Weak Local Parsing in a Theory Without Foot Inventories

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Hammond (1990a,b) and Hayes (1995) proposed that ternary stress alternation arises from the foot structure

(1) \( \ldots(\times \times)(\times \times)\ldots \)

in which an unfooted element intervenes between binary feet. He calls this weak local parsing. His use of this idea to account for the Estonian stress system is particularly compelling because it is completely straightforward whereas, as he observes, stress theories like Halle and Vergnaud (1987) are unable to give an adequate account of Estonian stress. Idsardi (1992) and Halle and Idsardi (1995) are no more successful. The theory of weak local parsing proposed by Hayes, however, is not successful in analyzing some stress systems which are closely related to the Estonian system. Finnish and Sentani, in particular, will be discussed in detail below. This paper will argue that although Hayes is correct in concluding that ternary alternation is a consequence of the foot structure above, he is mistaken about the conditions under which this configuration occurs.

In Frampton (2007) I adapted and generalized Sommerstein’s (1974) notion of a phonotactically motivated rule to iterative rules in general, and iterative footing rules in particular. The goal of this paper is to provide evidence for the theory of iterative footing developed there by showing that it provides a less stipulative and more general account of the appearance of nonabutting feet than the theory of weak local parsing proposed by Hayes. No prior knowledge of Frampton (2007) will be assumed.

Various core aspects of the stress theory of Halle and Idsardi (1995) are rejected: the two-stage approach to accounting for heaviness effects and the classic theory of iterative rules which is assumed. But several innovations in the theory of footing which are proposed in Idsardi’s 1992 thesis, and figure prominently in Halle and Idsardi, are important to the theory developed in this paper. Most crucially, I assume that footing rules are delimiter insertion rules, which insert right or left foot delimiters one at a time. I also adopt Idsardi’s proposal that edge marking rules which apply before iterative footing should take over the role assigned to assumptions about extrametricality in earlier stress theories.
1. Defect-driven rules

Consider the rule schema

\[
\begin{align*}
[-\text{voice}] & \rightarrow \emptyset / \_\# \\
\emptyset & \rightarrow \varepsilon / C\_\#
\end{align*}
\]

in a language in which underlying C-final forms are converted to V-final surface forms. For simplicity, suppose that underlying complex codas do not appear in the language. The two subrules of the schema are quite different, but they clearly cooperate in converting underlying C-final forms to V-final forms.

Sommerstein (1974) proposed that the grammar recognizes the cooperation that the linguist recognizes and that the grammar in fact has the rule

\[
*C/\_\# :: \begin{align*}
[-\text{voice}] & \rightarrow \emptyset \\
\emptyset & \rightarrow \varepsilon
\end{align*}
\]

in which the common motivation for the two subrules is abstracted from their structural descriptions and explicitly recognized as the trigger for their application. The rule schema is then recognized as the means of achieving a desideratum, with its subcases simply different means of satisfying the same desideratum. The schema supplies the two means and assigns them preferences. Deleting a voiceless consonant is the preferred means. If it cannot accomplish the objective, schwa epenthesis is used.

Suppose we consider footing from this perspective. Consider a simple case of left to right binary footing, the derivation (2) below. I assume that grid marks, denoted by ×, are footed, but ignore at this point how this metrical tier is created. So grid marks might be projected from moras or syllables, or perhaps syllable nuclei or nuclear elements.

(2) 

\[
\begin{align*}
\times \times \times \times \times \\
1. & \times \times \rangle \times \times \times \\
2. & \times \times \rangle \times \rangle \times \times \\
3. & \times \times \rangle \times \rangle \times \rangle \times
\end{align*}
\]

How might this derivation be viewed as desideratum driven? If the rule \( \times \times \rightarrow \times \times \rangle \) is imitated crudely, one would say that the desideratum is that every pair of grid marks is followed by a right delimiter. But the desideratum should be a condition on grid marks. This leads to the following condition on grid marks:

(3) 

\[
/ \times \_ \Rightarrow / \_\rangle
\]

Condition (3) requires that a grid mark which directly follows a grid mark must itself be followed by a right delimiter.

Suppose we call a violation of (3) a defect. Each step in the derivation (2) removes the leftmost defect. The derivation (2) is repeated below, with the leftmost defective grid mark at each stage indicated by ∧.
The desideratum (3) and left to right defect removal cannot be the whole story of this derivation, however, since there are many other derivations which also eliminate the leftmost defect at each stage. Some examples are given below.

(4) \[ \times \hat{x} \times \times \times \times \times \]
1. \[ \times \rangle \times \hat{x} \times \times \times \times \]
2. \[ \times \rangle \times \hat{x} \times \times \times \times \]
3. \[ \times \rangle \times \times \rangle \times \times \hat{x} \times \]

(5) a. \[ \times \hat{x} \times \times \times \times \times \]
1. \[ \times \rangle \times \hat{x} \times \times \times \times \]
2. \[ \times \rangle \times \hat{x} \times \times \times \times \]
3. \[ \times \rangle \times \times \rangle \times \hat{x} \times \times \]
4. \[ \times \rangle \times \times \rangle \times \hat{x} \times \times \]
5. \[ \times \rangle \times \times \rangle \times \times \hat{x} \times \]

The derivation (5a) makes it clear that the desideratum is directed towards ensuring that long strings of grid marks are broken up by foot delimiters but does not impose a lower limit on the length of these feet. If we combine the desideratum (3) with the derivational constraint *Unary, which forbids creating feet consisting of a single grid mark, then both (4) and (5b) are possible derivations, but (5a) is excluded. What then determines the distinction between (4) and (5b)? This is a question of what delimiter insertion rules are available to remove defects.

Consider then the iterative rule (6).

(6) \[
\times \hat{x} \times \times \times \times \times \rightarrow \times \hat{x} \times \times \times \times \times ; \text{ *Unary (left to right)}
\]

Following Sommerstein’s model, (6) calls on the repair operation \( \emptyset \rightarrow \) if and only if it brings a grid mark which does not satisfy the desideratum into compliance with it. The directional specification is an instruction to repair defects from left to right. This rule produces (4), and only (4).

Now consider the iterative rule (7), which differs from (6) only in having an additional repair operation available. The two repair operations are ordered. Repair operation order is a secondary determinant of how repairs are made. Leftmost repair takes precedence, but if two valid repairs both remove the leftmost defect, then repair operation order determines which repair is made. A valid repair is one which is carried out by one of the specified repair operations, satisfies the specified derivational constraints, and repairs the leftmost defect which can be repaired.

(7) \[
\times \hat{x} \times \times \times \times \rightarrow \emptyset \rightarrow \times \hat{x} \times \times \times \times ; \text{ *Unary (left to right)}
\]
This rule produces (5b), and only (5b). At the first step, for example, there are two valid repairs.

\[ \times (\times \times \times \times \times) \text{ and } \times (\times \times \times \times \times) \]

The first repair is chosen because of rule ordering. At the second step, there is only one valid repair, which uses the lower ranked repair operation.

