametricality (Right)

Although (8b) is elegant, it is also complex. Hence, I will continue the practice of simply stating extrametricality as a separate prarameter. The formulation in (8c) replaces ‘RLR’ by ‘EM(R)’. This does not mean that I reject Idsarsdi’s idea to formalize EM in terms of placing the domain bracket on the ‘internal’ side of the peripheral syllable. It is simply that the notation in (8c) is more perspicuous.

I will refer to the domains in (7) as *unbounded domains*, i.e. domains that coincide with morphological domain within which accent is assigned. For ease, I will assume that this domain is the word, $X^0$, ignoring for the moment words that display morphological structure.

If all accent location could be computed in terms of an unbounded domain (modulo EM), one could argue that the need for such a notion is hardly compelling. It could simply be assumed that accents are assigned to morphological domains directly, give or take a peripheral syllable. However, the unbounded domain, although required as we will see (maybe more so for WS systems than for the WI case that we have considered so far), is not sufficient to deal with antepenultimate accent (as, for example, in Macedonian). At first sight, one might propose to allow domains as in (9):

(9) [(σσσσσσ)σσ]

This, however, opens the door to an instruction scheme that would allows any substring of a word to be an accentual domain, which is surely an undesirable result. A radically different approach would be say that the accentual domains can ‘shrink down’ to two syllables, which, if we maintain the original option of making one unit extrametrical would give us the following two options on the right side (and comparable option on the left side):

(10) a. [σσσσσσ(σσ)]
b. [σσσσσ(σσ)σ]

Domains of this sort can be assigned following the instruction in (11):

(11) Align a *bounded* domain with the {right, left} edge of the {rightmost, leftmost} syllable

Let us call accentual domains of this sort *bounded* (as opposed to unbounded domains which comprise the whole word, modulo EM). Antepenultimate accent can now be derived by applying the ER(l) to the structure in (10b):

(12)

| | |
|---|---|
| x | ER(l) |
| [σσσσσ(σσ)σ] | D(Bounded/RLR) or: D(b-r) / EM(r) |

In the informal notation ‘D(b-r) / EM(r)’ we have to specify that the bounded domain lies on the right side of the word and that extrametricality has to be observed.

Our approach also allows a system with third syllable accent, which is a rarely if ever attested option, although perhaps not one that should be dismissed.

The availability of two types of domains as well as extrametricality creates a number of ambiguities for systems several kinds of systems.

(13)

| | Domain | EM | ER |
|---|---|---|---|
| Initial | B-l | no | left |
| | U | no | left |
| second | B-l | no | right |
| | U | yes | left |
| final | B-r | no | right |
| | U | no | right |
| penultimate | B-r | no | left |
| | U | yes | right |

This seems like a high price and I assume that if accentual systems were limited to the six choice considered so far, we would be inclined to adopt the unbounded domain as the only possibility with the option of having a mismatch of either one or two syllables.[9]

However, there is independent motivation for making a distinction between bounded and unbounded accentual domains which involves certain types of weight-sensitive (WS) systems. We find four basic varieties:

