Improving Tree Theory
Author(s): Alan S. Prince
Proceedings of the Eleventh Annual Meeting of the Berkeley Linguistics Society (1985), pp. 471-490

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0. Introductory

One of the compelling achievements of recent linguistics has been the creation of an explicit, tightly parametrized theory of lexical stress patterns. As with any work of many hands and plentiful combinatorics, the codification of metrical options has proceeded to some extent in a sedimentary rather than a fully integrative fashion; this has led to some intriguing redundancies and loosenesses of prediction. In what follows, I will offer two lines of attack on the problem of improving matters. First, I will show that within the logic of the theory as it is presently constituted, there is no need for a primitive notion of "unbounded foot" (more generally, "unbounded metrical unit"): thus, all primitive metrical units are bounded--maximally binary. Second, I will sketch a program for eliminating the burgeoning theory-of-destressing in favor of the already developed theory-of-stressing, through use of notions that have strong affinity with key elements of Lexical Phonology.

Here is a catalogue, somewhat raisonné, of the principles of Metrical Tree Theory:

(1) Tree Form

a. **Exhaustiveness.** Everything must belong to metrical structure.
b. **Level Structure.** (rime,foot,superfoot,.., word,..)
c. **Headedness.** Each unit has a single head at the (left/right) periphery.(If branching is strictly binary, then each category has headship uniformly left or right.)
d. **Maximality.** Units are of maximal size, within the other constraints on their form.
e. **Magnitude.** Feet are either maximally binary ('bounded'); or unlimited in extent ('unbounded').
f. **Quantity Sensitivity.** Nonhead (weak element) may be restricted to be a light syllable.
g. **Obligatory Branching.**In a quantity sensitive foot, Head may be restricted to be a heavy syllable.

(2) Rule Application

a. **Iterativity.** Metrical units are built iteratively throughout a domain; or only one is built .
b. **Directionality.** Structure at a level is built in a left-to-right sweep; or right-to-left.

(3) Extrametricality Theory

a. Extrametricality. A peripheral element may be disregarded in assigning structure by (1).

b. Stray Adjunction. An element left unaccounted for is adjoined to nearby structure.

(4) Destressing and Shifting.
Various rearrangements may take place after the primary build-up is over or during it.

Sources for this theory include Prince(1976), Liberman & Prince (1977), Selkirk(1980), Leben(1981), Kenstowicz (1983),Halle & Vergnaud (1978), Hayes(1981), the latter two being especially significant systematizing works. Recent approaches to Destressing and Shifting are found in Hammond(1984) and Hayes(1984).

Not all of these notions are confined to stress theory. To General Phonology belong surely Exhaustiveness-- which is but a prosodic echo of the requirement that all features be filled in at some point in derivation-- as well as Directionality and Iterativity, these being properties that many different kinds of rules may have. Extrametricality is shared with other branches of prosodic phonology and morphology (Prince (1983), McCarthy & Prince (1985)).

Properly metrical, then, are Level Structure; Headedness; Magnitude; and the parameters relating to syllabic quantity, Quantity Sensitivity and Obligatory Branching.

1. Unboundedness and Stray Adjunction

My first goal will be to reduce Magnitude from parameter to principle. Basic metrical units will then be at most binary, unbounded units having disappeared from the primitive vocabulary. To see that this is already immanent in the theory, consider the role of Stray Adjunction. If syllables can be created in the course of derivation, or more generally, if syllables or other structure can enter the purview of metrical rules at some late point due to the effect of Extrametricality on earlier rule applications, then-- assuming Exhaustiveness--there must be a rule of Stray Adjunction to connect them up to metrical structure. Although most previous uses of Stray Adjunction involve a single extrametrical unit at an edge, there is no reason to assume that the rule itself should be limited to such environments. Consequently, if some bounded unit happens to be located amid an otherwise unmetrified string, we would expect Stray Adjunction to attach local stray material to it until

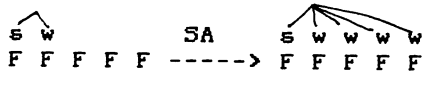
metrification is complete--thereby developing an unbounded structure from a bounded core. If stress patterns can be succesfully described in terms of the placement of bounded units, using only the established parameters of the theory, then the creation of unbounded units can be comfortably ascribed to Stray Adjunction, and our goal will have been reached.

Unbounded units have been given two principal roles: as feet, to find stressable syllables in systems that lack the closely articulated rhythmic pattern of alternating stress; and at the word level, to choose the primary stress from among a set of candidates.