There are three unfooted grid marks in the final representation in (5b), but none are defective. For descriptive purposes, grid marks which are left unfooted will be called orphans. The final representation above has a \textit{left orphan}, an \textit{internal orphan}, and a \textit{right orphan}. An internal orphan occurs in (5b) simply because of the particular array of repair rules and their ranking. If the repair operations had the opposite ranking in (7), abutting feet would be constructed. Footing would be just as in (4); the lower ranked repair operation would never be called upon.

The desideratum (3) is indifferent to what Hayes calls the distinction between weak local parsing and strong local parsing. How the derivation goes about satisfying the desideratum is a question of the repair operations that are available, their ranking, and the derivational constraints on their application. I assume that the unmarked case is for the highest ranked delimiter insertion rule to be the delimiter mentioned in the desideratum which drives the footing rule. The rule (7) is therefore a marked option, corresponding to the marked character of ternary footing.

In what follows, defect-driven rules will be written in a standard format. (7) will be written as:

\[(8) \times ; /\times \rightarrow \_ \_ \_ \_ \_ \_ \_ ; \text{Left} :: \begin{array}{c}
0 \rightarrow \langle \\
0 \rightarrow \rangle \end{array} ; \{ \text{*Unary} \} \]

The material to the left of :: identifies the type of phonological object which the rule applies to, the desiderata, and the criterion which ranks the defects. In footing, the defects are always ranked by leftness or rightness. The rule (8) has a single desideratum, but multiple desiderata are possible. If the desiderata are ranked, notions like “better repair of a defect” and “maximal repair of a defect” come into play, with obvious meanings. At each iteration of (8), a maximal repair of the most highly ranked defect which can be repaired (to any extent) is made. The material to the right of :: gives the repair operations (ranked) and the set of derivational constraints they operate under. If more than one repair can accomplish maximal repair of the most highly ranked repairable defect, repair operation ordering comes into play, choosing the most highly ranked repair operation.

In addition to the derivation (5b), it is useful to consider two more derivations produced by (8).
At the last step in (9b), *Unary blocks the highest ranked repair operation, ⟨-insertion, and a binary interval results. With foot stress right (iambic stress), this produces the stress pattern in (10).

Winnebago has this pattern for words without heavy syllables.

In (5b) and (9) the lower ranked repair operation is often used. In some systems, a lower ranked repair is called upon only in exceptional situations. Consider the rule (11), with the derivational constraint *#×⟨, which disallows the creation of a left orphan. Footing is right to left, driven by the mirror of the desideratum (3).

Crucially, the two derivational constraints conspire at the step marked † to prevent ⟨-insertion from removing the rightmost defect, so the lower ranked ⟩-insertion repair rule is called on. If stress is trochaic, this gives the well-known stress pattern of Garawa (Furby 1974). Grid marks are projected from each syllable in Garawa.
The effect of \(^*\#x\langle\), which blocks an orphan at the left edge, is that the second grid mark is never stressed.

Both Idsardi (1992) and Hayes (1995) derive this pattern by assuming that an edge operation applies at the left edge prior to iterative footing, which proceeds inwards from the opposite edge.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge operation</td>
<td>((x\times x\times x\times x\times x\times x\times x\times x\times x)</td>
<td>((x\times x\times x\times x\times x\times x\times x\times x\times x)</td>
</tr>
<tr>
<td>Iterative footing</td>
<td>((x\times x\times x\times x\times x\times x\times x\times x)</td>
<td>((x\times x\times x\times x\times x\times x\times x\times x\times x)</td>
</tr>
<tr>
<td>Iterative footing</td>
<td>((x\times x\times x\times x\times x\times x\times x\times x\times x)</td>
<td>((x\times x\times x\times x\times x\times x\times x\times x\times x)</td>
</tr>
</tbody>
</table>

Idsardi imposes the derivational constraint \(^*\text{Unary}\), which blocks further application of the binary footing rule which he assumes. Hayes imposes a similar constraint to prevent the single unfooted element which remains from being footed. Footing in Idasdi’s and Hayes’ theory therefore starts at the left edge, then resumes at the opposite edge.

Delimiter insertion in (12) proceeds strictly from right to left. In what follows, I will assume that delimiter insertion (in each cycle) is \textit{monodirectional}. This implies that an edge marking operation, if there is one, can only apply at the edge from which iterative footing proceeds. Defects can therefore be rendered inaccessible by delimiter insertion. This is computationally efficient since it limits the grid marks which must be scanned in determining if and how the next delimiter should be inserted.

In addition to derivational constraints, a second class of constraints, which I call \textit{preference constraints}, is important in some stress systems. Preference constraints have the same form as derivational constraints, but preference constraint violation is allowed if maximal repair of the most highly ranked repairable defect is not possible without violating a preference constraint. If such preference constraint violation is required, the preference constraints are minimally violated. Multiple preference constraints therefore must be ranked so that minimal violation can be determined. I assume that they are given as an ordered list. In fact, multiple preference constraints are rare.

Consider (15) and the illustrative derivations in (16). The list of preference constraints follows the set of derivational constraints, separated by the symbol \&.

(15) \(x; /x\_\_ \Rightarrow /\_\_\); Left :: \(\emptyset \rightarrow \); \{\(^*\)#\} \& \(^*\text{Unary}\)

(16) a. \(x\times x\times x\times x\times x\)  
    \(x\times x\times x\times x\times x\times x\times x\times x\times x\times x\)  
    \(x\times x\times x\times x\times x\times x\times x\times x\)  
    \(x\times x\times x\times x\times x\times x\times x\times x\times x\) 

b. \(x\times x\times x\times x\times x\times x\times x\times x\times x\times x\)  
    \(x\times x\times x\times x\times x\times x\times x\times x\)  
    \(x\times x\times x\times x\times x\times x\)  
    \(x\times x\times x\times x\times x\times x\times x\times x\times x\times x\times x\times x\) 

\(x\times x\times x\times x\times x\times x\times x\times x\times x\times x\times x\times x\)
At †, *)# prevents the formation of a binary foot. The only way to remove the leftmost defect is to violate the preference constraint *Unary. If stress is iambic, the pattern (15) is produced.

(17)  

a.  

b.  

c.  

d.  

e.  

f.  

g.  

h.  

This is the well-known stress pattern of Southern Paiute.

As in the case of Garawa, Idsardi and Hayes both obtain this pattern by carrying out an operation at one edge, then carrying out iterative footing proceeding from the opposite edge. Hayes assumes extrametricality (the dotted frame below) applies at the right edge, while Idsardi employs a delimiter insertion operation.