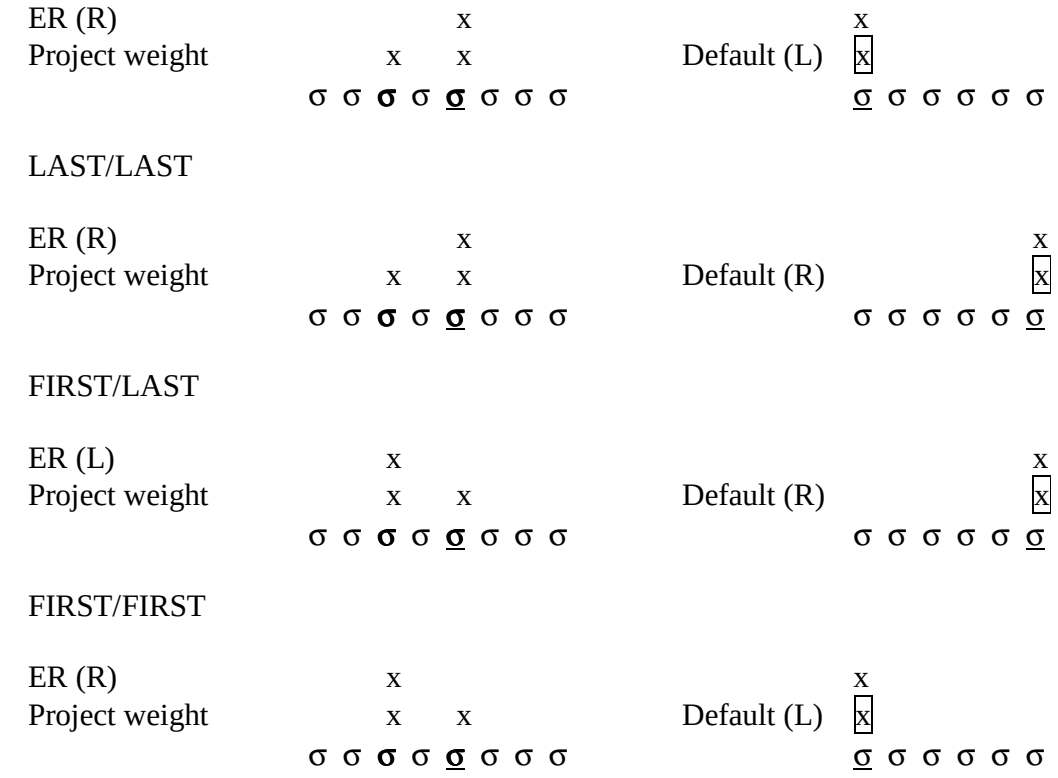
(14) Unbounded accent systems

a. Accent lies on the rightmost heavy syllable or, if there is no heavy syllable on the left most (first) syllable (Last/first)
b. Accent lies on the rightmost heavy syllable or, if there is no heavy syllable on the right most (last) syllable (Last/Last)
c. Accent lies on the leftmost heavy syllable or, if there is no heavy syllable on the right most (last) syllable (First/Last)
d. Accent lies on the leftmost heavy syllable or, if there is no heavy syllable on the left most (first) syllable (First/First)

Systems of this sort are attested and their formal representation has been subject to some debate. In foot-based approaches, one problem is that there is actually no way of deciding what the direction of foot assignment is, nor in F/F and L/L case whether the feet in such systems are left- or right headed; either way will work, since the only thing that matters is that feet identify heavy syllables as heads. In the absence of evidence for foot directionality and constituency, one might get suspicious as to whether unbounded systems are foot based at all. Indeed, Prince (1983) and Goldsmith (1990) suggest a simpler way of representing such systems. The first step is to designate heavy syllables as heads. The second is to identify a peripheral syllable as a 'default' head in all light words. The third step is to apply the End Rule. Heavy syllables are represented in bold, primary accent by underlining:

9 Note, incidentally, that the standard metrical approach suffers from the same kinds of ambiguities.

(15) LAST/FIRST




The default rule strikes one as a kind of End Rule, but is clear that it needs to be an independent step since its edge orientation is independent from the End Rule that delivers primary accent.

Clearly the domain in systems of this type is *unbounded*. It is, in fact, possible to find systems which combine this mode of derivation with the option of Extrametricality, which implies that the left- or rightmost syllable of the domain cannot be accented, whether heavy or not. Also noteworthy is the fact that systems of this type do not locate primary accent with reference to any kind of binary rhythmic foot structure. However, systems of this kind are still edge oriented as is clear from the fact that the location of primary accent is found by applying the End Rule (which looks for a left or right edge). What makes these systems different is that consideration of weight 'distracts' the End Rule from strictly peripheral syllables by projecting the inherent weight of syllables into the grid so that the End Rule can no longer see the light syllables. As a consequence, the ER can only promote the left or right most heavy syllable to primary accent status.