Descriptively, the commonly encountered principle for primary stressing is strikingly simple: elevate the first (or last) foot of the word to greatest prominence. In terms of the theory described under (1), this outcome is usually understood as following from the placement of an unbounded unit over the row of feet. Because of the Headedness condition (1c), the strong element or head of any unit is always peripheral: therefore it can only be the first or the last foot that becomes strongest in the word. However, the same general theory allows an entirely different explanation for the (hierarchical) peripherality of main stress.

Suppose that a bounded unit (eg.[s w] for initial-foot stress in words) is placed <u>noniteratively</u> over the foot-row. By <u>Directionality</u> this unit must be located at the word-edge. Although a long word may be only partially metrified by the bounded unit, the crucial information about primary stress has been installed. Stray Adjunction is entirely adequate to join up any material not included in the original bounded unit, completing the derivation. Figure (4) schematizes a typical course of events:

(5)



It is important to note that this manner of deriving peripheral main stress is fully within the standard theory. As long as there are rules placing single metrical units in edge position (here understood as noniterative applications), with Stray Adjunction to clean up after them, then there is no need to handle peripheral stress with a special primitive notion "unbounded unit", whose job it is to find edges. What we have here is a conceptual redundancy, of the sort that syntacticians have found it fruitful to eliminate, between the structural vocabulary ("unbounded unit") and the theory of rule application ("noniterative","directional"). Each contains an independent

mechanism of edge-location. Rationality compels us to seek the annihilation of one at the hands of the other. Since noniterative or edge-anchored application cannot be reduced, within present understanding, to the placement of unbounded units, it follows that we should try for the demotion of unboundedness to derived status.

Standing in the way of this desirable tightening of the theory is the use of unbounded structures (as feet) to find not only word-edges but heavy syllables as well. Two particularly interesting types of patterning recur in the descriptive literature:

(6) **Non-Alternating Systems**

a. Default-to-Opposite-Side.
   i. Main stress falls on the last heavy syllable, or if there are no heavies, the first syllable.
   ii. Main stress falls on the first heavy syllable, or if there are no heavies, the last syllable.

b. Default-to-Same-Side
   i. Main stress falls on the first heavy syllable, or if there are no heavies, the first syllable.
   ii. Main stress falls on the last heavy syllable, or if there are no heavies, the last syllable.

(Readers interested in empirical underpinnings of this typology should examine Hayes (1981).)

The Default-to-Opposite pattern is commonly derived from the properties of Quantity-Sensitive Unbounded feet, following the line of Prince (1976).To illustrate the pattern of description let us consider the system (6ai) in which stress falls on the last heavy syllable, or lacking heavy syllables, on the first syllable. Suppose we assign Quantity Sensitive feet [s w*] to words. Feet will be of two types: those beginning with a heavy syllable; and those beginning with a word-initial light syllable; in both cases the foot goes on to include the maximal string of following light syllables. Diagram (7) shows how three schematic words would be parsed by such feet (H=heavy syllable; L=light syllable):

(7)a. # (L L L) (H L L L) (H) (H L L) #
   b. # (H L L L) (H L L) #
   c. # (L L L L L L) #

Primary stress is then placed on the last foot. If there are heavy syllables in the word, the last of these will initiate the last foot, and thereby receive word stress. If there are only light syllables, the word will contain but one foot; as the last (and only)

foot, its strong element or head--its first element, the word's initial syllable--will receive primary stress. For the mirror image pattern, unbounded feet [w* s] will be called on, with word stress falling on the first foot.

The Default-to-Same systems do not succumb to this sort of analysis. To see this, observe that the foot structure portrayed in (7a,b) cannot be the basis for either the first heavy/first syllable or the last heavy/last syllable pattern.

Suppose we wish to compute the last/last pattern from feet [s w*]. Words without heavy syllables,as in (7c), will have initial stress by foot structure alone, and cannot be given the required final stress.

Suppose we wish to compute the first/ first pattern from feet [s w*]. For words beginning with light syllables, as in (7a), we must say that the second foot receives greatest prominence; but for those beginning with heavy syllables, as in (7b), we must say that the first foot is chosen. Therefore there is no way to assign main stress consistently to the foot-row, without illegitimate, unsanctioned peeking across hierarchical levels.

Since the Default-to-Same systems cannot arise from quantity- sensitive feet [s w*], it follows by symmetry that they can't arise from feet [w* s] either.