(18) Hayes (1995)  

<table>
<thead>
<tr>
<th>Edge operation</th>
<th>× × × × ×</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iterative footing</td>
<td>(× ×) × × ×</td>
</tr>
<tr>
<td>Iterative footing</td>
<td>(× ×)(× ×) ×</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Idsardi (1992)</th>
<th>× × × × ×</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iterative footing</td>
<td>(× ×) × × ×</td>
</tr>
<tr>
<td>Iterative footing</td>
<td>(× ×)(× ×)(× ×)</td>
</tr>
</tbody>
</table>

As far as I can determine, iterative footing rules are always subject to *Unary, often as a derivational constraint but sometimes only as a preference constraint. I will therefore assume in what follows that *Unary, as a preference constraint, is part of UG and does not need to listed in the description of an iterative stress rule.

In all of the examples above, the repair rules were able to eliminate all defects. This is not always the case. Consider the rule (19) and illustrative derivations (20).

(19)  

x ; / __x ⇒ / ⟨__⟩ ; Right :: [0 −→ ⟨⟩ ] ; { Unary, # ⟨⟩}

(20)  

a.  

b.  

c.  

At † in (20a) and (20b), *Unary and *# ⟨ conspire to make it impossible to remove the remaining defect. Note, however, that the defective grid mark in (20a) is footed. If stress is trochaic, the stress pattern (19) results.
This is the well-known stress pattern of Cayuvava.

Although stress patterns like Cayuvava and Winnebago are highlighted here in order to illustrate how marked repair operation order leads to ternary intervals between stress positions, it is worth emphasizing that the occurrence of the marked order is relatively rare.

The desideratum $\langle \, \times \, \rightarrow \, \rangle$ is used in left to right footing and the desideratum $\rangle \, \langle \, \times \, \Rightarrow \, \langle \,$ is used in right to left footing. Call these desiderata Left-Alternation and Right-Alternation respectively. Since a defect-driven iterative stress rule specifies the direction, I will simply call the desideratum Alternation with the understanding that this is interpreted according to the direction the rule specifies.

The default rules for alternating stress are given in (22).

(22) a. $\times$; Alternation; Left :: $\emptyset \rightarrow \rangle$

b. $\times$; Alternation; Right :: $\emptyset \rightarrow \langle$

Recall that *Unary is universally a preference constraint.

2. Heaviness effects in syllable counting languages

While most stress systems have binary or ternary rhythm to one extent or another, there are a few dozen stress systems which do not. Halle and Vergnaud (1987), Idsardi (1992), and Halle and Idsardi (1995) all use Koya, described by Tyler (1969), as a showcase example of the effects of heavy syllables, independent of rhythmic. In Koya, the initial syllable and all heavy syllables are stressed, with main stress on the initial syllable. There is no evidence of rhythmic stress. The intuition pursued by Halle and Idsardi, which I believe to be correct, is that stress systems that evidence both rhythmic stress and heaviness effects are some kind of a mixture of a Koya-type stress system and purely rhythmic stress system, not only at the phenomenological level but at the formal level as well. This line of analysis is not open to Hayes, since the notion of “foot inventory” plays a central role in his approach to footing. Koya is analyzed using unbounded feet, which play no role in his analysis of rhythmic stress.

Halle and Idsardi implement the idea of a mixed system by proposing a two-stage footing process. First, foot delimiters are inserted as if the language were a pure Koya-type language. Then, a purely rhythmic delimiter insertion rule applies. This approach is successful over a wide range of examples. It fails, however, in several of the examples discussed in the next section. The implementation that will be proposed here is that the mixing is at the level of desiderata; a Koya-type desideratum is combined with a rhythmic desideratum. Footing is driven by multiple desiderata.

As a starting point, I adopt Prince’s (1983) view of the ultimate origin of heaviness effects, the particular way in which heavy syllables are projected onto the metrical grid.
In many syllable counting languages, in addition to projecting a grid mark from each syllable, a stress mark at the second grid level is projected for each heavy syllable. I will call this inherent stress. In mora counting languages, on the other hand, a grid mark is projected from each mora. These languages also exhibit heaviness effects, but I will argue in a subsequent paper that these effects are due mainly to the interaction of delimiter insertion and Syllable Integrity, not inherent stress.

The footing rules in Koya therefore apply to forms like the one below, which is the projection of an 8 syllable word whose third and sixth syllables are heavy.

```
× × × × × × × ×
× ×
```

I assume that surface stress is determined only by foot structure and the trochaic/iambic parameter. If inherent stress is to survive to the surface, it must find itself in a stress position, foot initial if stress assignment is trochaic or foot final if stress assignment is iambic. I also suppose that grammar design is biased in favor of grammars which allow inherent stress to survive. Put otherwise, grammar design is biased in favor of those grammars which minimize stress deletion. If not for such a bias, there would be no reason to expect that so many syllable counting languages would evidence heaviness effects.

Since stress is initial in Koya and inherent stress does survive, the simplest proposal is that stress is trochaic and that the form above is footed as shown below.

```
⟨× × ⟨× × × × × × × ⟩
```

The simplest desideratum is simply the requirement that inherently stressed grid marks are in the environment ⟨⟩.

(23) Koya footing rules

Edge marking (EM):  \( \emptyset \rightarrow \langle / \# \rangle \)

Iterative footing (IF):  \( × ; / _\rightarrow / \_ ; \text{Left}: \emptyset \rightarrow \langle \)

Since there is edge marking at the left edge, monodirectionality implies that iterative footing must apply from left to right.

In the iambic mirror image of a Koya-type stress system, the relevant desideratum would be

```
/ × \rightarrow / _
```

I will call the one desideratum Trochaic-Alignment and the other Iambic-Alignment. Since the trochaic/iambic choice is extrinsic to the footing rules, it is sufficient to write the Koya iterative footing rule as:
(24) × ; Alignment ; Left :: θ → ⟨

with Alignment interpreted with respect to the trochaic/iambic choice.

2.1. Mixed systems

Suppose the Koya iterative rule is “blended” with left to right binary footing.

(25) × ; Alternation ; Left :: θ → ⟩ ; *Unary

There are several ways that one might imagine combining (24) and (25). Two obvious choices, differing only in repair operation order, are given in (26). Different desiderata order turns out to be unimportant.

(26) a. × ; \[Alignment \]
    \[Alternation\] ; Left :: \[θ → ⟩\] ; *Unary

b. × ; \[Alignment \]
    \[Alternation\] ; Left :: \[θ → ⟨\] \[θ → ⟩\] ; *Unary

The effect of the different repair operation orderings in (26a) and (26b) will be illustrated in the next section. (26a) is the footing rule for Finnish. With some minor modification of the derivational constraints, (26b) is used in Estonian and Tripura Bangla. Sentani illustrates a right to left mirror of (26b).

3. Finnish, Estonian, Tripura Bangla, and Sentani

I will proceed by first detailing the generalizations about the distribution of stress in each language that must be explained. The generalizations are presented in the form of recursive rules for assigning stress rather than the more typical verbal descriptions that are sometimes presented. So, for example, in describing Estonian (27b) will be given rather than (27a).