So far, then, we find further motivation for saying that the domain of accent must be the whole word in certain types of systems (i.e. unbounded systems), module EM. Let us now turn to the real motivation for also needing bounded domains. Consider accent rules of the following sort (discussed in more detail in van der Hulst, in prep.):

(16) 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* |
| III | x | x | x<< | x | |
| | x ) | x) | x x) | x) | **Aklan** |
| | (h) l] | (l h)] | (h)(h)] | (l l)] | *WS iamb + R: h<h]* |
| IV | x | x>> | x | x | **Awadhi** |
| | h l)] | (l h)] | (h h)] | (l l)] | *WI trochee + R: l>h]* |

Under the language names I indicated a possible analysis in the traditional metrical model. Note that system III and IV need a retraction rule.

In prose:

(17) Bounded accent systems (right side)

a. Accent lies of the last syllable if heavy or, on the penultimate syllable if heavy, or if both are light on the penultimate syllable (Last/First)
b. Accent lies of the last syllable if heavy or, on the penultimate syllable if heavy, or if both are light on the last syllable (Last/Last)
c. Accent lies of the penultimate syllable if heavy or, on the final syllable if heavy, or if both are light on the final syllable (First/Last)
d. Accent lies of the penultimate syllable if heavy or, on the final syllable if heavy, or if both are light on the penultimate syllable (First/First)

These descriptions can be simplified, and reduced to the ones in (18) if we forget about feet and simply add that the rules in question make reference to a two-syllable domain on the right-edge:

(18) Bounded accent systems (right side)

a. Accent lies of the rightmost heavy syllable or, if there is no heavy syllable on the left most (first) syllable (Last/First)
b. Accent lies of the rightmost heavy syllable or, if there is no heavy syllable on the right most (last) syllable (Last/Last)
c. Accent lies of the leftmost heavy syllable or, if there is no heavy syllable on the right most (last) syllable (First/Last)
d. Accent lies of the leftmost heavy syllable or, if there is no heavy syllable on the left most (first) syllable (First/First)

Note that (18), here applicable to the bounded domain, is identical to (14), which was applied to the unbounded domain. What this demonstrates is that the exact same four choices exist in the unbounded and bounded domain. It would seem then that right-edge bounded systems exhaust the logical possibilities that we find in unbounded systems.

While it is true that not all four options appear to be equally frequent, it is nonetheless the case that all four are empirically attested computational possibilities.

We now expect that the same four options can be found on the left side of the word and this is indeed the case:

(19) Left-edge

| | | | | | |
|---|---|---|---|---|---|
| I | x<br>[(h)l | x<br>[(l h) | x<br>[(h) h | x<br>[(l l) | **Ossetic**<br>*WS iamb* |
| II | x<br>[(h l) | x<br>[l(h) | x<br>[(h)h | x<br>[(l l) | **Malayalam**<br>*WS trochee* |
| III | x<br>(x<br>[(h l) | x<br>( x<br>[l(h) | >>x<br>(x x<br>[(h)(h) | x<br>(x<br>[(l l) | **Capanahua**<br>*WS trochee + R [h>h* |
| IV | << x<br>[(h l) | x<br>[(l h) | x<br>[(h h) | x<br>[(l l) | **Archi**<br>*WI iamb + R [h<l* |

We find the same four patterns as in (14) and (18):[10]

(20) Bounded accent systems (left side)
a. Accent lies of the leftmost heavy syllable or, if there is no heavy syllable on the right most (last) syllable (First/Last)
b. Accent lies of the leftmost heavy syllable or, if there is no heavy syllable on the left most (first) syllable (First/First)
c. Accent lies of the rightmost heavy syllable or, if there is no heavy syllable on the left most (first) syllable (Last/First)
d. Accent lies of the rightmost heavy syllable or, if there is no heavy syllable on the right most (last) syllable (Last/Last)

Summarizing, we seem to have four accentual possibilities in both bounded and unbounded domains when weight enters into the location of primary accent:

| (21) b. Weight-sensitive | Bounded (right/left edge) | | | | Unbounded | |
|---|---|---|---|---|---|---|
| LAST/FIRST | (**σ**σ) | (σ**σ**) | (**σσ**) | (σσ) | (σσ**σ**σ**σ**σσ) | (σσσσσσ) |
| LAST/LAST | (**σ**σ) | (σ**σ**) | (**σσ**) | (σσ) | (σσ**σ**σ**σ**σσ) | (σσσσσσ) |
| FIRST/LAST | (**σ**σ) | (σ**σ**) | (**σσ**) | (σσ) | (σσ**σ**σ**σ**σσ) | (σσσσσσ) |

10 These patterns are listed in a different order that is the mirror image of the patterns in (14) and (18), because in (19) the right-edge systems are listed as the mirror-image case of the right-edge cases in (16).