The solution proposed by Halle & Vergnaud (1978) is to call on a new parameter, listed above as Obligatory Branching (1g), a refinement of Quantity Sensitivity. Obligatory Branching feet are quantity sensitive-- w-nodes are light syllables-- but they are also super-sensitive, as it were --the head must be heavy as well. Such feet serve to unambiguously mark the presence and location of heavy syllables. If the examples of (7) were parsed by feet [s w*] constrained to be Obligatory Branching rather than merely Quantity Sensitive, the results would be as in (8):

(8) a. # L L L (H L L L) (H) (H L L) #
b. # (H L L L) (H L L) #
c. # L L L L L L #

The crucial difference is that initial strings of light syllables belong to no foot at all. If we now assign final word stress via a metrical unit [w* s], we elevate the last foot of (8a,b), but the last syllable of (8c).

Unboundedness plays a rather trivial role here and can easily be eliminated in the way suggested above for word-stress assignment; the real key is

the Obligatory Branching stipulation. Suppose that strictly bounded OB feet were used. The crucial distinction between heavy-syllable words (8a,b) and light syllable only words (8c) is equally well established, and in exactly the same way: light-syllabled words are footless. Let Stray Adjunction apply freely; it will iteratively attach adjacent unmetrified elements-- necessarily light syllables, since all heavies are taken up in feet--until the word is footed up. Stray Adjunction cannot apply to light-syllabled words like (8c) since there is no base structure to adjoin things to. Word stress is assigned at the right margin--using a bounded unit [w s], of course, to which Stray Adjunction may also freely apply.

Default-to-Same systems, then, do not require primitive unboundedness within the standard theory of (1)-(4). Default-to- Opposite systems, such as the one diagrammed in (7), make a more central use of unboundedness: when the Quantity Sensitive foot has no heavy syllable to stop it, it expands by Maximality to encompass the entire word, driving the foot-head to the margin, entailing for example (with [s w*] feet) initial stress in light-syllabled words. Thus, the QS unbounded foot performs two functions: it finds heavy syllables, and it finds word-edges. But we now know that each of these can be accomplished by other mechanisms of the theory: OB feet find heavy syllables; and noniterative application leads to peripheral placement of stress. The standard theory must therefore contain an analyis of Default-to-Opposite solely in terms of bounded units.

Consider the type of pattern in (7): last heavy syllable, or first syllable if no heavies. Assign OB feet (bounded); these pick out the heavy syllables. Assign a foot [s w] noniteratively left-to-right, i.e. initially. Stray Adjunction attaches any remaining unaccounted-for material to these basic feet. Assign word stress to the final foot, and with Stray Adjunction at the word level the job is done.

An apparently unpleasant feature of this analysis is that an extra rule is required to stipulate initial stress; under the [s w*] analysis, initial stress follows from Maximality defined over unboundedness, that is, from the very nature of the basic units. But the standard approach must pay for this local achievement within the larger empirical realm of nonalternating systems as a whole, basing the Default-to-Same/ Default-to-Opposite distinction on a stipulative choice between QS and OB unbounded feet. If we strengthen the theory by eliminating primitive unboundedness, then only OB can be used in the derivation of nonalternating systems. The choice that divides Default-

to-Same from Default-to-Opposite is whether or not a rule of peripheral stressing applies at the foot level. The option of noniterative application is made available quite independently. Thus it may be truly said of the revised theory that it too allows the occurence of initial stress to follow from the basic character of the theory, from free combination of available parameters. The conceptual difference is that the standard approach seeks to derive the initial stress from the nature of structures (maximality, unboundedness), whereas the revised theory derives it from the nature of rule application (noniteration, directionality).

We have seen that the descriptive functions assigned to primitive unboundedness are entirely overlapped by other necessary devices of the theory. We are therefore able to extract from inside the corpulent standard theory a proper subtheory that generates the same central array of patterns. Unboundedness, governed by maximality, seeks edges: but applications limited to edges are required anyway. Unboundedness, governed by Quantity Sensitivity, seeks heavy syllables and edges: but we need a special device for finding heavy syllables anyway (Obligatory Branching), and edges can be found as before. Sufficient technology therefore exists to place bounded units in positions where they mark the essential distinctions; Stray Adjunction does the rest.

2. Remarks on the Argument

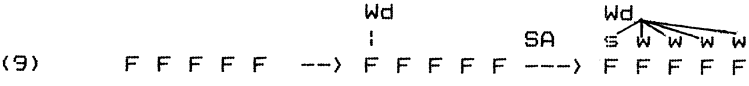
The argument has been presented in a stripped-down form so as to highlight its central contentions. Here I briefly discuss a number of auxiliary issues.