(27) a. If σₙ is stressed, then σₙ₊₃ is stressed if it is heavy or nonfinal and σₙ₊₂ is light, or σₙ₊₂ is stressed if it is heavy or nonfinal.

   \[\hat{σ} σ \quad → \quad \hat{σ} σ\]
   \[σ σ σ σ σ \quad → \quad σ σ σ \quad / \quad σ σ \hat{σ} σ σ\]
   \[σ σ σ \quad → \quad σ σ \quad / \quad s σ \quad s σ\]
   \[σ σ σ σ \quad → \quad \hat{σ} σ \quad \hat{σ} σ\]

b. An ordered list of stress assigning rules is much easier to work with than the difficult to parse verbal description. In addition to a recursive part, a rule for placing initial stress will be given for each language. These rules are not intended to be rules of the grammar, simply generalizations over the data which succinctly summarize what the grammar must explain.
The data on which the generalizations above are based come from various (mostly secondary) sources. The Finnish data is from Karttunen (2006), taken from Elenbaas (1999) and Kiparsky (2003). The Estonian data is from Hayes (1995), who takes it from Hint (1973). The complication of so-called superheavy syllables is not considered here because the issue is essentially orthogonal to the concerns of this paper. The Tripura Bangla is a dialect of Bangla (Bengali) spoken in the Tripura region of northwest India. Tripura Bangla data is from the thesis of Das (2001). Sentani is a Papuan language spoken in Papua Indonesia. The Sentani data is from Hayes (1995), who analyzes the dialect described by Cowan (1965).

Only small data sets will be considered in this section, sufficient only to illustrate the generalizations. An appendix contains many additional examples, for those who want more verification of the generalizations.

3.1. The data that footing theory must explain

3.1.1 Finnish

(28) a. ö.pas.kè.li.ja  
   [\(\dot{\sigma} \sigma \sigma \sigma\)]

b. ká.loas.te.lém.me  
   [\(\dot{\sigma} \sigma \sigma \sigma\)]

c. ká.las.tè.le.mi.nen  
   [\(\dot{\sigma} \sigma \sigma \sigma\)]

d. ón.nit.tè.le.mà.tì.ní.kin  
   [\(\dot{\sigma} \sigma \sigma \sigma\)]

e. või.mis.te.lít.te.le.mà.tsă  
   [\(\dot{\sigma} \sigma \sigma \sigma\)]

f. jär.jes.tèl.màl.li.sý; del.là.ní  
   [\(\dot{\sigma} \sigma \sigma \sigma\)]

Note the ternary intervals in (28b,e,f), all of the form \(\dot{\sigma} \sigma \sigma\).

(29) Finnish stress assignment

a. \#\(\dot{\sigma} \sigma \sigma\) \(\rightarrow\) \#\(\dot{\sigma} \sigma \sigma\)

b. \[\begin{align*}
\dot{\sigma} \sigma \sigma \sigma \sigma & \rightarrow \dot{\sigma} \sigma \sigma \sigma \\
\dot{\sigma} \sigma \sigma \sigma \sigma & \rightarrow \dot{\sigma} \sigma \sigma \sigma 
\end{align*}\] recursively from left to right

3.1.2 Estonian

Estonian is unusual in that many words have more than one acceptable stress pattern.

(30) a. ó.sa.vàtt  
   [\(\dot{\sigma} \sigma \sigma\)]

b. ó.sa.va  
   [\(\dot{\sigma} \sigma \sigma\)]

c. té.ra.và.màlt/té.ra.va.màltt  
   [\(\dot{\sigma} \sigma \sigma \sigma \sigma\)]

d. ká.ras.tå.túi.mà.le  
   [\(\dot{\sigma} \sigma \sigma \sigma\)]

e. vå.li.sàt.te.le  
   [\(\dot{\sigma} \sigma \sigma \sigma\)]

f. û.lis.tà.và.màt/û.lis.ta.và.mait  
   [\(\dot{\sigma} \sigma \sigma \sigma \sigma\)]

g. ó.sa.và.mà.ì.kí/ó.sa.va.mà.ì.kì  
   [\(\dot{\sigma} \sigma \sigma \sigma \sigma \sigma\)]

h. ú.sàl.tå.tå.ta.và.mà.tèks/ú.sàl.tå.tå.ta.và.mà.tèks  
   [\(\dot{\sigma} \sigma \sigma \sigma \sigma \sigma \sigma\)]
Note that there are no ternary intervals of the form \( \hat{\sigma}\sigma - \hat{\sigma}\), and that there are stressed final heavy syllables but no stressed final light syllables.

(31) Estonian stress assignment

\[
\begin{align*}
\text{a.} & \quad \#\sigma\sigma \rightarrow \#\hat{\sigma}\sigma \\
& \quad \left[ \begin{array}{c}
\hat{\sigma}\sigma - \\
\hat{\sigma}\sigma\sigma\sigma
\end{array} \right] \\
\text{b.} & \quad \hat{\sigma}\sigma\sigma\sigma \rightarrow \hat{\sigma}\sigma\sigma\hat{\sigma}\sigma / \hat{\sigma}\sigma\sigma\sigma
\end{align*}
\]

recursively from left to right

3.1.3 Tripura Bangla

(32) a. fa.til
b. fo.rík.ka
c. dúr.bit.ta.yôn
d. ó.β'i.nôn.dón
e. ó.nu.bòt.ti.ta
f. 3.no.nu.jó.ro.ni.yô.ta
g. 3.no.nu.jó.ro.ni.yô

Note the peculiar contrast between (32a) and (32b), even though (32c) shows that final heavy syllables may be stressed. (32c–f) are footed just as they would be under the ternary option in Estonian. But the penultimate syllable in (32g) would be stressed in Estonian.

(33) Tripura Bangla stress assignment

\[
\begin{align*}
\text{a.} & \quad \#\sigma - \sigma \rightarrow \#\hat{\sigma} - \sigma \\
& \quad \left[ \begin{array}{c}
\hat{\sigma}\sigma - \\
\hat{\sigma}\sigma\hat{\sigma}\sigma
\end{array} \right] \\
\text{b.} & \quad \hat{\sigma}\sigma\hat{\sigma}\sigma\sigma \rightarrow \hat{\sigma}\sigma\hat{\sigma}\sigma\hat{\sigma}\sigma
\end{align*}
\]

recursively from left to right

3.1.4 Sentani

(34) a. a.di.ló.mi.hí.be
b. ó.ðó.ka.wá.ле

Note
(34a) and (34b) together show that footing is right to left. (34c) and (34d) show that a binary interval between stressed syllables is chosen over a ternary interval if this puts stress on a heavy syllable. Note the pair of unstressed syllables that begin (34f) and (34g). Initial stress can only come from a ternary interval, (34b). Finally, note that the final syllable is stressed only if it is heavy, (34f), otherwise the penultimate syllable is stressed.