FIRST/FIRST (**σ**σ) (σ**σ**) (**σσ**) (σσ) (σσ**σ**σσσσ) (σσσσσσ)

It would seem that the PAF approach re-captures the parallels between bounded and unbounded system by reducing each type to four possibilities. In other words, the four logical possibilities that made unbounded systems 'uninteresting' for Hayes, can also be found for bounded systems. The original idea that bounded systems can be explained in terms of a restricted set of feet turns out to be ill-founded.

Turning back to weight-insensitive systems, we predict that the bounded and unbounded domains are also available for such systems, which creates the ambiguity that we listed in (13):

(22) a. Weight-insensitive Bounded (right/left edge) Unbounded

[LAST]/FIRST (σσ) (σσσσσσ)

[LAST]/LAST (σσ) (σσσσσσ)

[FIRST]/LAST (σσ) (σσσσσσ)

[FIRST]/FIRST (σσ) (σσσσσσ)

In fact, in weight-insensitive systems, the first clause which applies to heavy syllables simply does not apply, and can therefore not be set. This means that in weight-insensitive systems there are only two possibilities (ignoring cases with EM):

(23) a. Weight-insensitive Bounded (right/left edge) Unbounded

X/FIRST (σσ) (σσσσσσ)

X/LAST (σσ) (σσσσσσ)

However, possible *exceptions* may be used as diagnostics to decide whether an accentual system is bounded or unbounded. For example, Polish, with regular penultimate accent, is a bounded system because exceptions to penultimate stress fall within the 'three-syllable window' that is allowed by combining the bounded domain and extrametricality. Turkish on the other hand, with regular final accent, is an unbounded system because exceptions may pull the accent further inward than a three-syllable window would allow (see van der Hulst 1999 and in prep.)

Summarizing, we have proposed a set of parameters for deriving primary accent locations. The key idea is that primary accent is always located on a left- or rightmost syllable within the *accentual domain*.

To differentiate between bounded and unbounded systems, we need a *domain parameter* which contains three variables:

(24) Domain setting

Align an {unbounded, bounded} domain with the {right, left} edge of the {right, left} edge of syllable

We can state this parameter differently in the following manner. As suggested before, despite the elegance of the Idsardian formalization of extrametricality, we state extrametricality separately. We then, make explicit that the choice of a domain edge is only relevant for bounded systems. This means that the relevant parameter is dependent on the choice for the domain size parameter:

(25) Accent parameters

a. Domain size (unbounded/bounded) - If bounded: left/right

b. Extrametricality (no/yes) - If yes: left/right
If yes: segment/syllable

The extrametricality parameter has another dependent parameter which specifies the type of entity that is extrametrical. For the moment I assume that this is either the peripheral skeletal position (segment), or the peripheral syllable.

Once to domain is set, we can assign accent. This involves three choices, which we already have seen in (12). Firstly, heavy syllables are projected into the primary accent plane if the system is weight-sensitive. I assume that syllables that are lexically marked are automatically present in this plane (i.e. that is *how* they are marked). If there is no special (i.e. heavy or lexically marked) syllable, the accent plane will be provided with a mark by a *default rule*. Finally, an End Rule is needed to decide where the primary accent goes in case the accent plane contains more than one weight accent mark, or lexical accent mark. Hence the general scheme for primary accentuation consists of three parameterised constraints (i.e. parameters for short), as in (26):

(26) Accent parameters

c. Weight (no/yes) - If yes default is: leftmost/rightmost syllable

d. End Rule (leftmost/rightmost)