2.1 Peripherality

The method of implanting edge stresses suggested above does not automatically guarantee absolute peripherality. A bounded unit [w s] may be placed initially; a unit [s w], finally; giving second-from-edge stress. There are such cases in the literature (Tahitian, Goroa, Sindhi, Passamaquoddy,Ojibwa) but they submit to an extrametricality analysis as well, suggesting that the primacy of edgemostness should be insisted upon. (Particularly since such units may be composed with extrametricality, leading to even less heard-of systems.)

A plausible approach would be to attribute such edge stresses to the placement of a unary category, such a F (foot) or Wd (word). Initial foot stress would be derived, not as in example (5) by location

of [s w], but by association of the noncomplex category **Wd** in initial position (i.e. through noniterative, LR application.)



Since stray elements are always adjoined as weak non-heads, the same results are achieved as in (5). A similar approach would be to allow rules to mark head-position alone.

The problem is to force the kind of analysis in (9) over that in (5), given that the theory allows both. A number of moves are available, but lacking a conclusive argument, I will leave the matter open.

2.2 Shape of OB Feet

Deliberately left vague in the main discussion was the shape of the OB feet that form the basis for unbounded structures in nonalternating systems. In fact, the shape doesn't really matter--they could even be unary--, as long as Stray Adjunction works to tie everything up into feet (of any shape) before word stress is calculated. Hayes (1983,1985) shows that Quantity Sensitivity is strongly correlated with feet [w s]. Since OB is a subtype of Quantity Sensitivity-- indeed, its prototype-- Hayes's findings suggest that OB feet should be [w s] as well. There is no evidence as to exactly how Stray Adjunction should build on such cores.

3. Free Elements

The assignment of metrical structure is governed by a convention that has never, as far as I know, been explicitly stated in its full generality, even though it has been assumed in almost all descriptive work to date. The idea is this: once metrical structure has been erected, it can protect those elements in its domain from participating in further metrical construction. A stress analysis might contain two distinct rules of foot formation:
say a single foot is put down finally, and then iteration proceeds from the beginning (RL). Derivation would go as in (10a), preserving the first-assigned final foot; not as in (10b), overwriting it.

(10) a. o o o {o o} ---> [o o] [o] {o o}
b. o o o {o o} ---> [o o] [o o] [o]

Analysts have assumed implicitly, then, that rules establishing the metrical analysis of a domain apply only to free elements--those that are not already specified for the relevant metrical relation. From the perspective of general phonology, we see that such rules are feature-filling -- they provide information where none exists--rather than feature-changing. (This identification presupposes that the term feature ought to be generalized in the obvious way to include prosodic structure as well as distinctive features proper.) Let us call the constraint implied by descriptive practice the Free Element Condition (FEC) and state it as follows:

(11) **FREE ELEMENT CONDITION (FEC).** Rules of primary metrical analysis apply only to Free Elements--those that do not stand in the metrical relationship being established; i.e. they are "feature-filling" only.

A close look at the even most familiar metrical processes shows that the FEC must be assumed to play a central role in them. Consider derivational theories of syllabification, such as that propounded in Steriade (1982). We have two basic rules: an Onset Rule (OR), adjoining C to following V to form the basic syllable [CV]; and a Coda Rule (CR), adjoining C to a preceding V to close a syllable. The Onset Rule must precede the Coda Rule to encode the well-known fact that in the potentially ambiguous sequence VCV, only the parse V[CV] is found. As Steriade explicitly notes, the ordering OR < CR must be buttressed by a stipulation to the effect that the Coda Rule may apply only to what we have called 'free' elements, in order to avoid pathological derivations in which the Coda Rule overwrites the Onset Rule.

(12) C V C V ---(OR)---> [C V] [C V] --//-(CR)-> [C V C] [V]

Thus, if we accept the scattering of syllable formation rules among the other rules of the phonological derivation, as Steriade has proposed, we are already committed to a limited version of the FEC.

Within the stress theory we are discussing, the iteration of binary feet across a domain-- one of its most fundamental operations-- depends covertly on the FEC as well. At issue is why the window of foot-formation advances two syllables with each new iteration, allowing the domain to be sliced up into nonintersecting constituents. From the standpoint

of General Phonology, we should really expect a one-syllable advance: an iterative rule (for example, of tone- or backness-spreading) seeks out the very next place that will allow it to reapply; in the case of stress, if we bring but one new syllable into consideration after the iterative sweep has begun, that will be sufficient to form a new binary foot, so long as we can-- contrary to FEC-- seize on a syllable just metrified on the last iteration. Derivation (13) illustrates this unfortunate course of events:

(13)
o o o o -->[o o] o o -->[o [o o]] o -->[o[o[o o]]]

The FEC blocks this kind of derivation, since the crucial misstep takes place when a rule of primary metrification applies to an element that is not 'free' in the relevant sense. Thus it follows from the FEC-- and from nothing else-- that the window of analysis cannot include material from the previous iteration; commonly, this entails a two-syllable advance.