(35) Sentani stress assignment

\[ \begin{align*}
\sigma^- \# & \rightarrow \sigma^- \# \\
\sigma \sigma^- \# & \rightarrow \sigma^- \sigma \# \\
\sigma^- \sigma \& \rightarrow \sigma^- \sigma \sigma \\
\sigma \sigma^- \sigma & \rightarrow \sigma^- \sigma \sigma \\
\end{align*} \]

b. recursively from right to left

3.2. Finnish footing

Finnish footing is carried out by end marking and (26a), repeated below as (36.IF). Stress assignment is trochaic.

(36) EM: \( \emptyset \rightarrow \langle / \# \_ \_ \_ \_ \_ \_ \rangle \)

IF: \( \times ; \left[ \begin{array}{c}
\text{Alignment} \\
\text{Alternation}
\end{array} \right] ; \text{Left} : \left[ \emptyset \rightarrow \langle \right] ; \text{*Unary} \)

Before proving that (36) accounts for the generalizations formulated earlier, we first work through an example, which derives the foot structure and surface stress pattern of rā.kas.ta.jāt.ta.re.no. ko. The last step is Stress Projection (SP), which projects foot initial stress as needed and removes inherent stress marks which are not foot initial. At some points in the iteration of IF there is more than one valid repair of the leftmost defect. The alternate, and the reason it is rejected, is shown at the right. Recall that a valid repair is one which increases the well-formedness of the leftmost accessible defect whose well-formedness can be increased. If there are multiple valid repairs at a stage in the derivation, the choice between them is made primarily on the basis of maximal repair and secondarily on the basis of repair operation order.
Rhythmic stress and inherent stress are in partial conflict, which the rule (36.IF) mediates. Sometimes the rule does not permit foot structure to put inherent stress in a position in which it will survive to the surface and sometimes the presence of inherent stress distorts the structure that would otherwise obtain, (37.IF.2) above, so that inherent stress survives to the surface.

In order to show that (36) is empirically adequate, we need to show that it predicts (29), repeated below:

\[(29) \text{a. } \# \overset{\sigma}{\sigma} \sigma \]
\[\text{b. } \left[ \begin{array}{ll}
\overset{\sigma}{\sigma} \sigma \sigma \rightarrow & \overset{\sigma}{\sigma} \sigma \sigma \\
\overset{\sigma}{\sigma} \sigma \sigma \rightarrow & \overset{\sigma}{\sigma} \sigma \sigma 
\end{array} \right] \text{ recursively from left to right} \]

Edge marking gives (29a). To verify (29b), it is sufficient to show that (36) produces the transitions (38) and that these are the only actions of (36.IF) that build new feet. Only (38a) produces a ternary interval between stressed syllables. Here, $\sigma$, $\sim$, and $-$ are interpreted as grid marks. They must be, since delimiters are inserted into a tier of grid marks. $\sigma$ may or may not be inherently stressed, $\sim$ is not inherently stressed, and $-$ is inherently stressed.

\[
\left[ \begin{array}{llll}
\sigma \sigma \rightarrow & \sigma \sigma \\
\sigma \sigma \sim \sigma \rightarrow & \sigma \sigma \sim \\
\sigma \sigma \sim \sigma \rightarrow & \sigma \sigma \sim \\
\sigma \sigma \sim \sigma \rightarrow & \sigma \sigma \sim
\end{array} \right]
\]

There are no other foot building actions of (36) because all environments $\sigma \sigma \sigma$ and $\sigma \sigma \#$ occur on the left side of (38) and *Unary prevents a transition from $\sigma \sigma$. The only other action of (36.IF) is $\langle \sigma \sigma \rightarrow \langle \sigma \sigma \rangle$, but this does not build a new foot.
The foot structure built by (38a) are almost identical to those discussed in Hayes (1995, Chap. 8) under the rubric “weak local parsing”. The theory of weak local parsing as formulated there, however, is inadequate to analyze Finnish. Hayes posits that a stress system can choose weak local parsing or not, as a parametric choice. If it does, then weak local parsing is forced unless the result is ill-formed. He also posits, as a locality principle, that weak local parsing can skip only a minimal prosodic unit, a mora, i.e. a light syllable. If weak local parsing is chosen, then, he derives the fact that only light syllables can be skipped. But then it should be the case that if weak local parsing is in effect, then

\[
\ldots \rangle \circ \sigma \sigma \ldots \rightarrow \ldots \rangle \langle \sigma \sigma \ldots
\]

regardless of the weight of the syllable following the internally orphaned light syllable. We will see shortly that this is (optionally) the case in Estonian. But it is not the case in Finnish, since in Finnish the syllable following the internal orphan must be heavy. Hayes’s theory can probably be successfully revised so that the choice of weak local parsing or not is dependent at each step on the local environment, as in the theory presented here, at least descriptively. We will see in the discussion of Sentani, however, that further problems arise. In Sentani, a right to left trochaic system, heavy syllables can be internally orphaned.

3.3. Estonian footing

Because *Unary is in effect in Finnish, adjacent syllables are never stressed. Weaker constraints, however, are sufficient to prevent stress clash. Because foot stress is assigned at the left edge of feet if stress is trochaic, a unary foot at the right edge of a word will not cause stress clash. The unary foot below, for example, does not cause stress clash in a trochaic system.

\[
\ldots \rangle \times \times \rangle \times \rangle \#
\]

Estonian does not allow arbitrary unary at the right edge, but does allow inherently stressed grid marks to be in unary feet at the right edge, presumably in order to allow inherent stress to more fully survive to the surface. Call the weakened *Unary constraint *Unary\(_w\).

Estonian has a certain amount of optionality in stress assignment. One option is produced by (39), which is just (26b) amended by weakening *Unary to *Unary\(_w\). Stress assignment is trochaic.

(39) EM: \( \emptyset \rightarrow \langle / \# \)

If: \( \times: \left[ \begin{array}{c} \text{Alignment} \\ \text{Alternation} \end{array} \right] ; \text{Left}: \left[ \begin{array}{c} \emptyset \rightarrow \langle \\ \emptyset \rightarrow \rangle \end{array} \right] \); *Unary\(_w\)

The other option restricts \langle -insertion by imposing the derivational constraint *\times\rangle.
We begin with an illustrative example of the application of (39). There is variation depending on whether the $\emptyset \rightarrow \langle \$ repair option is available in the context / × ___.

(40)  
\[ \begin{array}{c}
\text{EM} \\
\langle x \chi \times \times \times \times \times \times \chi \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \time
Footing in the account above responds to inherently stressed grid marks according to the footing to the left that has already been carried out when the inherently stressed grid mark is encountered. In a two-stage account of heaviness (footing associated with heavy syllables first, then iterative footing), decisions about inserting foot delimiters associated with heavy syllables must be made in advance of iterative footing. As far as I can see, Halle and Idsardi’s two-stage account of heaviness effects cannot account for the Estonian stress pattern.