Since the end rule setting can only be decided on in case the accent plane contains more than one grid mark, it is an open question whether the End Rule needs to apply if the default rule has applied. In a WS system we have independent evidence for the ER value from domains that contain more than one heavy syllable. No harm is done if the ER simply reinforces the result of thee default rule. In WI systems, however, the effect of the Default Rule and of the End Rule cannot be distinguished. Thus, in WI system we could also assume that all the work is done by the End Rule. In that case we have to see the default rule as a clause that is only relevant if weight is projected. This leads us to the final formulation of the accent parameters:

(26) Accent parameters

a. Domain size (unbounded/bounded) - If bounded: left/right

b. Extrametricality (no/yes) - If yes: left/right
If yes: segment/syllable

c. Weight (no/yes) - If yes default is: leftmost/rightmost syllable

d. End Rule (leftmost/rightmost)

It has not escaped my attention, of course, that the notion of a bounded domain, by being a bisyllabic unit, bears a strong resemblance to the notion foot. Bounded domain assignment together with the End Rule (left or right) places a left- or right headed foot-like unit on either the left or right edge of the word. The procedure differs from standard metrical theory, however, in not viewing the assignment of a bounded domain as an iterative procedure that, nor does it make a distinction between the foot head and the word head. Rather the head of the bounded domain in (12) *is* the head of the word. Whether or not the default rule represents a 'grammaticalization' of a rhythmic foot-like entity (assuming that rhythmic is represented in terms of feet, which we haven't decided on yet) cannot be decided, although that is a real possibility. However, I would like to maintain that the localization of primary accent in all types of systems considered so far is (from a synchronic point of view) is non-metrical and can be handled in terms of the computational machinery in (25) and (26).

Here is an analysis of Polish primary accent, using the PAF theory:

(28) Accent parameters

a. Domain size (unbounded/**bounded**) - If bounded: left/right

b. Extrametricality (**no**/yes) - If yes: left/right
If yes: segment/syllable

c. Weight (**no**/yes) - If yes default is: leftmost/rightmost syllable

d. End Rule (**leftmost**/rightmost)

In shorter form, the same information is encoded in (29a), while (29b) and (29c) provide the analysis of Dakota (WI, S) and Rotuman (WS, U/PU):

(29) a. Polish

| | |
|---|---|
| x | ER(l) |
| [σσσσσσ(σσ)] | D (b, r) / EM (n) |

b. Dakota

| | |
|---|---|
| x | ER(r) |
| [(σσ)σσσσσσ] | D (b, l) / EM (n) |

c. Rotuman

| | | |
|---|---|---|
| x | x | ER(r) |
| x x | x | W (y) / DF (l) |
| [σσσσσσ(h h)] | [σσσσσσ(l l)] | D (b, r) / EM (n) |

By making the default dependent on a positive value of the weight parameter, we get the result that in a WS system the grid columns in the accent plane have a height of two, whereas in WI sensitive systems they have a height of one:

(30) a. **Rotuman**

| | | | | |
|---|---|---|---|---|
| x | x | x | x | ER (r) |
| x | x | xx | x | DF (l) |
| (h l)] | (lh)] | (hh)] | (l l)] | |

b. **Polish**

| | | | | |
|---|---|---|---|---|
| x | x | x | x | ER (l) |
| (h l)] | (lh)] | (hh)] | (l l)] | |

I see no harm in this distinction if we do not interpret the height difference across different systems as meaningful.

## 3. Conclusions

In this article, I have motivated to separate primary accent from rhythm, improving on and adding to the arguments in van der Hulst (1996, 2009). I then suggested a formal theory of accent placement, fine-tuning the proposal in van der Hulst (2009). For a more elaborate defense and application I refer to van der Hulst (in prep.). With primary accents in place, we can now ask how rhythmic structure is assigned. One thing we know for certain: primary accent assignment in the systems considered in the previous section does not presuppose a prior rhythmification. This means that rhythmification does not precede primary accent assignment in non-count systems. My claim since van der Hulst (1984) has always been that once the 'complexities' of accent systems are properly located in the assignment of primary stress in terms of a system that allows four patterns (L/F, L/L, F/L, F/F), rhythmic patterns can most likely be dealt with in terms of minimal stipulation or variation. For a theory of rhythm I must again refer to van der Hulst (in prep.).

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