4. Limits of the FEC

It is appropriate and useful to inquire whether the FEC governs all metrical rules, always. Since any metrical operation can be construed as adjunction, we might ask: is all adjunction, then, Stray? The answer must be no, for two quite independent reasons.

First, cyclical application allows (and must allow) re-writing of structure from earlier cycles, limited by the Strict Cycle Condition. Various issues, some prickly, involving the relation of the Strict Cycle to the FEC (and to prosodic structuring in general) assert themselves at this point. I will not be able to discuss them, much less resolve them, in the providentially limited space available here.

Second, an entire component of the theory-- called "Destressing and Shifting" in (4) above-- is devoted precisely to making rearrangements in established metrical structure. Rules of destressing in particular must be allowed to implement drastic changes in structural affiliation and category membership, of just the type banned by the FEC. The rest of this paper will be devoted to integrating such rules into the theory.

5. Toward a Theory of Destressing Operations

5.1 An Observation and a Hypothesis

Heavy syllables have special status in the theory of foot-form outlined under (1) above; two parameters are given to restrict foot-dependents and foot-heads so that heavy syllables can attract stress regardless of their position in the word. We find rules stressing both heavy and light syllables (Quantity Sensitive, Quantity Insensitive); we find rules stressing only heavy syllables (Obligatory Branching); strictly excluded, and not found empirically, are rules-- easy to imagine-- that can only stress light syllables. I would like to suggest that rules of de-stressing can be classified in an entirely parallel way: while we quite often find rules destressing light syllables, and rules destressing any syllable as well, we do not appear to find rules destressing heavy syllables only. This relationship is charted in (14):

(14)

	THERE ARE:	
a.	Rules destressing only light syllables.	a′. Rules stressing only heavy syllables.
b.	Rules destressing any syllable.	b′. Rules stressing any syllable.
c.	NO rules destressing only heavy syllables.	c′. NO rules stressing only light syllables.

Here we have, if the facts are right, an impressive duality: the first column can be derived from the second (and vice versa) by exchanging the words 'heavy' and 'light', 'stressing' and 'destressing'. I would like to offer the following slogan to summarize the typological finding:

(15) **Observation.** Heavy syllables not only tend to attract stress, they also tend to retain it.

Statement (15) --an empirical hypothesis in the sense "low-level guess about what the facts are"--has a banal ring, but no work familiar to me assumes or explores it. More to the point: it does not follow from any version of metrical theory. Significant results have been achieved in predicting the contexts of destressing (Prince (1983b), and especially Hammond (1984)); but this is not among them.

The strictness of the parallelism in (14) between stressing and destressing suggests that at bottom there is only phenomenon, only one set of principles at play; yet there must be two domains of action. I suggest that the distinction between the rule types lies solely in their relationship to the Free Element Condition: basic stressing rules respect it; destressing rules are stressing rules that do not. There is then no special provision for destressing operations, no "theory of metrical transformations" with its own devices (Hammond (1984)). The proposal can be stated as in (16):

(16) **Hypothesis.** Destressing is the reassertion of the basic foot vocabulary in the 'feature-changing' mode; that is, no longer governed by the FEC.

Under (16), only three types of destressing environment can exist: (1) Quantity Insensitive, in which any syllable is reduced adjacent to a stressed syllable; (2) Quantity Sensitive, in which a light syllable is reduced adjacent to a stressed syllable; and (3) Obligatory Branching, in which a light syllable is reduced adjacent to a heavy syllable. (I assume bounded feet; note that unbounded deletions could provide a new style of argument for primitive unboundedness.) Of these, the Quantity Insensitive and Quantity Sensitive varieties are frequently found; examples of the Obligatory Branching type do not readily spring to mind-- perhaps some explanation is owed here. At any rate, it is clear that if hypothesis (16) can be sustained, with the concomitant disappearance of an entire component, the theory will be notably strengthened, and a significant empirical generalization--the persistence of heaviness--will have been given its due.