We can see the problem easily by comparing the stress patterns of ó.sa.va, ó.sa.vätt, and té.ra.và.màltt/té.ra.và.màltt.

(42) a. ó.o.o.o
   b. ó.o.o.
   c. ó.o.o.o / ó.o.o.

Since ó.o.o.o and ó.o.o. have different stress patterns, it must be the case the first stage of a two-stage theory must produce ××(×). Crucially, however the theory accounts for optionality in Estonian stress, there is no option in (42b).

This leaves the two-stage theory with no way to account for the optionality in (41c). The first stage rule which inserts a left delimiters cannot count the number of syllables which precedes it in order to determine if delimiter insertion is obligatory or optional. Counting syllables is the prerogative of iterative footing. A delimiter must be inserted, as it was in (42b) and the stress pattern ó.o.o. is impossible. Hayes (1995, p. 329) makes essentially the same point about Halle and Vergnaud (1987). As far as I know, the criticism has never been answered.

3.4. Tripura Bangla footing

The footing rules are given in (43). Stress assignment is trochaic.

(43) EM: \[
\begin{array}{c}
[ \emptyset \rightarrow \langle / \# \circ \circ \circ \rangle ; \text{Unary} \\
\emptyset \rightarrow \langle / \# \circ \circ \circ \rangle ; \text{Unary}
\end{array}
\]

IF: \[
\begin{array}{c}
\times ; \text{Alignment} \\
\times \times \times \times ; \text{Alternation} ; \text{Left} \rightarrow \left[ \emptyset \rightarrow \langle \rangle ; \text{Unary} \right] \{ \times \times \times \times \}
\end{array}\]

The edge marking rule is inelegant, but no better alternative seems to be available. In Cayuvava, with right to left footing, *#( was responsible for spans of two unfooted grid marks at the beginning of some words; # × ×(× ×)… In Tripura Bangla, with left to right footing, we will see that *#) is responsible for spans of two unfooted grid marks at the end of some words. Since stress is trochaic, 3 unstressed syllables can appear at the end of some words; …σ σ σ σ #. The effect of the derivational constraints is illustrated by the derivations (44) and (45).
Submaximal repair is forced by *Unary\textsubscript{w}. *Unary\textsubscript{w} and *)# conspire to prevent IF from applying again to remove the remaining defect.

We now turn to showing that (43) accounts for the generalizations (33), repeated below.

(33)  

a. \# ∨ ~σ, otherwise \# ˘σσ  

\[
\begin{align*}
\sigma\sigma & \rightarrow \sigma\sigma \\
\sigma\sigma & \rightarrow \sigma\sigma
\end{align*}
\]

b. \[ \begin{array}{ccl}
\sigma\sigma\sigma\sigma & \rightarrow & \sigma\sigma\sigma\sigma \\
\sigma\sigma\sigma\sigma & \rightarrow & \sigma\sigma\sigma\sigma
\end{array} \]

 recursive from left to right

(43.EM) gives (33a) directly. To verify (43.IF), it is sufficient to show that (46) is a complete transition table for (43.IF).

\[
\begin{array}{ccl}
\langle\sigma\sigma\rangle & \rightarrow & \langle\sigma\sigma\rangle \\
\sigma\sigma & \rightarrow & \sigma\sigma
\end{array}
\]

"rule order"

\[
\begin{array}{ccl}
\sigma\sigma & \rightarrow & \sigma\sigma \\
\sigma\sigma & \rightarrow & \sigma\sigma
\end{array}
\]

"maximal repair"

There is no defect, therefore no action.
3.5. Sentani footing

The iterative footing rule for the dialect of Sentani described by Hayes (1995) is almost a right to left mirror of the Tripura Bangla iterative rule. Stress is trochaic, so \( ^{*}\text{Unary}_w \) allows inherently stressed unary feet at the right edge, which is the edge from which footing is initiated. Both Tripura Bangla and Sentani allow an inherently stressed unary foot at the right edge.

(47) Edge marking: \( \emptyset \rightarrow \rangle / \_\_\# \)

Iterative footing: \( \times ; \quad \begin{array}{l}
\text{Alignment} \\
\text{Alternation} \\
\end{array} \); Right :: \( \emptyset \rightarrow \rangle \); \{ \text{*Unary}_w, \text{*#} \}

In spite of the similarity of the footing rules, the stress pattern of Tripura Bangla is nothing like a mirror of the Estonian ternary pattern. Some illustrative examples follow.

(48) \( \text{ә.nay.nә.kәn.sin.de} \) ‘they (pl.) will throw it away’

<table>
<thead>
<tr>
<th></th>
<th>EM</th>
<th>IF</th>
<th>IF</th>
<th>IF</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \times \times \times \times )</td>
<td>( \times \times \times )</td>
<td>( \times \times \times \times )</td>
<td>( \times \times \times \times )</td>
<td>( \times \times \times \times )</td>
</tr>
<tr>
<td></td>
<td>( \text{ә.nay.nә.kәn.sin.de} )</td>
<td>( \text{ә.nay.nә.kәn.sin.de} )</td>
<td>( \text{ә.nay.nә.kәn.sin.de} )</td>
<td>( \text{ә.nay.nә.kәn.sin.de} )</td>
<td>( \text{ә.nay.nә.kәn.sin.de} )</td>
</tr>
</tbody>
</table>

Note: The alternative is ruled out by rule ordering. Neither it nor the chosen output removes either violation of the defect which is skipped and both equally repair the next most prominent (most right) defect.

In (48) a heavy syllable is internally orphaned. Since Hayes assumes that locality requires internally orphaned syllables to be light, his theory does not produce this footing. In order to reconcile the Sentani facts with his theory of weak local parsing, he must (p. 331) posit an otherwise unmotivated late “pretonic destressing rule” in order to account for (48) and similar examples.

Two more illustrative derivations are given in (49) and (50).
We now turn to showing that (47) accounts for the generalization (35), repeated below.

(35)  

a. $\sigma \rightarrow \#$, otherwise $\sigma \sigma \sigma$

b.  

\[
\begin{align*}
\sigma - \sigma \sigma & \rightarrow \sigma \sigma \sigma \\
\sigma \sigma \sigma \sigma & \rightarrow \sigma \sigma \sigma \sigma
\end{align*}
\]

recursively from right to left

(51) is a complete transition table for (47).

\[
\begin{array}{c|c}
\text{a.} & \sigma - \# \rightarrow \sigma \# \\
\text{b.} & \sigma \sigma \sigma \rightarrow \sigma \sigma \sigma \\
\text{c.} & \sigma \rightarrow \sigma \sigma \\
\text{d.} & \sigma \sigma \sigma \rightarrow \sigma \sigma \sigma \\
\text{e.} & \# \sigma \rightarrow \sigma \sigma \sigma
\end{array}
\]

allowed by *Unary_w

*Unary_w combined with *

*(maximal repair)

*(rule order)

* Unary

and *

# prevent any repair.

(51a,b) explain (35a). (51c–e) explain (35b).