The present proposal depends on a specialized feature of tree theory: to assign stress, we start out from nothing, from unspecification, and impose both stress (headship of foot) and stresslessness (nonheadship) in one rule. Foot formation is as much an act of unstressing as of stressing, and the process will appear to be one or the other, depending on the circumstances of application. In particular, if it is 'feature-changing' and if the stressing part is vacuous, it will give the appearance, to the unwary, of simple de-stressing. But the mask is easily stripped off.

5.2 Some English

English is as rich in destressing as in stressing, and well-studied to boot. Here I offer a brief account of four major destressing rules in order to illustrate how the general theory works out in practice.

I will assume that stress in English is assigned iteratively right-to-left (Liberman & Prince (1977)), in binary feet of which only the first is Quantity Sensitive (Hayes (1982)); as a consequence, all initial syllables will be provided with a stress (Halle (1973)) on the last iteration. I will also assume that de-stressing is as in SPE and Kiparsky (1979); I will not be dealing with the important work of Hammond (1984).

All words must receive an initial stress, but only some retain it: the whole pattern will emerge from the discussion. Let us first consider the case where the initial stress is lost to a rule known as Pre-Stress Destressing. Some typical examples are cited in (17):

(17)

Stressless Initial	Stressed Initial
America	ambiguous
Monongahela	Montana
police	poltroon
Astyanax	October, November

A light initial syllable is destressed when it precedes another stress. We must say: a Quantity Sensitive foot [w s] is installed word-initially, completely overwriting (hence deleting) the unary foot that is the residue of the basic stress rule. Derivation proceeds like this:

(18)

Str		DeStr
ameri(ca)	----> [a] [meri] ca	-----> [[a me] ri] ca

(Parenthesis indicates extrametricality: see Hayes (1982).)

Of course, it is not enough to simply place a certain kind of foot in a certain position: 'PAmela', for instance, does not become 'paMEla'. (If it were, we could treat this as the first rule of stressing, its output protected by the FEC.) With Prince(1983b) and Hammond(1984), I assume that de-stressing rules are subject to strong general conditions which sharply limit the amount of rule-specific stipulation allowed;

indeed, in the present context, the natural conjecture is that such conditions reduce the rule vocabulary to that of stressing itself: choice of foot and manner of placing it.

Two conditions bear directly on the examples at hand: first, that destressing and shifting rules must apply only to increase eurhythmy, typically to eliminate clash (adjacency) of stresses; second, that main-stress of the relevant domain cannot be affected by such rules. (For detailed justification of these ideas, see Hammond (1984)). The proposed rule of foot- placement-qua-destressing is doubly blocked from applying to 'Pamela', because it cannot affect a main stress and because the word suffers from no dysrhythmy that would be ameliorated by rearranging its prosody. Similarly, a word like 'polypropylene' does not receive an initial, overwriting [w s] foot because it already satisfies the conditions of eurhythmy.

A second rule with SPE origins is "Post-Stress Destressing", importantly generalized in Hayes(1982): it requires the deletion of a stress on a light syllable immediately after another stressed syllable. In present terms, this is just the imposition of a Quantity Sensitive foot [s w], eliminating a clash. Some cases:

(19)	Reduced	Unreduced
a.	elementăry	sedentàry
b.	directŏry	accusatòry
c.	Tatămagouchi	Monòngahela
d.	Kilĭmanjaro	Embàrcadero
e.	Winnĭpesaukee	Ticònderoga

Examples (a,b) illustrate that suffixes -ary,-ory lose stress when preceded by a stress. Examples (c,d,e) have relevance in terms of Hayes's analysis of English stress: parsing right-left with binary feet [s w], we derive structures like [ta][tama][gouchi], carrying an extra stress on the 2nd syllable. But it is in just the position to be removed by Post-Stress Destressing. The words in column 2 show that the rule does not affect heavy syllables.

In forms like [ta][tama][gouchi], there is a competition between Pre- and Post-Stress Destressing; that is, between using [s w] or [w s] to resolve the clash. Hayes ensures correct dominance by ordering the Post-Stress rule first. This is regrettably the opposite of the ordering which Kiparsky (1982), improving tacitly on Prince (1974), discovers necessary for a different range of facts. Surely the interaction ought to be adjudicated by principle--

presumably, there is some rhythmic advantage in initial stress, as we know from phrasal patterns-- but the matter must be left open here.