Hayes’ theory predicts stress on the initial syllable in (34g), han.d@.bó.k@. He comments: “In light of parallel forms like [d@.ka.wá.le and ha.bów.do.kó.ko ke, (34b) and (34c), my numbering], it is plausible that Cowan simply omitted secondary stress
here; if not, then clearly the theory and analysis would need serious revision.” These forms are parallel in the theory that Hayes proposes, but not in the theory proposed here. It seems likely that Hayes’ theory has empirical problems in addition to the questions raised by the need to posit pretonic destressing.

4. The predictions of directionality and serialism versus the predictions of Optimality Theory

Kiparsky (2003) and Elenbaas (1999) have proposed OT analyses of Finnish. Karttunen (2006), in an extremely interesting paper shows that both of these analyses fail. His main point, which is made very convincingly, is that it is very hard to be sure that an OT analyses is correct because of “the specter of an unexpected competitor suddenly emerging to eliminate the desired winner.” Karttunen translated both analyses into computer programs, using a sequential sieve to determine optimality, and discovered unexpected competitors for both. It is not surprising that good linguists missed taking into account the unexpected competitors since candidate sets containing hundreds of thousands of competitors had to be examined.

No doubt, some revision of the preferences can produce a correct analysis. But an examination of the unexpected competitors which were overlooked by Kiparsky and Elenbaas and discovered by Karttunen’s program reveals a more fundamental problem. Neither Kiparsky’s nor Elenbaas’s analysis correctly predicts stress on kálasleleminen (˘ ¯ ˘ ˘ ˘ ˘ ˘ ˘), for example. In both analyses, (52b) is chosen over (52a).

(52) a. (˘ −)(˘ )(˘ −)
   b. (˘ −)(˘ )−

To make the point as clear as possible, both the analyses would also choose (53b) over (53a), but correctly produce (53c).

(53) a. (˘ −)(˘ )(˘ )(˘ )(˘ )(˘ −)
   b. (˘ −)(˘ )(˘ )(˘ )(˘ )−
   c. (˘ −)(˘ )(˘ )(˘ )(˘ )(˘ )−

This strongly suggests that there is a much deeper problem than the particular arrays of constraints that Kiparsky and Elenbaas decided on. In a left to right footing system, the weight of the 12th syllable should not affect whether or not the 3rd syllable is stressed.

It is a fact about left to right footing systems that the presence or absence of stress on a particular syllable depends on what is to its left and what is in a limited window to its right. Finnish and Estonian are typical, with a window of length 2. In these languages, the distribution of foot level stress on the syllables inside the dotted frame depends only on the weights of these syllables and σ_{n+1} and σ_{n+2} and is independent of
any syllables which may follow $\sigma_{n+2}$.

$\#(\sigma_1 \cdots \sigma_n : \sigma_{n+1} \sigma_{n+2} \sigma_{n+3} \cdots \#)$

Stress on the syllables in the solid frame depends only on the weights of these syllables and the weights of the syllables in the dotted frame, the lookahead window.

The fact that OT can so easily produce systems which violate this basic principle of directional footing (limited lookahead) shows that although OT is capable of mimicking serial left to right footing to some extent, true left to right behavior eludes it. In order to produce an empirically adequate analysis of Finnish, an extensive constraint conspiracy is required. Constraints like ALL-FT-LEFT are simply insufficient to produce the desired behavior.

4.1. Stress systems of type $L_k$ and $R_k$, $k$-lookahead

A stress system is said to be of type $L_k$ if the foot level stress on $\sigma_1 \cdots \sigma_j$ in the word $\sigma_1 \cdots \sigma_j \sigma_{j+1} \cdots \sigma_n$ is independent of the absence, presence or attributes of any syllable $\sigma_i$ with $i > j + k$. The type $R_k$ is the right to left analog of $L_k$. Note that if a system is of type $L_k$, it is automatically of type $L_{k+1}$. We say that a stress system is $k$-lookahead if it is of type $L_k$ or $R_k$.

It is important to understand that being of type $L_k$ or $R_k$ is a fact about a natural stress system, not a fact about a theory of that system. It is a straightforward prediction of rule-based serial theories (under certain obvious assumptions) that left to right iterative footing will produce stress systems of type $L_k$ for some small value of $k$. This corresponds with the empirical facts. OT theories of stress make no such prediction. In fact, as Kiparsky’s and Elenbaas’s work evidences, it is nontrivial to coerce OT to produce such a system.

Although Finnish and Estonian are typical, there are stress systems which require somewhat deeper lookahead. Lenakel is a good example of a stress system which requires 3-lookahead. Putting aside issues of heaviness, which do not bear on the lookahead question, the stress pattern is given below:

(54)  

<table>
<thead>
<tr>
<th></th>
<th>a. $\dot{\sigma}$ $\sigma$</th>
<th>a. $\dot{\sigma}$ $\sigma$ $\dot{\sigma}$ $\sigma$ $\sigma$</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>b.</td>
<td>$\sigma$ $\dot{\sigma}$ $\sigma$</td>
<td>b. $\dot{\sigma}$ $\sigma$ $\dot{\sigma}$ $\sigma$ $\sigma$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>$\dot{\sigma}$ $\sigma$ $\dot{\sigma}$ $\sigma$</td>
<td>c. $\dot{\sigma}$ $\sigma$ $\dot{\sigma}$ $\sigma$ $\sigma$ $\dot{\sigma}$ $\sigma$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>$\dot{\sigma}$ $\sigma$ $\sigma$ $\dot{\sigma}$ $\sigma$</td>
<td>d. $\dot{\sigma}$ $\sigma$ $\sigma$ $\dot{\sigma}$ $\sigma$ $\sigma$ $\dot{\sigma}$ $\sigma$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The antepenultimate syllable is never stressed, even when the binary left to right count falls on the antepenult. 3-lookahead is required to determine that a syllable is the antepenult. In (54), for example, third syllable stress varies in (54b–d), but stabilizes after at least 3 syllables follow.
4.2. The assumptions which guarantee 3-lookahead

All of the derivational or preference constraints on delimiter insertion which have been considered to this point are highly local. They can be evaluated by looking at most 2 places to the left and right. By 2 places I mean two symbols, which includes grid marks, delimiters, and end marks. If less local constraints are admitted, deeper lookahead would be required. A constraint *⟩××#, for example, could lead to 4-lookahead. I suppose that derivational and preference constraints are restricted to those which can be evaluated by examining 2 places to the left and right.