English provides two rules which pose clear problems for the theory. First, Sonorant Destressing (Kiparsky (1979), Hayes (1982)): this rule destresses a syllable closed by a sonorant, as in 'merchandise', 'Arkansas', 'serpentine', when it is both preceded and followed by a stress. Here is a rule that appears to apply only to heavy syllables (of a certain type), grossly contrary to our expectations. But this is an artefact: there is no need to prevent the rule from applying to light syllables, where its effect would be vacuous; and it could apply as well to syllables ending in a long vowel-- relevant examples are few, but 'diplomat', cf. 'diplo:macy', is a good candidate. The real restriction is that it may not apply to syllables closed with a consonant,e.g. stalactite: these, then, are 'heavy' with respect to the rule, which is Quantity Sensitive, all others 'light'. Language-specific variations in the definition of heaviness are well-known, although this particular bifurcation is not a popular one and has been ruled impossible in some theories (Prince (1983), but see Stowell (1979) on Seneca). Even if some distinctions are ultimately found between 'stressability' and 'reducibility', giving somwhat different meaning to 'heaviness' as applied to the domains of stressing and destressing, the present theory retains its essential content.

Then there is Fidelholtz's Law, a.k.a. the 'Arab' Rule, (Ross (1972)), which distinguishes between the final stress in 'Ahab' and the final unstress in 'Arab': a syllable containing a short vowel is destressed when it immediately follows a more prominently stressed light syllable. A final secondary stress on 'pyrex', 'Cantab', etc., is safe, because the initial syllable is heavy; safe on such as 'Hittite' and 'cathode' because of the long vowel; but lost in 'Essex', 'Arab', 'polyp', 'bollix', etc. The difficulty with this rule is that it displays sensitivity to quantity in both target and trigger, w and s. The reducing syllable must be 'light' in the sense that it can't contain a long vowel (not an uncommon definition typologically), the context syllable must be light in the usual sense: open, with a short vowel. The foot imposed might be described as "obligatory non-branching" --both head and nonhead must be light-- a type unsanctioned by the standard theory (but see McCarthy (1979a)); with the additional fillip that the meaning of 'light' depends on foot-position. In short, Fidelholtz's Law does not fall cleanly to

direct assault by the forces marshalled here. However, it has never been treated in any but the loosest of prosodic theories, which I take as a kind of consolation ex silentio. It is not impossible that further understanding of the nature of constraints on foot-types (perhaps along the lines of Hayes (1985)) will illuminate the process.

It is striking that every one of the reduction rules is sensitive to syllabic quantity, in one form or another. In Hayes (1982), the English stress rule starts off Quantity Sensitive at the edge and then iterates without regard to quantity. The respite from quantitative considerations is brief. The present theory gives a very direct account of many aspects of the destressing system; it also identifies some problems worthy of serious resolution.

5.3 Some Hebrew

The phonology of Biblical Hebrew provides an example of a single stress rule that applies in both feature-filling (FEC governed) and feature-changing modes. In the necessarily concise presentation that follows, I will be building on the general results of Prince (1975); readers seeking detail should consult that work.

Biblical Hebrew distinguishes two forms for many words: the 'pausal' form, which appears at the end of the intonational phrase, and the 'contextual' form, which appears elsewhere. For the most part, the differences between the forms are predictable and seem to stem from the pausal form's bearing phrasal main stress.

In the matter of main word stress, the pausal forms give a transparent indication of the fundamental rule: primary stress falls on the last syllable if it is closed by a consonant; vowel- final words have penultimate stress. The following chart lists some typical examples:

(20)

	Underlying	Pausal	Context	Gloss
a.	/katab +uu/	kaatáabuu	kaatbúu	they wrote
b.	/katab +tem/	kətabtém	-same-	you (m.pl.) wrote
c.	/quum +uu/	qúumuu	-same-	they arose
d.	/kookab+iim/	kookaabíim	-same-	stars
e.	/malak+ay+hem/	malkeehém	-same-	their(m.pl.) kings
f.	/dabar+e+ka/	dəbaarékaa	dəbaarkáa	your(m.s.)word

(Word-stress is bolded; long vowels are written double; spirantization of stops /p t k b d g/, which takes place following all vowels, underlying or inserted, is not marked.)

The contextual stress pattern differs from the pausal in only respect: when the pausal form has penultimate stress falling on a syllable that is underlyingly light, as in (20a,f),the context form has final stress. Stress, then, shifts rightward off a light syllable.

A variety of lengthenings regularly apply. Vowels lengthen finally (20f) and under word stress (20a). More strikingly, vowels lengthen in open syllables that immediately precede the locus of pausal main stress: such vowels have been underlined in (20). Notice that these vowels lengthen in both pausal and contextual forms, whether or not the environmental condition is satisfied in the context form: whence the lengthening in k<u>aa</u>tbúu, from /katab+uu/, even though the syllable is surface-closed, and even though the lengthening vowel and the surface-stressed syllable are not adjacent at the relevant point of derivation. This fact shows unequivocally that every word receives the 'pausal' stress pattern-- yielding katabuu -- on the basis of which Pre-Tonic Lengthening, as it's known, can be computed-- giving k<u>aa</u>tábuu. Phrasal placement of the word then determines whether stress shifts (context) or stays put (pausal).

Equally significant is the reduction of light syllables. In open syllables, short vowels reduce to schwa; many ultimately delete. Thus /dAbarEka/ ==> d-baarékaa (pause), d-baar-káa (context). The last form illustrates a singular fact: any vowel that occasions stress shift is also one that reduces. This suggests an explanation for the peculiar restriction that stress may only shift from light syllables: shift is not an independent rule of Hebrew grammar at all, but rather a concomitant of the more general reduction process.

Following Prince (1975) and McCarthy (1979b), I propose that the reduction pattern emerges from the imposition of an alternating stress pattern on the word. Quantity Sensitive feet [w s] are iterated from right to left. (Reduction and deletion of vocalic material takes place in w-syllables, but quite late.) These moves seem ordinary enough. The twist is that foot-formation follows on the prior and entirely distinct rule that lays the groundwork for main stress. We can think of this rule as attaching a unary foot finally, subject to extrametricality of the final vowel. Derivation proceeds as in (21):

(21)

Lexical:	/dabar+eka/	/malak+ay+hem/
M.Str.	daba(ré)(ka)	malakay(hem)
Alt.Str.	[dabá](ré)ka	[má][lakáy](hém)
PTL	[dabáa](ré)ka	
Other	[dabáa](réka)	[má][lakée](hém)

The Free Element Condition plays a crucial role, governing the interaction of the two processes of primary metrification, the Main Stress Rule and the Alternating Stress Rule. Once Main Stress has applied, its product cannot be overwritten; Alternating Stress must therefore begin its right-left sweep not at the absolute end of the word, but at the rightmost unmetrified point. This is exactly the pre-tonic syllable, which is now protected from reduction. The rule traditionally called Pre-Tonic Lengthening (PTL) is now understood to apply in the environment of stress-clash: it mitigates a dysrhythmy by lengthening the distance between adjacent stresses. (For an almost identical rule in Cayuga, see Prince (1983a) and especially Benger (1984).)

So far the derivation is entirely concerned with lexical matters; but the notions 'pausal' and 'contextual' are defined phrasally. I propose that the rule of Alternating Stress also operates in the (rather extensive) phrasal component of Hebrew phonology, persisting from level to level in the manner made familiar by Lexical-Phonological theory. At the phrasal level, words are completely metrified, so the FEC is called off and the Alternating Stress rule applies in a feature-changing fashion. In contextual forms, when the penult is light, the resurgence of Alternating Stress may overwrite the output of the "Main Stress" rule entirely, shifting stress and setting up a vowel for later reduction. The derivation (21), column 1, would continue as in (22):

(22)

Lex.Out.	[dabáa](réka)
Alt.Str.	[dabáa][rekáa]
Other	[dəbáa][rkáa]

Before "pause", the lexical main stress may not be obliterated, presumably because it is also the phrasal main stress; this recalls the condition, noted above, that reduction and shift rules may not affect the main stress of the domain of their application.

Many complexities remain to be discussed. Recent work such as McCarthy (1981), Dresher (1983), and Rappaport (1984) offers much that is relevant. The fundamental generalizations seem quite secure, however, and the exposition here has aimed to deal directly with them.

Identifying the shift process with the independent rule of Alternating Stress explains its major properties: (1) that stress shifts from light syllables only; (2) that it shifts rightward. The Free Element Condition forces the rule to respect structure placed by the Main Stress rule, starting its RL iteration with the pre-tonic (penultimate, sometimes antepenultimate) syllable. This establishes a natural environment for Pre-Tonic Lengthening. Phrasally, free of the FEC, Alternating Stress overwrites any structure in its domain, giving rise to the observed shift.

6. Conclusion

A look at the logic of an explicit parametrization of metrical tree theory has shown that significant improvements can be made, essentially by trimming the fat. Unboundedness need not be a primitive of the theory, because its functions are already shared out among various independent parameters and processes. The Free Element Condition, implicit till now, must govern primary metrical analysis (including, I believe, rules of extrametricality); destressing can be understood, with notable empirical gain, as a reassertion of the basic foot vocabulary in the feature-changing mode.

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