The assumption that delimiter insertion is monodirectional is also crucial. Otherwise, one could have a Koya-like system with ∅ → ) at the right edge, and left to right iterative ∅ → ( to the left of every inherently stressed grid mark. With trochaic stress, this produces stress on inherently stressed grid marks if there are any, otherwise on the initial grid mark. In such a system, stress on the initial syllable depends on looking ahead as far as necessary to determine if there is a following inherently stressed grid mark. Formally, the system requires infinite lookahead. Monodirectionality, however, insists that iterative footing must be carried out from right to left (i.e. starting at the edge where edge marking applies). That system is 1-lookahead, because 1-lookahead is sufficient to determine that a grid mark is initial.

3-lookahead also assumes that the choice of iambic versus trochaic foot stress requires no lookahead. At least one language, Yidiny, is known to violate this. The Yidiny footing rule (55) is quite simple.

(55) × ; Alternation ; Left :: ∅ → )

The complexities of Yidiny footing come from the fact that the iambic/trochaic choice is made on a word by word basis, and is quite late in the derivation; after footing and after a rule of penultimate lengthening (with inherent stress assignment) which applies in the context ___σ#. Because binary feet are constructed left to right, words are subject to penultimate lengthening if and only if they have an odd number of syllables.

The languages discussed in the last section attempt to realize inherent stress as surface stress by making the delimiter insertion rules sensitive to the presence of inherent stress. Yidiny uses a different strategy. Inherent stress is assigned to grid marks which correspond to syllables with a long vowel, but the delimiter insertion rules ignore inherent stress. The iambic/trochaic choice, however, depends on the presence and position of inherently stressed grid marks. The default in Yidiny is trochaic stress, but if there is inherent stress at the right edge of any foot, iambic stress is chosen instead, presumably to allow the inherent stress to surface. Iambic stress is therefore chosen if a word has an even numbered long syllable (counting from the beginning of the word, starting at 1) or, because of penultimate lengthening, an odd number of syllables, otherwise trochaic foot stress is chosen.

Because of this peculiar system, Yidiny is effectively infinite lookahead. Footing is clearly left to right, but stress on the initial syllable depends on scanning a potentially
unlimited distance to the right in order to complete the full word footing and make the iambic/trochaic choice.

Appendix A. Finnish, Estonian, Tripura Bangla, and Sentani word lists

(56) Finnish

må ki, jår. jes, tön.tä  /owl/,  ∑- ∑-  ∑-  ∑-
pé.ri.jä  /owl-
kú. nin. gas  /owl-
ká. las. tè. let  /owl-
mér. ko. nó. min  /owl-
ré. pe. à. má  /owl-
ér. go. nó. mi. a  /owl-
ó. pas. ké. li. ja  /owl-
kái. nos. tè. li. jat  /owl-
strúk. tu. ra. lis. mi  /owl-
má. te. ma. tí:k ka  /owl-
ká. loas. te. lém. me  /owl-
ká. las. tè. le. mi. nen  /owl-
il. moit. tâu. tu. mi. nen  /owl-
pú. he. li. mê. la. ni  /owl-
óm. nit. tè. le. mà. ni. kin  /owl-
jår. jes. tèl. má. lîs. tâ. má  /owl-
il. moit. tâu. tu. mi. sès. ta  /owl-
tél. mât. tô. my: des. tân. sâ  /owl-
vói. mis. te. lít. te. le. màs. ta  /owl-
rá. kas. ta. ját. ta. rè. na. ko  /owl-
jår. jes. tèl. má. lî. sý: del. là. ni  /owl-

(57) Estonian

pá. lat, pá. latt, pát. tu, nó:. rikk  /owl/,  ∑- ∑-  ∑-  ∑-
ó. sa. vâtt  /owl-
ó. sa. va  /owl-
só: ye. mát. tel  /owl-
pá. ri. mát. teltt  /owl-
té. ra. vâ. mältt/ té. ra. va. mältt  /owl-
pí. mes. tâ. va. le/pí. mes. ta. vâ. le  /owl-
ýp. pet. tâ. yat. tâks/ ýp. pet. ta. yat. teks  /owl-
ú. lis. ta. màit/ ú. lis. ta. và. mait  /owl-
pí. mes. tâ. vas. se/pí. mes. ta. vás. se  /owl-
(58) Tripura Bangla

aıt.na  ['verandah']
fór.kar  ['government']
fá.til  ['earthen pot']
gó.ra  ['root']
fo.rík.ka  ['examination']
bí.fíj.jon  ['immersion']
gó.ra.li  ['ankle']
fóm.pot.ti  ['wealth']
fák.na.mi  ['precocity']
út.tja.rón  ['pronunciation']
fsj.ròk.kòn  ['reservation']
fo.ri.b́ef  ['environment']
fóm.por.kí.to  ['related']
fán.bi.da.ník  ['constitutional']
š.ma.nó.fík  ['inhuman']
ó.βí.ínón.dón  ['congratulations']
ó.nu.kóm.pa  ['compassion']
a.bór.zó.na  ['garbage']
dúr.bit.ta.yón  ['criminalization']
dúr.gó.tó.na  ['accident']
ké.rá.mo.tí  ['ingenuity']
fo였다.dýa.ło.só.na  ['deliberation']
fo.k.kó.fá.tit.tó  ['partisanship']
fo.ri.sa.ło.na  ['direction']
š.fíj.rók.kí.tó  ['unreserved']
š.fáb.dá.nó.ta  ['carelessness']
š.fo.ri.háid5.dônh  ['inevitable']
š.nó.bó.lím.bón  ['resourcefulness']
ó.nu.bót.tí.ta  ['obedience']
fá.ró.dóf.fí.kó.tá  ['expertness']
ar.yo.zo.ni.yo.ta ‘necessity’
3.fo.ri.böt.ti.to ‘unchanged’
ə.nu.mu.ho.ro.ni.yo.ta ‘unfollowability’
3.fo.ri.böt.to.ni.yo.ta ‘unchangeable’
ə.nu.mu.ho.ro.ni.yo.ta ‘unfollowability’

(59) Sentani

yó.ku ‘dog’
kám.bi ‘neck’
an.kéy ‘ear’
fa.lóm ‘head’
ha.ba.káy ‘tobacco’
ho.kó.lo ‘young’
hon.ków.na ‘he burnt him’
how.bó.ke ‘he killed something’
u.ków.na ‘he told him’
han.dó.bó.ká ‘we pl. killed something’
ho.nam.bón.de ‘he will kill something for him’
ə.náy.né.wán.de ‘they pl. will go tell him’
ə.dó.ca.wá.le ‘I saw thee’
ha.bów.do.kó.ke ‘he hit me aor.’
ə.náy.na.kén.sín.de ‘they pl. will throw it away’
a.di.ló.mi.hí ‘you two will collect them’
a.di.ló.dó.mi.hím ‘let me collect them’
ha.bów.no.kó.ká.le ‘I struck him aor.’

References


